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ABSTRACT

This paper focuses on analysing the evolution of the terms of trade of products in the agricultural and food trade in the second half of 20th century. We have compiled 56 new price indices for internationally-traded agricultural products. Furthermore, in order to obtain real prices, the agricultural price series have been deflated by an international trade price index that includes major changes in the prices of not only manufactured goods, but also other commodities, such as energy products, which have had so much influence on the shocks occurring in the period. Another feature of this work is the use of a new time series method. We shall analyse the presence of two structural breaks in non-stationary series, as well as establishing the years of structural break endogenously. Our aim is to characterise the distinct trends of the groups of products by determining which groups experienced the greatest decline, and the possible causes, both economic and institutional.

Keywords: Singer-Prebish Hypothesis, terms of trade, agricultural and food trade, agricultural prices

RESUMEN

Este trabajo se centra en el análisis de la evolución de los términos de intercambio de los productos del comercio agrícola y alimentario en la segunda mitad del siglo pasado. Hemos construido 56 nuevas series de indices de precios de productos agrarios que participaban en el comercio internacional. Para lograr precios reales, las series de precios de los productos agrarios han sido deflactadas por un índice de precios del comercio internacional que recoge los cambios en los precios no sólo de los productos manufacturados sino también de otros como los productos energéticos, que tuvieron una importante influencia en los shocks que ocurrieron en aquel periodo. Otra aportación de este trabajo es el uso de una nueva técnica de análisis de series temporales. Hemos analizado la presencia de dos rupturas estructurales en series no estacionarias, estableciendo además los años de la ruptura de forma endógena. Nuestro propósito es caracterizar las distintas tendencias de los diferentes grupos de productos, estableciendo que grupos experimentaron los peores comportamientos y sus posibles causas, tanto institucionales como económicas.

Palabras clave: Hipótesis Singer-Prebisch, términos de intercambio, comercio agrícola y alimentario, precios agrícolas.

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1. INTRODUCTION

One of the most recurrent debates in the literature on development economics has concentrated on the discussion regarding a possible deterioration of real terms of trade for low-income countries. This hypothesis was formed simultaneously, but independently, by R. Prebisch (1950) and H. Singer (1950), who argued that the terms of trade for primary products had suffered a **continuous and persistent** deterioration and that this was one of the key factors limiting the growth of the least developed economies[3].

The list of the principal studies, compiled by Nguyen (1981) and extended by Diakossavas and Scandizzo (1991), indicates that the debate remains open[4]. The results obtained regarding the secular (continuous) trend of relative prices differ according to the period under analysis, the definitions used and the estimation techniques employed. In recent decades some studies have improved the price series; examples are Spraos (1980) and Grilli and Yang (1988). Others have been concerned with the use of more refined methodologies, as in the case of Sapsford (1985), who employed structural models. Diakasowas and Scandizzo (1991), as well as Ocampo and Parra (2003), have utilised time series methods together with structural break models. Lastly, others, such as Hadass and Williamson (2001) have focused on the impact of this deterioration upon developing countries.

The lack of consensus is remarkable, both with regard to whether the Prebisch-Singer hypothesis has been verified and concerning the theoretical arguments which would explain the deterioration in the terms of trade. Some of the more recent studies, which use more adequate price series, tend to emphasise the existence of a long-term deterioration in the terms of trade for primary products in contrast to manufactures, but on the other hand question whether this was a secular or continuous trend; they suggest instead that this was concentrated in certain times, particularly the interwar years and the 1980s, and therefore suffered a two-step fall (Ocampo and Parra, 2003).

According to Diakosavvas and Scandizzo (1991), consensus is even more difficult to reach with regard to the impact of the deterioration in the terms of trade upon developing countries, that is to say upon the situation in which countries exporting primary products are left in terms of income and welfare. This means that even if the thesis of deterioration in primary product prices were correct, the far-reaching economic and technical changes which have occurred in the world economy and caused this variation in prices are difficult to measure by the simple quotient which expresses the real terms of trade relation.

3 See the terms of the theoretical debate in Hadass and Williamson (2001), Ocampo and Parra (2003) and Cashin and McDermott (2006).

4 See also Cuddington and Urzua (1989).

In this context, our objective (clearly related to the abovementioned debate) is to concentrate on analysing the evolution of the terms of trade for products comprising agricultural and food trade in the second half of the last century. We therefore attempt to evaluate in what direction the real prices of these products have moved. In line with the abovementioned literature, which emphasises that the behaviour of the terms of trade for primary products has varied significantly, depending on the products and period in question, we have attempted to perform a highly disaggregated analysis for the set of products of agricultural origin, with the aim of excluding raw materials not of this nature. There already exist many studies which, using the price indices constructed by Grilli and Yang (1988), have approached the problem by including agricultural and raw material prices together, but we believe that these obey different logics.

Consequently, we have constructed 56 new series of price indices for specific agricultural products which were traded internationally between 1950 and 2000 and are representative of all the groups comprising such trade[5]. Additionally, to obtain real prices, the series of agricultural prices has been deflacted by an index for international trade prices which includes the important changes in the prices of not only manufactures but also of other goods, such as energy products, which had such a great influence upon the shocks occurring in the period under study. In summary, we are specifically working with the evolution of the real prices of agricultural products and food. The reason for selecting this option is that we are especially interested in determining the behaviour of the prices of each group of products of agricultural origin, not in contrast to another product group, such as manufactures, but instead to the set of all the goods which have formed part of international trade. This allows a more complete understanding of the impact of the evolution of export prices for developing countries, and especially for the least developed, since these do not import exclusively manufactures; for example, energy products constitute an important part of their imports. The significant rise in energy prices and their strategic character within the international economy has led us to believe that it is important to choose this option.

A second contribution of the present study is the utilisation of a new time series methodology which helps to fill the gaps left by some previous studies. On the basis of the work of Clemente *et al* (1998), we shall analyse the presence of two structural ruptures in non-stationary series, and in addition establish endogeneously the years of structural rupture[6]. We shall study when this deterioration occurred and its nature. Concretely, we shall attempt to analyse whether this occurred in specific periods or, by contrast, was gradual and continuous.

This set of analyses is aimed at characterising the different behaviour of the product groups which comprise international agricultural trade, determining in which of them the greatest deterioration took place and approximating the possible causes, both economic and institutional.

5 The problem with other studies is that they concentrate on a limited number of products or limited time periods (Muñoz and Sosvilla, 1993).

6 As Ocampo and Parra (2003) state, "unfortunately, the methodology used so far only admits a structural change. This means that there is still space for another possible step to be "hidden" behind the statistical estimations.

Following this introduction, the study is divided into three sections. The second section describes the construction and long-term evolution of the series. Their econometric analysis and the presentation of their principal results is performed in the third section. Finally, some conclusions regarding the results obtained are presented.

2. CONSTRUCTION OF THE SERIES AND EVOLUTION OF THE REAL PRICES OF AGRICULTURAL AND FOOD PRODUCTS

In order to analyse the possible deterioration in real agricultural prices, 19 price indices have been constructed for the group of products which, according to the Standard International Trade Classification (SITC Revision 2), form part of agricultural and food trade. Additionally, a general index of agricultural and food trade prices has been elaborated, with the objective of analysing their aggregated evolution. To obtain these price indices, we have calculated 56 price series for distinct products; these are the unitary value of world exports of each of them, on the basis of the trade figures compiled by the Food and Agriculture Organisation (FAO) of the United Nations[7]. The prices of the distinct products have been aggregated to construct the price indices, and weighted according to their share of world exports in each year.

The deflactor used to calculate the real prices of agricultural and food products is the unit value index of total world trade (WTO 2003). This, as we stated earlier, gives us a wider vision than simple comparison with the evolution of the prices of manufactures, given that the structure of trade has changed substantially since the mid-XX century. The increased dependence upon fuel, upon raw materials for industry, upon processed foods and upon minerals has changed the structure of countries' imports.

INSERT TABLE 1

An initial vision of the evolution of agricultural and food product prices is summarised in Table 1, which presents the annual rates of growth for the index of real prices of agricultural and food products and for the 19 groups which comprise it (see the first column). Taken together, the reduction was substantial, since the real price of agricultural products fell at an annual rhythm of 1.02% during the second half of the past century[8]. The deterioration was very gentle in the two first decades, was sharp in the period 1973-1988, when relative agricultural prices fell at an average annual accumulative rate of 2.34%, and was very slight once more in the final fifteen years.

7 These figures are available in paper format, the FAO Yearbooks (FAO, 1947-2000) and in electrionic format, the FAOSTAT (2004) database. The price series were supplemented for the period 1950-1960 by a document from the United Nations Statistical Office (United Nations, 1987) which offers the movements of the same products which are included in our sample, for the period 1950-1984, and which was kindly provided to us by the Office.

8 See similar results in Bloch and Sapsford (1997) for the deterioration of raw material prices after the Second World War.

The behaviour of the distinct product groups was fairly hetergeneous. In general, less elaborated products suffered a very substantial decrease in their real prices, far greater than that of the aggregated index. This is the case of raw materials and basic foods (SITC groups: 21. Leather and hides, 22. Oil seeds, 26. Textile fibres, 29. Other commodities and 04. Cereals), the traditional tropical export products (06. Sugar, 07. Coffee, tea and cocoa, and 232. Natural rubber) and other products (42. Vegetable oils 41. Animal fats). By contrast, agricultural products and processed and high-value foods displayed better behaviour (02. Dairy products, 05. Fruit and vegetables, 08. Animal feeds 09. Miscellaneous edible products), or even suffered no deterioration (01. Meat, 03. Fish, 11. Beverages, 12. Tobacco and 24. Cork and Wood). The latter (except tobacco and wood), although their real prices increased in the long term, were unable to avoid (as occurred for the remaining products) experiencing a sharp fall in the period 1973-1988, when the increase in oil prices produced a strong shock in international markets (see Column 3 of Table 1).

In addition to the shocks produced by energy prices, which we shall analyse further on, we believe that the long-term behaviour of the real prices of the set of agricultural products and food and of the majority of groups comprising it can be explained by two factors: supply-demand disequilibria and the fact of operating in markets severely distorted by extremely interventionist sectorial policies. These disequilibria were generated by a strong rate of growth of production, which tended to exceed that of population and per capita food consumption as a consequence of the low income elasticity of this type of products, or their demand declining due to competition from new synthetic substitute products.

In summary, the interactions between technological progress, demand and public intervention are the principal reasons behind the deterioration of the real prices of agricultural and food products in the second half of the XX century. However, as has been shown, the behaviour of the distinct groups of products has displayed a certain degree of heterogeneity, and thus it is appropriate to attempt to evaluate in greater detail the importance of these factors in explaining price behaviour.

Productivity gains in the agriculture of the period were greater than those of preceding historical periods and those of other sectors. The technological advances which led to the green revolution and the mechanisation of agriculture explain this important growth. Between 1961 and 2000, according to our calculations based on figures from the FAOSTAT (2004) database, production grew extraordinarily in some product groups. Thus, it doubled for 'cereals', 'animal feeds', 'sugar' and 'coffee, tea and cocoa'. It tripled for 'natural rubber', 'oil seeds', 'fruit and vegetables', 'meat' and 'fish' and even quadrupled in the case of 'vegetable oils'. The groups 'forest products and 'beverages', were two exceptions to this accelerated rhythm of production growth. It is not surprising that in their cases real prices increased continuously throughout the second half of the XX century.

This formidable increase in production, in distinction to what occurred at worldwide level until the interwar period, was based on a strong capitalisation of agriculture which considerably increased its productivity, normally above the rate of increase of the economy as a whole[9]. As Giovanni Federico (2005) has stated, a highly intensive growth of agriculture replaced, from the second postwar period onwards, the more extensive growth which had predominated since the mid- XIX century.

Another key variable was the evolution of consumption in each of the groups. In many of them, this tended to increase less than production. The low income elasticity of demand of the majority of products which comprised trade, in contrast to what occurred with consumption demand for manufactured goods and services (especially in the developed world) is without a doubt a key element for the understanding of the evolution of international prices in a context of sharp growth in world income[10]. Furthermore, this was an essential factor for the understanding of the heterogeneous behaviour in the long term of the evolution of real prices among product groups. Thus, for example, Table 1 shows the contrast between the slow growth of per capita consumption for the groups of cereals, sugar and coffee, tea and cacao, with a strong deterioration in their real prices, in contrast to the strong growth in the consumption of fruit and vegetables and meat, whose real prices displayed better behaviour.

Lastly, above all in certain raw materials, such as textile fibres or natural rubber, technological innovation (especially in the chemical industry) permitted some products to be replaced by synthetic substitutes, which caused demand for them to fall sharply and, consequently, severely affected their real prices. In general, in the classification of the groups of products that we have performed, the interaction of these variables helps to comprehend the evolution of their real prices in the long term.

3. ECONOMETRIC ANALYSIS OF REAL PRICE TRENDS FOR AGRICULTURAL PRODUCTS AND FOOD

As described in the introduction, with the aim of determing whether there exist points of rupture or discontinuity in the series, and of examining changes in their trend which may determine the character of the shock, our objective now is to analyse the evolution of the real prices of the products which comprise international agricultural trade, employing to this end time series analysis techniques.

Firstly, to determine whether structural shocks exist, we have performed the conventional unit root tests on the real price series for aggregated agricultural trade between 1951 and 2000, and similarly for the 19 product

9 Hayami and Ruttan (1985) concluded that following the Second World War, technological innovation was used to create a new agricultural production function on an international scale, based on capital and technical inputs.

10 Works such as those by Gelhlar and Coyle (2001), Yates (1960), Yu, Hertel, Preckel and Eales (2002), Reimer and Hertel (2004) Cranfield *et al.* (2003) and Regmi, *et al.* (2001)) show the demand inelasticity of these products, which in addition became progressively accentuated over the period.

groups which comprise it. Using the Augmented Dickey-Fuller (1981) and Philips Perron tests (1988), we now examine whether a unit root is present and whether the different series are stationary.

INSERT TABLE 2

Column 1 of Table 2 gives the results of the Augmented Dickey-Fuller (ADF) test. As can be seen, for neither the aggregated series nor the 19 product groups can the null hypothesis of nonstationarity (the existence of a unit root) be rejected.

In turn, according to the Phillips-Perron tests (Column 2), this does not occur for three groups (232. Natural rubber, 26. Textile fibres and 29. Other raw materials) which, following this criterion do not display a unit root. Consequently, their trend adapts well to the Prebisch-Singer pattern of continuous deterioration in their terms of trade.

This result can easily be explained if we take into account that in these cases the chemical industry permitted very early on (in the 1950s) their partial substitution by synthetic products. Natural fibres, such as cotton, were replaced by new materials such as nylon or polyester (Baffes, 2005). The application of new technologies gave rise to competition between different products applied to the same use, as in the case of natural rubber and its substitutes.

Secondly, with the aim of establishing the character of the discontinuities which exist in the majority of the groups, we have tested the hypothesis of structural change, that is to say, whether in reality we are faced with nonstationary series which, in the long term, undergo changes in their level or trend. Following the proposal made by Perron and Vogelsang (1992), we propose two tests of structural change where the year of rupture is determined endogenously for the sixteen series and the aggregated series which, following both the Dickey-Fuller and Phillips-Perron criteria, we previously verified as displaying a unit root. The first of these is the so-called *Additive outlier model* (AO), in which structural change is produced instantaneously; in other words, it is no more than a temporary event in the series. The second we have called the *Innovational outlier model* (IO), in which the change in the mean is gradual instead of instantaneous, affecting the trend of the series and, consequently, various periods. In addition, basing ourselves on the work of Clemente *et al* (1998), we propose the same unit root tests for the case in which the series present two structural changes [AO (2) and IO (2)].

The following equation represents in a general form the models to be tested. The models include dummy variables in the trend (TDU_AGRi_t) and in the level (DU_AGRi_t), which take the values $TDU\_AGRi_t = (t - DU\_AGRi_t)$ and $DU\_AGR\ i_t = 1$, if $t \geq TBi$ and 0 otherwise, TBi being the moments in time of rupture.

$$\Delta XAGR_t = \mu + \beta t + \gamma XAGR_{t-1} + \Sigma c_j \Delta XAGR_{t-j} + \alpha DU\_AGR\, i_t + \delta TDU\_AGR\, i_t + \zeta 1\, DTB\_AGR\, i_{1t} + \zeta 2\, DTB\_AGR\, i_{2t} + \varepsilon_t \qquad (1)$$

Several conclusions may be extracted from its results. Firstly, the aggregated series of the set of agricultural products and food, and similarly 12 of the 16 groups examined (leather and hides, cereals, oil seeds, animal fats, vegetable oils, fruit, dairy products, tobacco, forest products, processed products and meat), suffered a structural break of a permanent nature in and around the 1970s. Both the aggregated index and these 12 groups display, around 1976, a structural break in the level (AO2) and in the trend (IO2) during the 1970s.

Specifically, the aggregated index of the real prices of agricultural products and food presents a structural rupture in 1976-1977, which suggests that they suffered, with a lagged effect, the impact experienced by the world economy of the first oil crisis of the 1970s.

Consequently, the ruptures produced by the increase in the price of oil deeply affected almost all the product groups into which we have divided agricultural and food trade. As the group of graphs 1 shows, in a significant number of cases this meant that the stagnation or slight fall which their prices had experienced until then, suffered an additional decrease to that undergone during the shocks, which determined as a whole and throughout the period a profound deterioration of their real prices (Leon and Soto, 1995).

Secondly, of these 12 groups, 10 of them (leather and hides, cereals, oil seeds, animal fats, vegetable oils, animal feeds, vegetables and fruit, dairy products, forest products and tobacco), in addition to 2 which had no previous experience of this type (sugar and honey and coffee, tea and cocoa) underwent a structural rupture with changes in both level and trend in the mid 1980s. However, even when they shared this common experience, from then onwards their behaviour was notably heterogenous. We shall now attempt to explain the principal trends.

On the one hand, in the groups which in the previous section we classified as behaving more poorly (leathers and hides, cereals, oil seeds, animal fats, vegetable oils, coffee, tea and cocoa and sugar, which had in general seen their real prices stagnate or fall slightly until the beginning of the 1970s), the shocks experienced involved not only one or two sharp falls but also a subsequent trend towards a decline in their prices. The cause of this deterioration, as stated in the previous section, can be explained by two types of argument: supply-demand disequilibria (generated by the strong growth of production and stagnating demand) and because they were exchanged in markets which were heavily distorted by highly interventionist policies.

Basic foods, such as cereals, sugar, oil seeds and vegetable oils and fats suffered from the 1970s onwards a considerable decline in the rhythm of growth of their consumption, since by then they were faced with mature markets and a deccelaration of the rate of growth of the population, which until then had formed the basis of growth in demand. This may explain the new changes of level and trend in the mid-1980s for the following groups:

cereals and oil seeds (see in Table 2 ruptures of type AO2 and IO2, between 1984 and 1989). It should be remembered that these are products which in the 1970s reached their maximum levels of consumption per capita and were progressively replaced by other, high-value, foods[11]. Furthermore, we must understand that the global production of these goods increased greatly, especially in the developed world, where subsidies and continuous protection caused in the 1980s serious problems of oversupply, which through export subsidies were shifted to other countries, thereby depressing international prices[12].

INSERT GRAPH 1

Thus, for example, the Common Agricultural Policy of the European Union tended to stimulate production for cereal exports. Subsidies, saturated markets and the exploitation of technological progress transformed their trade pattern from net importer to that of net exporter in the 1980s (Pinilla and Serrano, 2009)[13]. Such policies produced numerous surpluses between 1976 and 1987, which through export subsidies were placed on the international markets.

In other groups, something similar occurred to raw materials, which as we have seen suffered a continuous deterioration in their prices, although in more advanced periods. For example, cane and beet sugar were increasingly replaced by sweeteners extracted from maize (isoglucose, glucose, dextrose), and even by artifical sweeteners (saccharine). Moreover, this sector was highly distorted by the policies of the high-income countries, in which farmers received up to twice the international market prices, thereby generating incentives to increase production (Tyres and Anderson, 1992). As a result, prices were subjected to strong pressure due to the excessive supply from high-income countries. Nevertheless, they managed for a long time to remain within the limits set by the International Sugar Agreement (ISA, 1954-1985) (Gilbert, 1996). Subsequently, in 1985, when these agreements and controls were suspended, their relative prices suffered a deep shock (see Table 2, AO, IO in 1985).

Similarly, the group of coffee, tea and cacao was affected by strong interventionism, had a highly concentrated and saturated consumption in the industrialised countries and experienced a significant increase in production through increases in productivity and the extension of cultivated land, both in traditional producers (Brazil) and new competitors (Vietnam), succeeded in maintaining their prices via the International Coffee Organisation (ICO), which used production quotas to moderate and reduce price volatility (Gilbert, 1996). Following the abandonment of these practices in 1986, the fall in their real prices accelerated sharply (see Table 2, change of level and tendency, AO1, IO1 in 1985).

11 Rosegrant and Paisner (2000) and FAO (2002).

12 Lindert (1991), Tyres and Anderson (1992), Diaz-Bonilla and Tin (2002) and Askoy (2005).

13 Dyson (1996) and García-Delgado and García-Grande (2005).

On the other hand, cattle feedstuffs, fruit and vegetables, dairy products and processed food evolved somewhat better; they behaved similarly until the 1970s i.e. they stagnated or fell slightly; however, they stabilised their prices following the shocks or, in general, slowly recovered them until the end of the century (see in Table 2 points of rupture of type IO, AO, around 1982-1987). This appears to be related to the incipient protagonism in diets, at worldwide level, of products such as dairy products, fruit and vegetables and processed food[14]. To the price behaviour of the latter can be added some products such as cattle feedstuffs, closely related to the expansion of the livestock sector.

Lastly, the most dynamic behaviour is displayed by five groups (meat, forest products, tobacco, fish and beverages), with a positive long-term growth in their real prices. Whether they experienced two shocks with important falls in their prices, in the 1970s and 1980s (tobacco and wood) or the first on earlier dates (meat and fish), or only one in the 1980s (beverages), they all (except meat) overcame the shocks and recommenced the trend to increasing prices which they had followed prior to the shocks. The final outcome, as we have said, was the most positive behaviour of all agricultural products and food.

To summarise, only those products which had higher income elasticity or greater difficulties in increasing their production at a rhythm similar to that of the products which benefitted most from the new technologies of the green revolution and mechanisation, and difficulties in being replaced by synthetic substitutes, finally experienced improvements in their terms of trade.

4. CONCLUSIONS

We have concluded, from a long-term perspective, that the deterioration in the terms of trade for agricultural products and food was strong and clear in the second half of the last century. Additionally, and from a comparative product group perspective, we have shown that these displayed fairly heterogeneous behaviour. In general, we can conclude that less elaborated products suffered a very heavy fall in their real prices, far in excess of that of the aggregated index. This group of products, which we have termed **"group with greatest degree of deterioration"** is comprised of raw materials and basic foods (SITC groups: 21. Leather and hides, 22. Oil seeds, 26. Textile fibres, 29. Other commodities and 04. Cereals), traditionally exported tropical products (06. Sugar, 07. Coffee, tea and cocoa and 232. Natural rubber) and vegetable oils and animal fats (SITC groups 42 and 41, respectively).

14 On this question, consult among others Teuteberg (1992), Grigg (1995), Delgado *et al* (1999), Rosegrant and Paisner (2000), Gehlhar and Coyle (2001), Moreno *et al* (2002) and FAO (2002).

Nevertheless, the other question raised initially is whether this deterioration was continuous, as Prebisch and Singer suggest, or by contrast took place in steps, responding to the different shocks which took place in the international economy of the period. On this point, our results align themselves with recent studies, such as those by Ocampo and Parra (2003) or Zanias (2005)[15], since they conclude that neither as a whole nor for the great majority of the agricultural and food product groups (with the exception of the groups of natural rubber, textile fibres and other raw materials) was there a **continuous and persistent** deterioration in the terms of trade; instead, this deterioration occurred in stages. In concrete, from the 1970s onwards, when the international economy was struck by the energy crisis, the set of agricultural products and food and a large part of the groups which comprise it experienced a structural break which signified a sharp fall in their real prices.

From then onwards the behaviour in the evolution of the different product groups was heterogeneous. While in some groups this rupture was only a cyclical shock (Table 1 shows the recovery of the real prices of fruit and vegetables, dairy products and eggs, processed foods, fish and forest products, for example), for the majority the deterioration in their relative prices, following a new structural break in the 1980s, was sharp until the end of the century, (leather and hides, cereals, oil seeds, animal fats, vegetable oils, coffee, tea and cacao and sugar).

In summary, it was especially these latter products, from the beginning of the 1970s until the end of the period, together with those three which validated the Prebish-Singer hypothesis for the entire period, which within agricultural trade saw a marked deterioration in their terms of trade, coinciding with those which, from the long-term perspective we have already termed the "**group with greatest degree of deterioration"**.

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15 Price series for both primary products and manufactures displayed a structural rupture in the second half of the XX century, at the beginning of the 1980s, specifically in 1980 and 1984, respectively..

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Table 1

Evolution of real prices, consumption and world production of agricultural and food products
(Average annual accumulative rates of growth)

	Real prices				Consumption Kcal / pc / day			Production (thousands of tons)		
Group of products	**1951 2000**	**1951 1973**	**1973 1988**	**1988 2000**	**1961 2000**	**1961 1973**	**1973 2000**	**1961 2000**	**1961 1973**	**1973 2000**
AGGREGATED INDEX	**-1.02**	**-0.30**	**-2.34**	**-0.42**	**0.55**	**0.62**	**0.52**	**2.44**	**3.07**	**2.16**
232. Natural rubber	-3.71	-3.67	-1.93	-5.11	n.a.	n.a.	n.a.	3.16	4.03	2.78
26. Textile fibres	-2.92	-2.44	-2.37	-3.76	n.a.	n.a.	n.a.	1.14	2.38	0.59
21. Leather and hides	-1.80	-0.45	-2.18	-3.29	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
04. Cereales and cereal preparations	-1.68	0.52	-4.42	-1.72	0.40	0.63	0.30	2.09	2.55	1.89
29. Other commodities	-1.61	-1.59	-2.06	-0.73	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
22. Oil seeds	-1.59	1.58	-4.90	-2.61	n.a.	n.a.	n.a.	3.27	3.70	3.08
41. Animal fats	-2.43	-1.23	-4.06	-1.96	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
42. Vegetable oils	-2.31	-0.40	-4.90	-1.92	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
06. Sugar	-1.99	0.12	-2.70	-4.31	0.60	1.22	0.32	2.40	2.97	2.15
07. Coffee, tea and cocoa	-1.34	-0.72	-1.58	-1.81	0.14	-0.24	0.31	1.96	0.41	2.65
08. Animal feeds	-0.89	3.56	-5.57	-2.45	n.a.	n.a.	n.a.	2.60	5.10	1.50
05.Fruit and vegetables	-0.45	-0.18	-0.94	-0.21	1.11	0.27	1.49	2.92	2.53	3.09
02. Dairy products	-0.44	0.36	-1.44	-0.52	n.a.	n.a.	n.a.	1.48	n.a.	n.a.
09. Miscellaneous edible products	-0.36	1.12	-2.48	-0.25	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
01.Meat	0.34	4.10	-3.27	-1.69	1.70	1.87	1.62	3.10	3.55	2.91
5. Forest products	0.50	1.70	-2.13	1.56	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
12. Tobacco	0.74	1.29	0.37	0.05	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
03. Fish and fish products	1.93	4.71	-0.98	0.28	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
11. Beverages	2.40	3.65	0.76	1.69	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.

Source: Authors' elaboration, using the FAOSTAT (2004) database.

Table 2

Unit root tests and structural rupture for the logarithm of the real price series for trade in agricultural and food products

	Unit root tests		Rupture in mean TB *Additive outlier model*			Rupture in trend TB *Innovational outlier model*		
Product group	**DFA**	**PP**	**AO(1)**	**AO (2)**		**IO(1)**	**IO (2)**	
AGGREGATED INDEX	-2.25 *	-2.52 *	1977 *	1971	1977 *	1976 *	1953	1976*
232. Natural rubber	-3.5 *	-4.45						
26. Textile fibres	-3.50 **	-4.98						
21. Leather and hides	-2.88 *	-3.66 **	1986 *	1971 **	1991 *	1972 *	1972 *	1987 *
04. Cereals and cereal preparations	-1.76 *	-2.26 *	1981 *	1978 *	1988 *	1973 *	1975 *	1984 *
29. Other commodities	-1.68 *	-4.71						
22. Oil seeds	-1.52 *	-2.32 **	1981 *	1977 *	1987 *	1978 *	1977 *	1983 *
41. Animal fats	-2.51 *	-3.46 **	1982 *	1977 *	1987 *	1978 *	1978 *	1984 *
42. Vegetable oils	-2.14 *	-2.78 *	1977 *	1977 *	1982 *	1978 *	1978 *	1984 *
42. Sugar and honey	-1.69 *	-2.12 *	1988 *	1972 **	1983 *	1985 **	1970 **	1980
07. Coffee, tea and cocoa	-3.66 **	-3.43 **	1984 *	1975	1984 *	1985 *	1957	1985 *
08.Animal feeds	-1.49 *	-3.06 *	1981 *	1971	1981 *	1972 *	1972 *	1983 **
05.Fruit and vegetables	-1.91 *	-2.43 *	1971 *	1971 *	1988 *	1971 *	1972 *	1989 *
02.Dairy products	-2.27 *	-2.98 *	1975 *	1976 *	1988 **	1976 *	1975 *	1986 **
09. Miscellaneous edible products	-2.05 *	-2.25 *	1980 *	1962 *	1978 *	1976 *	1959 **	1976 *
01.Meat	-1.62 *	-2.66*	1980 *	1962 *	1976 *	1972 *	1962 *	1972 *
5. Forest products	-1.53 *	-2.17 *	1994 *	1977 *	1990 *	1991	1978 *	1987 *
12. Tobacco	-2.01 *	-2.40 *	1972	1975 **	1987 *	1983	1971 *	1983 *
03. Fish and fish products	-1.75 *	-2.98 *	1966 *	1966 *	1988 *	1967 *	1967 *	1984***
11. Beverages	-2,83 *	-3,07 *	1987 *	1959 *	1987 *	1984 *	1955	1984 *

Source: Authors' elaboration, using the FAOSTAT (2004) database.

Unit root test.

The functional form contrasted with 3 lags:
$\Delta XAGR_t = \alpha + \beta_t + \delta XAGR(-1) + \sum_i \gamma_i \Delta XAGR_{t-j+1} + \varepsilon_t$.
Values of the t statistic corresponding to the coefficient of the lagged variable $XAGR_{t-1}$.
The critical value at 1%, 5% and 10% are -4.156, -3.504 y –3.181, respectively
(t-ratios significant * at 1%, ** at 5% and *** at 10%.)

Structural break test

The IO and AO tests which incorporate structural changes require a regression of the form:

$\Delta XAGR_t = \alpha + \beta t + \delta XAGR_{t-1} + \sum c_j \Delta XAGR_{t-j} + \omega DU\_AGR_t + \omega TDU\_AGR_t + \omega 1DTB\_AGR\ i_{1t} + \omega 2\ DTB\_AGR\ i_{2t} + \varepsilon_t$.
Critical values to test for the unit root are -4.94 for "IO" models and -5.57 for "AO" models
[(Clemente *et al,* 1998) T=100, P=5]
(t-ratios significant * at 1%, ** at 5% and *** at 10%.)

Appendix. International Food and Agricultural Trade: Real Prices Indices

(Index Numbers, 1980=100)

Year	AGREGATED INDEX	01. Meat	02.Dairy products	03. Fish and fish prod.	04. Cereals & cereals preparations	05. Fruit & vegetables	06. Sugar & honey	07. Coffee, tea & cocoa
1951	156	65	122	49	137	136	97	114
1952	135	80	142	56	148	144	86	115
1953	137	84	145	59	155	152	79	130
1954	145	89	138	65	141	156	74	182
1955	138	92	147	62	133	150	75	142
1956	126	87	141	65	129	178	80	140
1957	127	87	134	65	128	180	106	135
1958	118	94	123	70	128	181	75	137
1959	124	99	138	72	130	162	77	120
1960	123	103	134	72	127	161	77	112
1961	124	109	126	77	133	143	71	116
1962	123	107	125	81	139	140	70	111
1963	131	115	132	80	145	154	106	114
1964	134	125	134	83	146	146	114	125
1965	132	128	144	87	141	153	77	120
1966	132	134	140	93	144	157	73	115
1967	130	132	135	85	152	157	71	111
1968	126	131	126	80	149	152	70	109
1969	128	138	129	94	147	154	78	108
1970	126	138	121	101	133	142	82	118
1971	127	141	143	107	134	144	86	103
1972	129	150	159	112	125	142	97	99
1973	145	164	132	142	154	130	100	97
1974	139	122	118	108	173	98	147	86
1975	128	116	127	95	155	111	177	77
1976	120	114	118	114	136	106	119	112
1977	124	108	110	121	110	109	86	189
1978	115	111	117	123	108	114	85	143
1979	109	108	107	113	101	110	76	119
1980	100	100	100	100	100	100	100	100
1981	98	97	102	104	105	99	95	72
1982	93	96	105	100	95	103	73	74
1983	94	91	98	104	96	103	76	80
1984	98	87	88	100	99	102	74	99
1985	93	86	87	97	91	112	69	97
1986	97	94	99	112	79	115	72	121
1987	94	96	97	119	64	112	62	82
1988	100	96	105	121	75	112	65	75
1989	102	97	117	118	83	111	69	63
1990	102	100	118	120	76	112	71	52
1991	101	100	115	132	69	126	56	49
1992	102	104	121	131	73	124	49	44
1993	100	96	119	126	71	114	50	46
1994	100	93	114	122	69	120	54	64
1995	100	89	115	121	69	120	54	69
1996	100	90	117	121	86	126	52	56
1997	101	88	112	124	76	124	51	74
1998	104	84	117	136	70	129	51	79
1999	100	79	108	133	64	125	40	69
2000	94	77	98	126	60	109	36	59

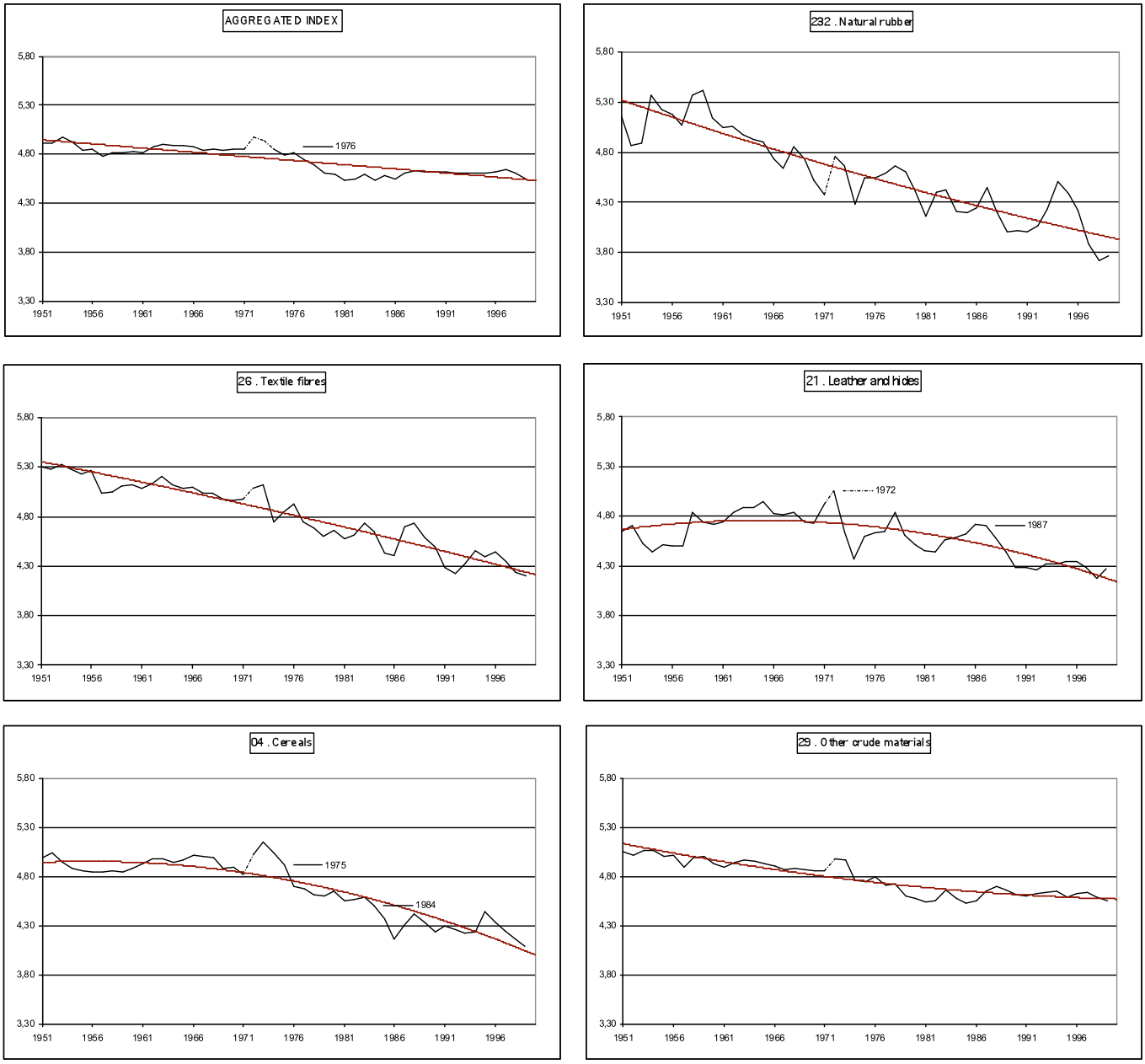
Year	08. Animal feeds	09. Miscellaneous edible prod.	11. Beverages	12. Tobacco	21. Leather & hides	22. Oil seeds	232. Natural rubber	26. Textile fibres
1951	107	112	57	92	174	144	276	286
1952	127	118	61	100	104	128	174	200
1953	130	125	60	108	110	152	130	197
1954	133	135	57	113	92	151	134	207
1955	127	122	62	117	84	133	215	195
1956	121	105	65	112	92	136	187	187
1957	107	106	84	118	90	131	177	194
1958	108	104	115	119	90	133	160	154
1959	127	102	75	123	127	153	214	156
1960	122	99	77	122	114	137	226	166
1961	111	113	80	123	112	137	171	168
1962	124	115	74	124	115	136	155	162
1963	138	124	91	140	127	152	158	170
1964	133	128	92	135	132	151	144	183
1965	139	126	94	134	132	160	139	168
1966	147	127	93	141	141	159	135	161
1967	140	128	106	145	125	153	114	163
1968	134	123	111	147	123	152	104	155
1969	135	126	102	150	126	143	129	154
1970	143	123	99	146	115	145	114	144
1971	141	126	113	133	114	151	92	144
1972	141	129	122	131	137	147	79	145
1973	238	145	131	124	157	207	117	162
1974	156	136	100	100	104	183	107	167
1975	112	132	90	106	78	142	72	116
1976	125	122	93	110	99	134	94	127
1977	144	125	101	112	103	156	94	138
1978	123	116	122	115	104	132	98	116
1979	112	106	108	107	126	122	106	109
1980	100	100	100	100	100	100	100	100
1981	106	98	85	101	91	110	82	105
1982	97	93	88	112	86	97	64	97
1983	104	94	93	115	85	106	81	101
1984	99	94	89	111	96	119	83	114
1985	76	90	97	116	98	96	67	105
1986	84	99	139	124	101	84	67	84
1987	80	93	147	125	112	75	70	82
1988	95	97	148	132	111	93	85	110
1989	88	98	145	138	98	91	68	114
1990	74	99	168	151	85	75	55	98
1991	74	101	170	147	72	76	55	90
1992	77	103	168	148	72	72	55	73
1993	77	99	147	142	71	80	58	68
1994	71	98	141	138	75	80	69	75
1995	65	97	145	131	75	70	90	86
1996	84	101	167	132	77	84	80	81
1997	93	100	172	140	77	90	68	85
1998	77	104	189	146	72	81	49	78
1999	64	100	199	138	65	66	41	69
2000	69	94	184	133	72	66	43	67

Year	29. Other commodities	41. Animal fats	42. Vegetable oils	5. Forest products
1951	212	198	188	92
1952	158	124	168	94
1953	152	128	156	96
1954	158	174	166	99
1955	159	158	156	107
1956	150	155	182	101
1957	151	164	172	103
1958	134	158	162	96
1959	148	136	166	110
1960	149	129	168	102
1961	139	137	164	103
1962	135	122	161	101
1963	141	123	155	103
1964	145	138	163	107
1965	142	165	178	110
1966	139	154	167	109
1967	135	126	161	107
1968	131	106	149	110
1969	132	119	144	118
1970	130	142	162	114
1971	130	143	170	115
1972	129	119	156	121
1973	147	149	172	136
1974	144	168	220	127
1975	117	125	164	105
1976	116	125	124	110
1977	121	127	143	109
1978	112	126	138	106
1979	113	129	138	110
1980	100	100	100	100
1981	98	95	94	92
1982	94	93	83	87
1983	96	90	88	92
1984	107	109	133	90
1985	98	105	111	88
1986	93	75	76	95
1987	95	70	65	93
1988	105	77	77	97
1989	110	72	81	106
1990	107	63	74	108
1991	101	63	73	108
1992	100	65	72	110
1993	102	68	77	122
1994	103	73	92	124
1995	105	78	102	112
1996	99	78	83	113
1997	102	83	82	122
1998	104	82	97	129
1999	99	68	77	131
2000	96	59	60	118

Fuentes: Author's elaboration on the basis of FAO (1947-2000) and FAOSTAT (2004

Graph 1

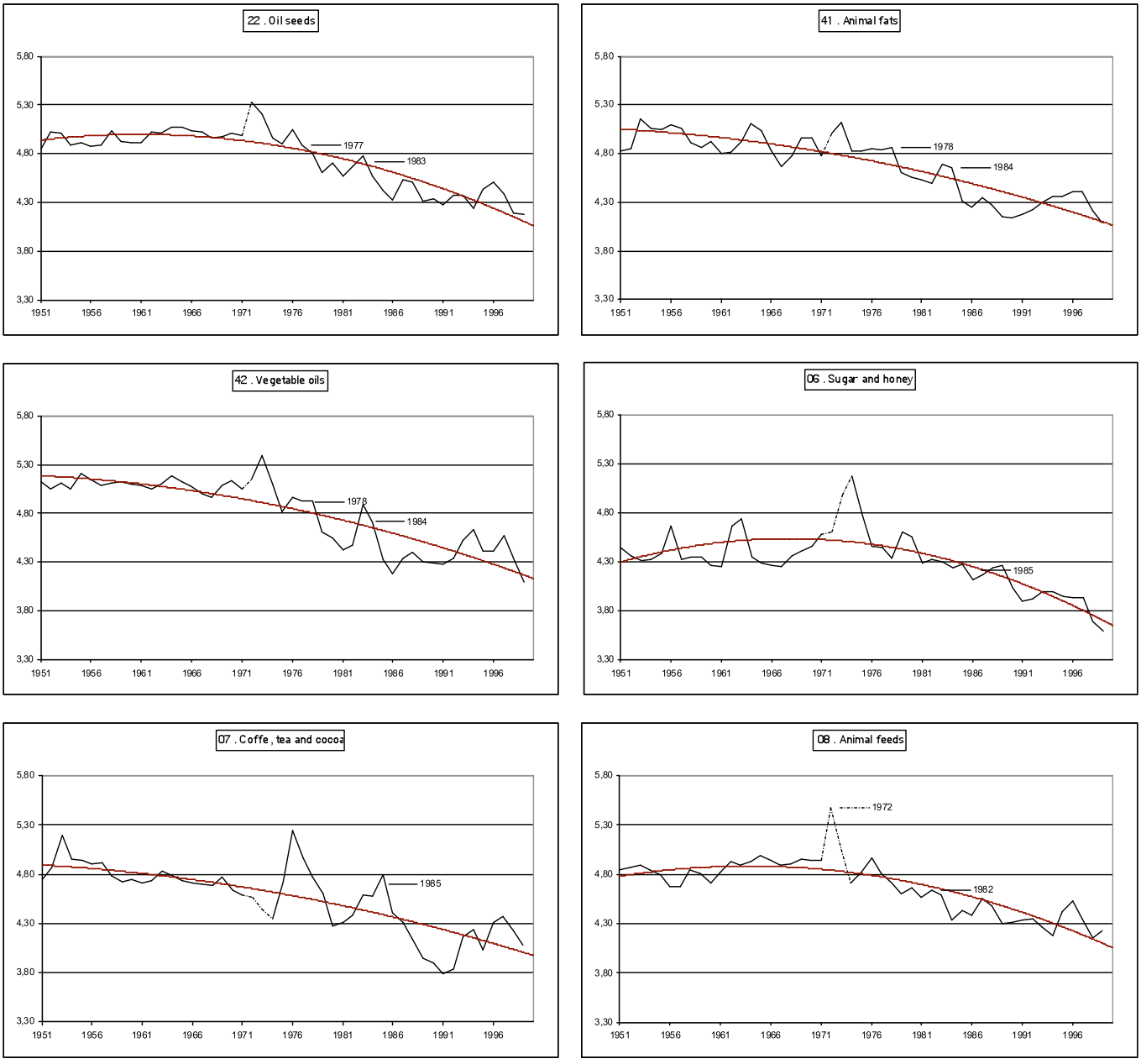
Evolution of the real prices of agricultural products and food. Aggregated index and groups showing greatest deterioration.



Source: Authors' elaboration on the basis of FAOSTAT (2004). Note that the dates coincide with the ruptures in the trend of the series (IO1) and (IO2)]. The series may be consulted in the Appendices.

Continuation Graph 1

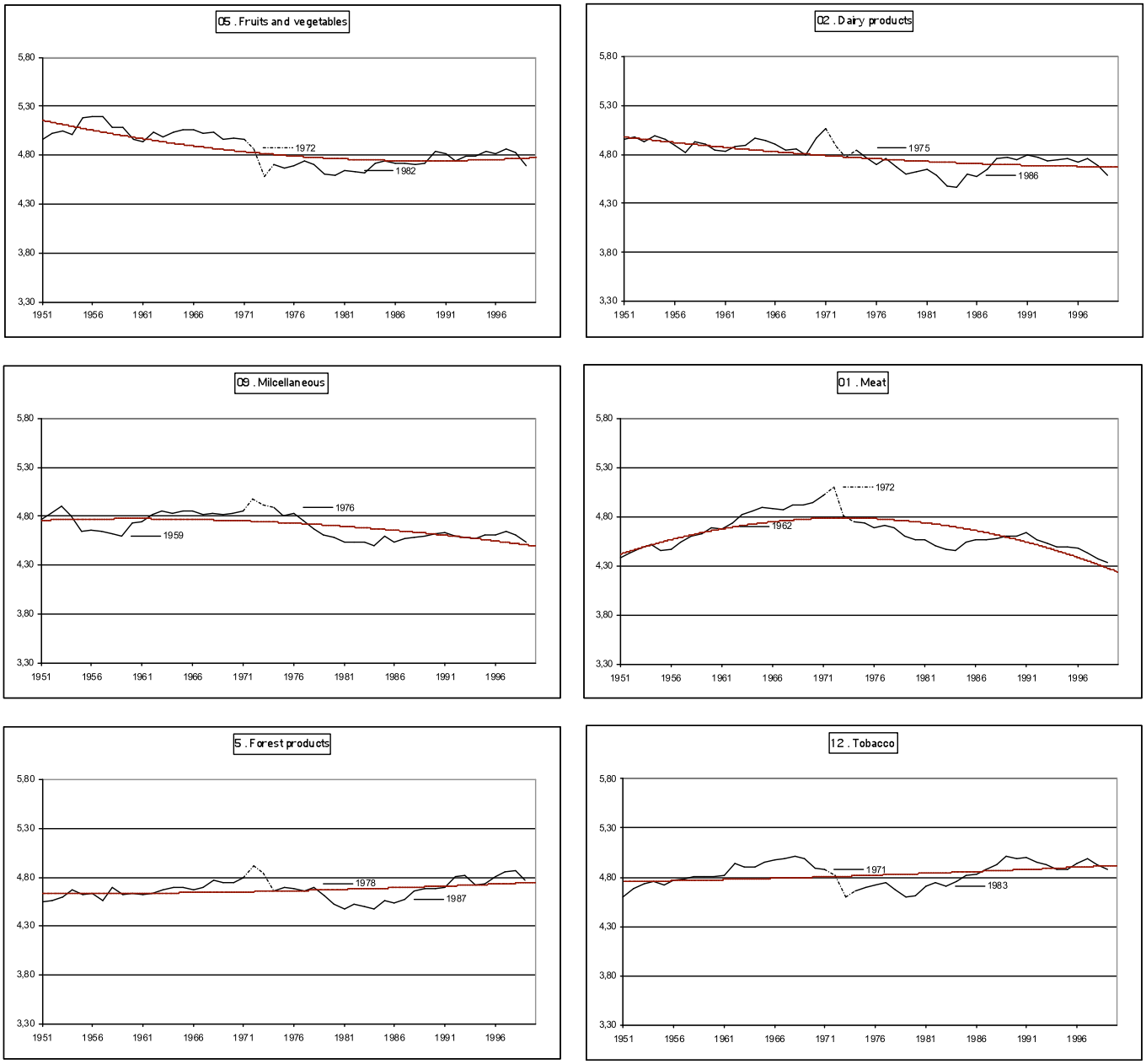
Evolution of the real prices of agricultural products and foods. Groups displaying better behaviour than the aggregated index.



Source: Authors' elaboration on the basis of FAOSTAT (2004). Note that the dates coincide with the ruptures in the trend of the series [(IO1) and (IO2)]. The series may be consulted in the Appendices.

Continuation Graph 1

Evolution of the real prices of agricultural products and foods. Groups displaying better behaviour than the aggregated index.



Source: Authors' elaboration on the basis of FAOSTAT (2004). Note that the dates coincide with the ruptures in the trend of the series [(IO1) and (IO2)]. The series may be consulted in the Appendices.

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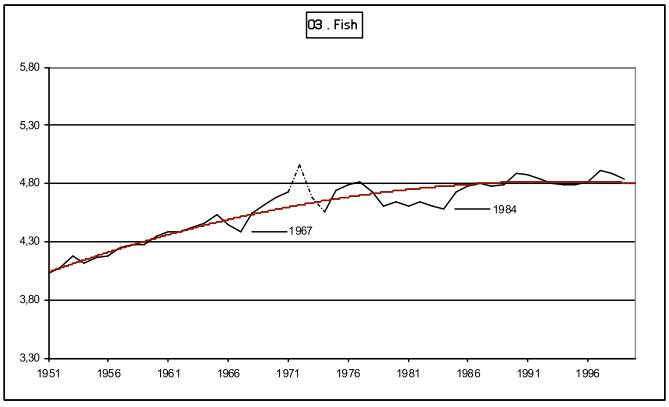
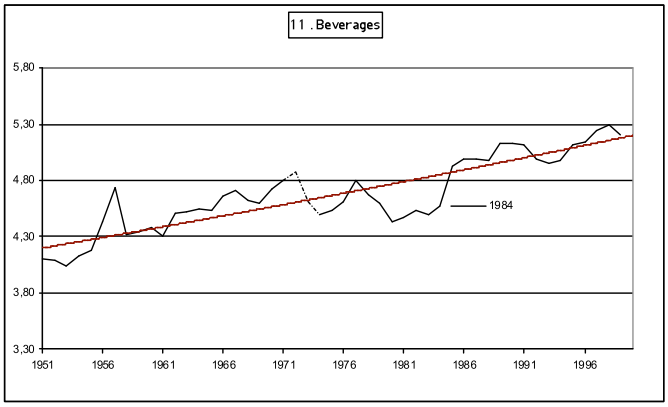
Evolution of the real prices of agricultural products and foods. Groups displaying better behaviour than the aggregated index.





Source: Authors' elaboration on the basis of FAOSTAT (2004). Note that the dates coincide with the ruptures in the trend of the series [(IO1) and (IO2)]. The series may be consulted in the Appendices.