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Agriculture's Terms of Trade: Issues and Implications.

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Agriculture's Terms of Trade: Reflection on some issues.

A. Introduction.

A widely held perception is that agriculture's terms of trade secularly decline, as a reflection of Engel's Law whereby demand for agricultural products rises less quickly than for manufactured goods and services as economic growth occurs and incomes rise. Consequently agriculture is seen as a declining sector, and one which should receive less policy priority than others in efforts to promote growth. That position has not always been the case, and there are many, particularly at the current juncture in global economic change, who now argue that agriculture needs to move up the policy agenda. This paper does not seek to address the full sweep of arguments for giving more priority to agriculture, but rather examines whether the evidence for a secular decline of its terms of trade actually exists, and whether there are systematic biases in the way analysis of this question has been conducted.

At the heart of this concern is the question as to whether the welfare agriculturalists in general are particularly disadvantaged and threatened by the broad impacts of economic change. For, at the centre of debates about the terms of trade is a question about the changing relative welfare of those working in the agricultural sector relative to others in other sectors. It is undoubtedly the case that a major process of structural adjustment takes place as development occurs. Labour leaves the land and moves to other sectors, farm businesses expand and the capital takes an increasing share of the returns. However other sectors also have to restructure, and replacement of labour by capital is typical in established manufacturing and service activities. With globalisation whole industries have substantially relocated from countries where they were originally established. Is agriculture particularly disadvantaged. It has a growing and relatively stable market for food, and growing markets for biofuels. There may be increasing volatility in prices due to weather shocks, but the future for its products is assured.

Agricultural and development economists have addressed a great deal of attention to agriculture's terms of trade, and there have been a number of reviews or reflections (e.g. Scandizzo and Diakosavvas (1987), Singer (1999), and Cypher and Dietz (2004)), plus John Spraos' major contribution in 1983 examining the theoretical, philosophical and measurement issues involved in interpreting the terms of trade. The body of research on the topic is huge.

Therefore, rather than attempt a comprehensive review, this paper sets out to reflect on a number of issues which have been of personal concern over a number of years. These include (1) the issue of what agricultural commodity prices should be compared to if we are concerned with the welfare of agriculturalists, (2) the general absence of product quality adjustment when analysis is undertaken comparing agricultural to manufactured goods prices, (3) the extent to which energy prices are or will be the driver of both manufactured and agricultural prices, and (4) the question 'since the service sector is typically the largest in the economy, would it not make sense to address agriculture's terms of trade with that sector'?

No attempt will be made to address the many other methodological issues which beset measurement of changes in terms of trade. Nevertheless it is important to acknowledge that these exist and include (1) what type of index to use to aggregate prices, (2) the appropriate price deflator to use, (3) the associated issues of purchasing power parity and exchange rate choice when making international comparisons, (4) choosing the base period for

a study over a period of years, or (5) the problem of choosing reliable representative prices for the farm-gate or wholesale prices depending on the country or objective of the study. If producer welfare through trade is the topic of concern, analysis at the farm-gate should ideally be chosen, but that raises extremely problematic issues, including the thorny question of what we mean by a farmer (see for example the work by Berkeley Hill (1962). This paper does not set out to address these issues, although they are factors which lead to debate about the conclusions of individual studies.

As Spraos observed (1983, p.7) "terms of trade changes usually come about as part of a package and .. a deterioration or improvement in the terms of trade can be the inevitable consequence of other developments which may make the net outcome in welfare terms ambiguous. There may be no grief in the deterioration of the terms of trade if it is the result of rapid increases in productivity or (in the context of unemployment) in job opportunities." It is particularly important to bear this injunction in mind when presuming to draw policy inferences from narrow measures such as commodity terms of trade. A key objective of this paper is to question whether the popularly accepted wisdom of declining commodity terms of trade is correct and, if so, whether this necessarily spills over into a negative view of the prospects for agriculture as a sector.

B. General Observations.

Comparatively little of the contemporary literature refers to **agriculture's** terms of trade. The predominant emphasis is on commodity terms of trade; that is some comparison of the changing price of a commodity bundle to a bundle of manufactures, and most literature is concerned with developing countries. In the 19th century the early classical economists (Ricardo, Malthus, Torrens, Mill and Jevons)[1] believed that limited land and resources to produce food would constrain the 'geometric' tendency of the human population to grow, which in turn would mean that food and agricultural products would retain a high scarcity price. Whether that should mean rising as opposed to stable agricultural terms of trade is debatable, but that is how the 'Malthusian' position is generally interpreted. As shown by the review by Scandizzo and Diakasavos (1987) that proposition continued to hold sway during the turmoil of the first fifty years of the 20th Century (see Table 1),.

Table 1. Changing perceptions of agriculture's terms of trade 1817-1985. (Number of studies).

	Rising terms of trade of LDCs/primary products	Declining terms of trade of LDCs/primary products	Trends not empirically convincing or analytically justifiable
1817-1900	5	0	0
1900-1949	11	3	1
1950-1985	9	38	34

Source: Scandizzo and Diakasavos (1987), Table 2.1.

The classical hypothesis was overturned in 1950 when Raul Prebisch and Hans Singer independently published their celebrated papers which theorized on why the terms of trade of

[1] These are the five authors accounting for the number 5 in the first row of Table 1.

the agricultural exporting developing countries would secularly decline. From that time testing the Prebisch-Singer hypothesis (PSH) has become a major research activity, and the developing country aspect of terms of trade change (and inequalising trade) has eclipsed broader considerations of the welfare of agriculturalists versus others in a general global sense. However, even after 1950, the Scandizzo and Diakasavos review produced an almost even balance with 38 studies published between 1950 and 1985 concluding for declining commodity terms of trade as opposed to 34 which were deemed inconclusive.

In the next section there is a discussion of some more recent papers examining the PSH, which mostly challenge the conventional view that the agricultural commodity terms of trade are secularly declining. The commodity price shocks observed in 2008 led to a resurgence of views that agricultural, mineral and fuel commodity prices might in future increase relatively. Although the exceptionally high commodity prices abated sharply in the last quarter of 2008, those concerns have persisted in many quarters. If that is correct, the question arises as to what products or input prices might commodity prices rise relative to? Can manufactured goods prices fall relative to the prices of their basic fuel, mineral and agricultural commodity constituents? That is a question addressed in section E below

C. Studies of the Prebisch-Singer Hypothesis 1985-2008.

The main charge of Prebisch (1950) and Singer (1950) was directed at the validity of the assumption in trade theory that factor and product markets were classically competitive in both the "centre" of the global economy (the developed countries) and at the "periphery" (the less developed countries). Prebisch argued that this process operated at the periphery, competing down export prices of primary commodities to the benefit of consumers at the centre. In contrast at the centre, in the production of manufactured goods more monopolistic forces were argued to operate, particularly in the labor market, locking the gains of productivity increases into higher wages and salaries, with firms having sufficient market power to pass these costs on in higher prices to markets in both the periphery and centre. Reinforced by views about "unequal exchange" (Emmanuel, 1972), the ability of multinational firms to extract rents from their investments in the periphery, and the acceptance of the low income elasticity of demand for food, the case for declining tropical agricultural commodity terms of trade seemed compelling.[2]

Numerous studies have examined the declining terms of trade hypothesis by analysing changes in the value of a basket of primary commodities[3] against a bundle of industrial commodities. One of the key analyses was conducted by Grilli and Yang (1988). They attempted to address some of the key methodological issues in comparing values of different bundles over a long period of time, by constructing new price indices for 24 non-fuel commodities for the period 1900-1986 and a new index of manufactured goods prices based on the United Nations Manufacturing Unit Values (MUV) index as the deflator. They also generated a revised version of the United Nations index of manufactured export unit values as an alternative deflator for the commodity price series. Grilli and Yang concluded that from 1900 to 1986 there had been cumulative trend decline of 40% in non-fuel commodity prices relative to the export unit price of manufactured products from industrial countries. Although this was "possible magnified by the relatively greater effect of quality improvements on the

[2] For a longer discussion of this and counter positions see Colman and Nixson (1994) pages 146-152.

[3] The commodity price series constructed by Grilli and Yang were for: coffee, cocoa, tea, sugar, beef, lamb, bananas, rice, wheat, maize, palm oil, cotton, jute, wool, hides, tobacco, rubber, timber, copper, aluminium, tin, silver, lead, and zinc.

price of manufactures, (it) probably reflects a net fall in the purchasing power of a given basket of non-fuel primary commodities" (p.34). The rate of decline identified was different for different groupings of commodities by type (food, metals, agricultural non-food, tropical beverages, cereals, and non-beverage foods), but the overall conclusion was of secular decline in commodity terms-of-trade, something clearly disadvantageous to developing countries highly dependent on these commodity exports, and also to developed countries with a high proportion of primary commodity exports (e.g. Australia, Canada and New Zealand).

The following two graphs display, for the main commodity aggregates, the series of Grilli and Yang data extended by Pfaffenzeller et al. 2007[4]. Figure 1 compares the price index of all commodities deflated by the MUV index according to whether arithmetic or geometric weights are used. The importance of this choice can be immediately seen. The geometrically weighted series is relatively flat from 1900 to 1975, whereas the arithmetic series shows a much more marked downward tendency, although it is also relatively flat from the mid-1920s until 1974. After the very sharp spike coinciding with the oil price shock of 1974/5 there is a very sharp downward movement in both series culminating in the start of the next spike which reached its peak in mid-2008.

Figure 1. All Commodities Price Deflated by MUV 1900-2008

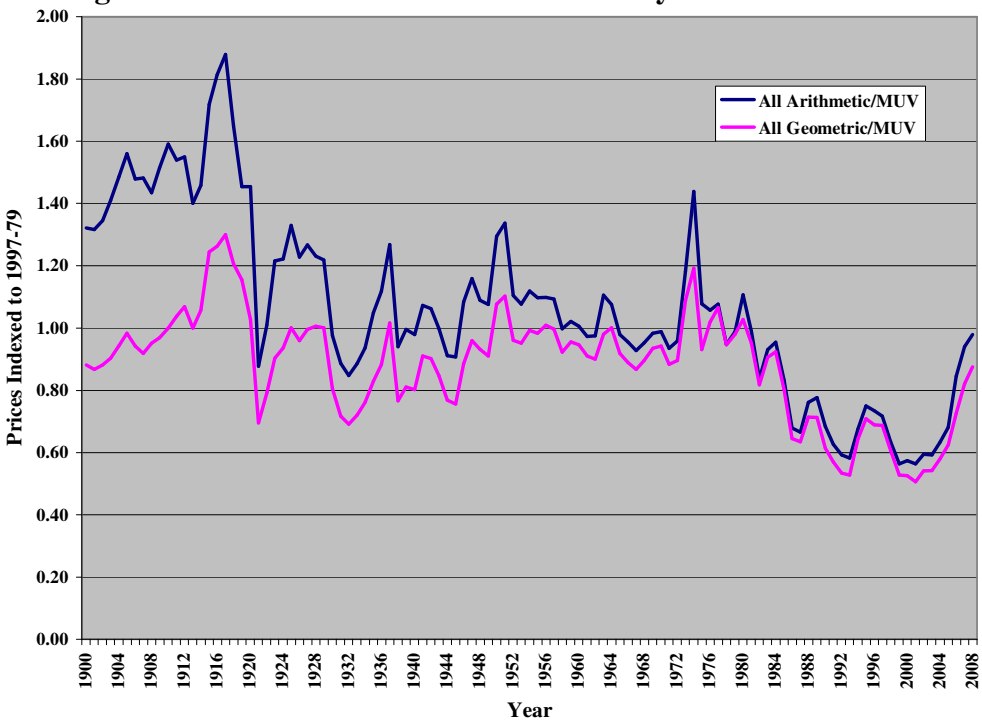
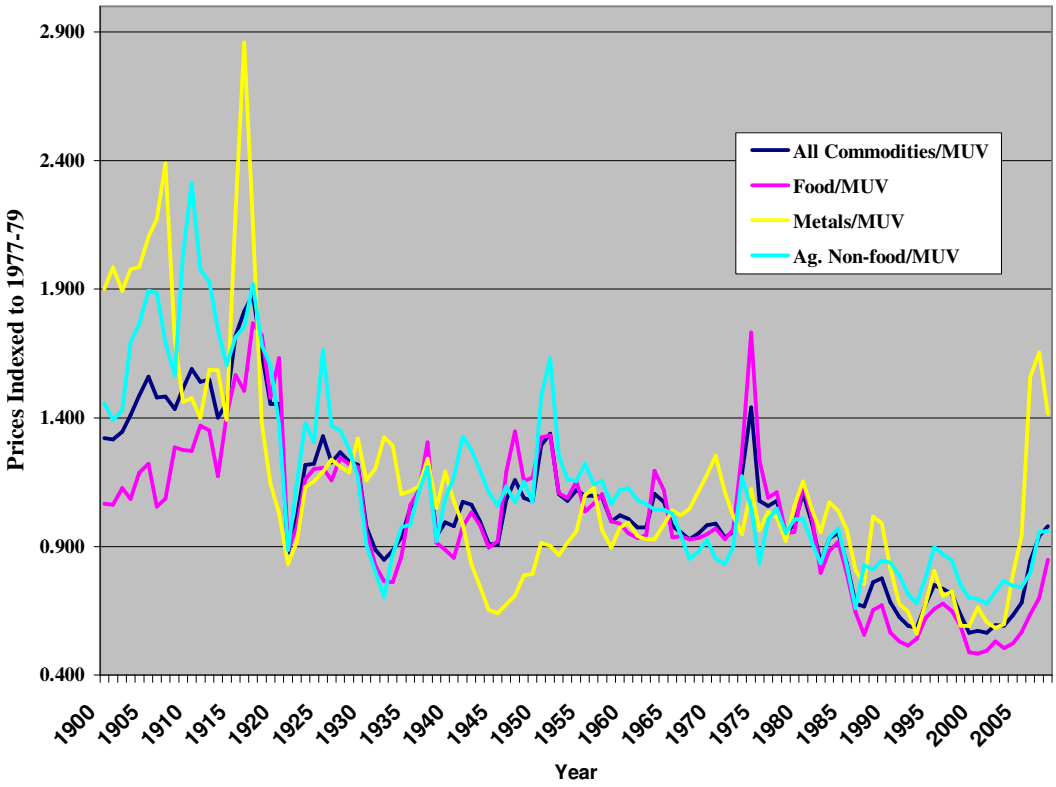


Figure 2 highlights the differences in the price series of different commodity groups using arithmetic weights. If the analysis is started at or before the sharp metals price spike in 1916, the real price of metals relative to manufactures shows a marked decline until the early 1970s as does the index for agricultural nonfood commodities. The relative food price index until 1974 shows the least visual evidence of any secular declining trend. However, if years before 1920 are omitted there is little evidence of price decline until after the commodity price boom of 1974/75, after which there was a large period of decline until 2006, when the latest commodity price boom began.

[4] The update to 2007 has generously been made available by personal communication from Stephan Pfaffenzeller as the paper only published data to 2003.

Figure 2. Real Price Indices updated 1900-2008 , by Commodity Group (Arithmetic weights).



Since Grilli and Yang's original paper there have been a number of studies of the data, applying different econometric refinements to essentially the same data, and it is worth trying to summarise the key findings of some of these by reference to the graph.

1. Cuddington and Urzua (1989) looking at the period 1900-1983 concluded that the hypothesis of secular decline was not robust against alternative of a once-for all shift in commodity prices in 1920/21. In support of this it can be clearly seen from Figure 2 that there was a very sharp spike in prices in 1918 followed by a long period to 1980, which while volatile, was comparatively flat.
2. Powell (1991) examined the GY data using cointegration analysis and found that taking account of three negative jumps in 1921, 1938 and 1975 non-oil commodity prices and manufactured goods prices are cointegrated and that this measure of the terms of trade is stationary with three breaks, where each break marks a negative shift. He argues p1494) that this "representation is preferable to the 'stable declining terms of trade' due to excessive kurtosis of commodity price changes", and observes that the changes take place after relatively sharp increases in commodity prices, and hypothesizes that booms may be "followed by a correction greater than that warranted by previous equilibrium". That raises the question as to whether post-2008 will witness another such over-correction or whether there will be a rise in certain non-oil commodities' terms of trade? Figure 2 displays evidence of Powell's three peaks in the all commodity series as well as the start of a fourth in 2007.

3. Cuddington (1992), in order to avoid complications associated with aggregation, studied the prices of Grilli and Yang's 24 commodities plus oil and coal over the period 1900-1983 and concluded that the terms of trade of 16 of them were trendless, 5 were negative and 5 were positive. The five judged to have negative trends were hides, palm oil, rice, maize and wheat, the latter two of which are of more importance as exports for developed rather than developing countries. He concludes "that the Prebisch-Singer hypothesis should certainly not be considered a universal phenomenon or 'stylised fact'". That is not surprising given the variation in trade composition among developing countries, but it did challenge the general concensus.
4. Leon and Soto (1997) adding an extra decade of data to 1992 produced results which differ from Cuddington's, which may not be too surprising given the observable downturn in all the lines in Figure 2 after 1980. Out of 24 commodities they concluded that real commodity prices of 17 had negative trends, three were trendless and four were positive. Therefore, while agreeing that the P-S hypothesis is not universally applicable "it is the case of most commodities". This divergence of conclusion underlines those methodological issues in relation to period of data selected. If we now tested the period 1900 to mid-2008, what results might emerge, given the dramatic price changes (up and down) which occurred in 2008? Canadian No. 1 western spring wheat, in store, St. Lawrence topped Ca$600 per metric tonne in the first quarter of 2008, US No. 2 yellow maize, Gulf ports reached almost $250/tonne in the second quarter. Other commodity prices likewise hit remarkable highs, with oil topping $130 a barrel on average in June 2006, before falling back sharply. It is price surges like this, along with those identified by Powell in 1921, 1938 and 1975, which produce results questioning the Prebisch-Singer hypothesis (PHS) of secular decline.
5. Cashin and McDermott (2006), reviewing a series of studies by them with other authors, conclude that there is no reliable evidence of a long term decline in real commodity prices, and that there is difficulty in identifying trends because commodity prices have long-lasting shocks (and/or long-lived cycles) and that the amplitude of movements in commodity process are often large. In their view (p27) "perhaps the most important feature of commodity prices is their variability….."
6. In a very recent paper Balagtas and Holt (2009) also examine the Grilli and Yang data for 24 commodities extended to 2004. They use estimation methods "belonging to the family of smooth transition autoregressions", which can test for a complex set of time-series properties including non-linear structural adjustment and multiple breaks. They conclude (p.103) "Using forward simulations of the simulated models to evaluate the long-run price behaviour (*relative to the MUV index*)[5], we find very limited support for the PSH. Only in the case of wool do we find evidence of secular decline in terms of trade. In part this is because the big peaks and valleys observed in many of the commodity prices seem to be adequately characterized by non-linearity".

It would be possible to extend this list of studies but to do so would only serve to emphasise the diversity in studies and outcomes according to the econometric methodology, specification, time period, data source, commodity weights and level of aggregation. A key

[5] Words in italics added.

feature that emerges is that of structural breaks in the series over the span of the last century, and of the high degree of variance caused by periodic booms and slumps. If the trend analysis makes no allowance for structural breaks, it would appear that agricultural commodity terms of trade have moved negatively when measured against the prices of oil, minerals and of manufactures without any adjustment for quality change. When breaks and other sophisticated underlying process possibilities are allowed for, that simplicity is challenged, and the PSH does not universally apply. This was implicitly acknowledged by Singer himself when he states (1999, p.11) "The simplest version on which the discussion has perhaps unduly concentrated is the simple proposition regarding the barter terms of trade …of a long run tendency for prices of primary products to decline in relation to manufactured products..".

If the objective is to assess what has happened to the terms of trade of a group of countries, any particular country, or a group of individuals within a country it is necessary to focus upon measures specific to the entity concerned, and to extend analysis at this level to the income terms of trade and the factoral terms of trade. Ideally, as Spraos has argued (1983) it is the latter, which should be addressed to study the extent of welfare changes arising through trade. After considering a number of issues the paper turns briefly to these other measures in section F below. But before addressing these the paper seeks to highlight the narrowness of analysing issues of agriculture's terms of trade using the Grilli and Yang data by considering the implications of adjusting the manufacturing price deflator for quality improvements and of broadening the price comparison to the service sector.

D. The Issue of Quality Adjustment.

Sarkar (1986) examines what he identifies as six classes of criticism of the measurements leading to acceptance of the PSH. Among these is that the standard measures of the commodity terms of trade make insufficient (i.e. no) allowance for the much greater quality improvement in manufactures than in commodities. That argument is that the price of manufactures should be adjusted downward to allow for this quality adjustment, since a large part of any increase in the nominal price of many manufactured goods is that they are significantly improved products offering much more service and characteristics than before; in other words that a product with, say, 1960 characteristics would have a much lower price than the product currently marketed.. Sarkar rejected this argument, along with the other five when he said (p.362) "The ideal alternative to a unit value index is a 'specific' price index which has a quality adjustment mechanism built into its construction so that the index relates to a 'constant quality' of goods. In the post-war years, several experiments were made comparing this index with a unit value index representing the same universe. These have not supported the proposition that a unit value index is 'subject to excessive inflation because it under-allows for quality improvements". That does, however, seem to be a challengeable conclusion, and there is now considerable evidence that the quality improvement factor in manufacture is considerable.

As we are ultimately interested in questions of changes in welfare through trade and specialization it is important to try and adjust TOT measures for quality changes in the bundles of goods traded. Indeed Triplett (2004, p.9) states that "quality change has long been recognized as perhaps the most serious measurement problem in estimating price indexes." If the quality of the bundle B purchased (or purchasable) by bundle A has increased then A is able to acquire more of the characteristics embodied in B than is reflected in the simple price relative. From this perspective the TOT = $(PA_t/ PB_t).QB_t$, where QB_t is an index of the change in quality of bundle B. This is an exceptionally important adjustment when looking at

agriculture's TOT because of the apparent large improvements in quality (i.e. real price reductions) of so many manufactured products. While there have also been improvements in the quality of agricultural products which are not reflected in PA_t this may be assumed to be on a lesser scale than for manufactures.

There is little or no literature to enable comparison of the relative understatement of quality improvement in our two price indices, but the absence of a measure for agriculture is not of major significance from the standpoint of assessing what has happened to the relative welfare of the agriculturalists. That they have not been able to capture this unrecorded benefit, while unfortunate, is not as important as the fact that they have been able to capture the quality improvements in B without having to pay higher prices than those recorded in PA_t.

It is self-evident that there has been a huge rate of quality improvement in many consumer durables, such as computers, mobile phones, other elelectronic products and automobiles so that their real price has declined relative to their nominal prices. However, measuring real price reduction equivalence of quality change in not straightforward as Triplett's exploration of alternative methodologies reveals. Nevertheless the improvements for many products are large, whichever method is used. This is revealed by some of the examples Triplett presents in his Table 3.1 (p93), reproduced below.

Table 2. Comparison of two alternative hedonic price methods of measuring "quality" change. The adjacent period dummy variable versus the characteristic price index method.

Study and period	**Dummy variable**	**Characteristics price method**
Dulberger (1989 Table 2.6)		
Computers AARG (1972–84)	-19.2%	17.3%
Okamoto and Saito (2001, Charts 2 and 5)		
TVs (AARG 1995-99)	-10.4%	-10.4%
PCs (AARG 1995-99)	-45.1%	-45.7%
Digital cameras (AARG Jan.2000-Dec. 2001)	-21.9%	-21.9%
Silver and Heravi (2002,2003)		
TVs (total 11 month change)	-10.5%	-10.1%
Washing machines (Total 11 month change)	-7.4%	-7.6%
Berndt and Rappaport (2002, Table 2)		
PC desktops (AARG)		
1991-1996	-37.0%	-38.4%
1996-2001	-35.7%	-37.3%
PC laptops (AARG)		
1991-1996	-26.9%	-26.0%
1996-2001	-39.6%	-40.6%

What is self-evident is the large estimated scale of some of the annual 'quality' for price changes over different periods- for digital cameras around 22% in two years - for laptop

computers around 40% over the six years 1996-2001 - and for washing machines in the UK in 2003 a 'quality to price' change of around 8%.

In another series of studies Trajtenberg (1990, p180) conducted a study of CT (Computed Tomography) scanners and estimated that the hedonic price index declined by 13% a year from 1973 to 1982.

Another example, to highlight the basic point, emerges from hedonic pricing work by Zvi Griliches (1961). He concluded that "about one-third of the price rise of 4-door sedans in the USA 1937-1950 can be attributed to quality change no matter what weights are used", which is to say that the quality adjusted price would have been two-thirds of the nominal price change. Later Berndt and Griliches (1990) conducted a number of quality adjustment tests on quality adjusted microcomputer prices 1982-1988 and obtained rates of adjustment of between minus 20-30% per annum.

A final example cited here is from the work of Gordon (1990) who undertook estimates to calculate what adjustment would be needed to the US series on Producer Durable Expenditure to allow for quality improvement in machinery and equipment. His conclusions were that (1) the quality-adjusted New PDE deflator rises almost 3% p.a. less than the (standard) NIPA PDE deflator, (2) annual USA growth of real investment estimate is raised from 3.2 to 6.2 p.a. 1947-1983, and (3) the ratio of equipment investments to GNP almost triples, relative to rough constancy in NIPA data. That represents a major revaluation, on a scale which dwarfs any comparable quality adjustment that might be made to agricultural commodity price indices if the research was available to permit that.

Other examples could be cited from the literature to support the basic argument here, namely that to compare price indices of agricultural products to price indices of traded manufactured products, while bearing some messages about changing agricultural TOT, entails missing a key factor. A constant relative price (PA_t/ PB_t), if such a thing was observed, should not be interpreted as indicating no change in agriculture's TOT, but rather would in itself point to an improvement because of the 'quality' improvement in manufacture. A decline in (PA_t/ PB_t) may not represent a decline in agriculture's terms of trade if the quality improvement in commodity bundle B is sufficiently large.

E. Why not compare agricultural to service sector prices?

It is somewhat surprising that so little attention has been paid to comparing agriculture's terms of trade to those of the service sector, and that the pre-occupation with the manufacturing sector has been so overwhelming. If one takes the World Bank definitions of sectors as presented in the World Development Review 2008, in only 8 out of 125 countries was the GDP contribution of agriculture greater than that of services in 2006, and in only 17 did industry contribute a higher proportion than services (Table 4, pages 340-341). Even for the low income countries as a whole the service sector is shown as generating 51% of GDP. Given that there are so many low paid workers in the service sector it would seem a serious oversight to ignore changes in agriculturalist's welfare relative to those in the service sector.

One study which has addressed this issue is that of Surajit Deb (2006), which studied terms of trade changes in India between the three sectors for period 1950 to 1997. Deb has approached this using a procedure somewhat different from the standard comparison of price indices. Rather he has chosen a National Income Accounting approach to measure the

differences in sector value added (Va_j of sector *j*) caused by the deviation of that sector's implicit price deflator, P_{va_j} relative to P_{va}, the implicit price deflator for the whole economy, or the deviation of the sector specific price index of final demand for the *j-th* sector (P_{D_j}) to P_D the price index of final demand. These give two alternative versions of the terms of trade effect on each sector, which he calls respectively the production effect and the income effect. The equations for these two measures can be represented as

Production gain/loss = $(X'Vaj * P_{va_j} / P_{va}) - X'Vaj$

Income gain/loss = $(X'Vaj * P_{D_j} / P_D) - X'Vaj$

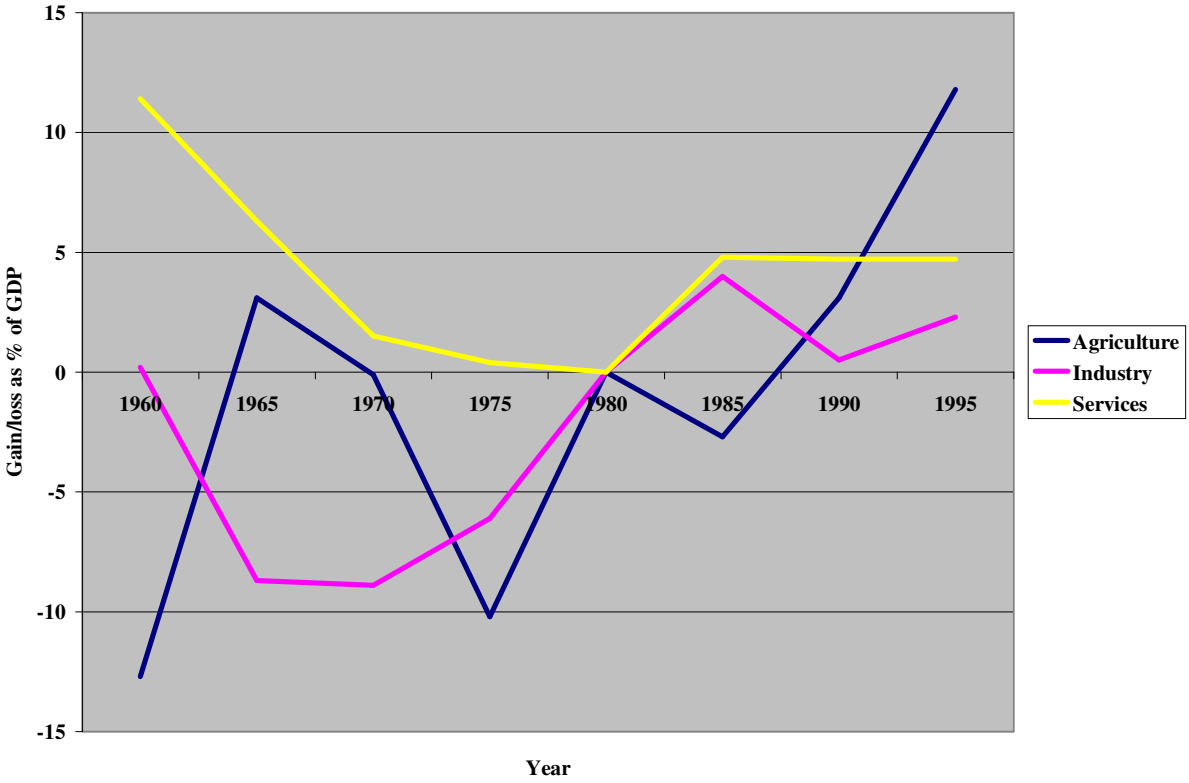
Where $X'Vaj$ = sectoral GDP of the j-th sector at constant prices

Figure 3 below summarises Deb's results by the 'production' method, and it reveals a comparatively positive picture for agriculture over the period 1950-1995, as also does the data for 'income, method[6]. The volatility of the series for all three sectors is apparent, particularly in the 1950s, but there is no evidence here to suggest a secular decline in Indian agriculture's net barter terms of trade. Rather, it would appear fair to conclude that the NBTT of agriculture improved against that of the service sector in the latter half of the 20th century, and held its own against industry. Deb also performs calculations by both methods over a slightly shorter period of time for all Indian states. This shows a generally positive picture for the agricultural sector of most states.

Deb's results are of considerable interest. One aspect is the methodology used, which deserves more attention. Another is the fact that, given the global importance of India, these results appear to provide a counterweight to the generalised story about the decline of agriculture's terms of trade in developing countries. Thirdly, and of central relevance to this paper, there is good reason to consider comparison to the service sector when considering the welfare of those in agriculture, and that when that is done in this case agriculture performs relatively well.

[6] I am grateful to Surajit Deb for making his data available to produce this Figure.

Figure 3. Terms of Trade (Income) Effect, by Major Sectors, India 1960-1995 (Base 1980-81).



Based on Deb (2006, Table 1).

F. Biofuel and oil price linkage to agricultural commodity prices.

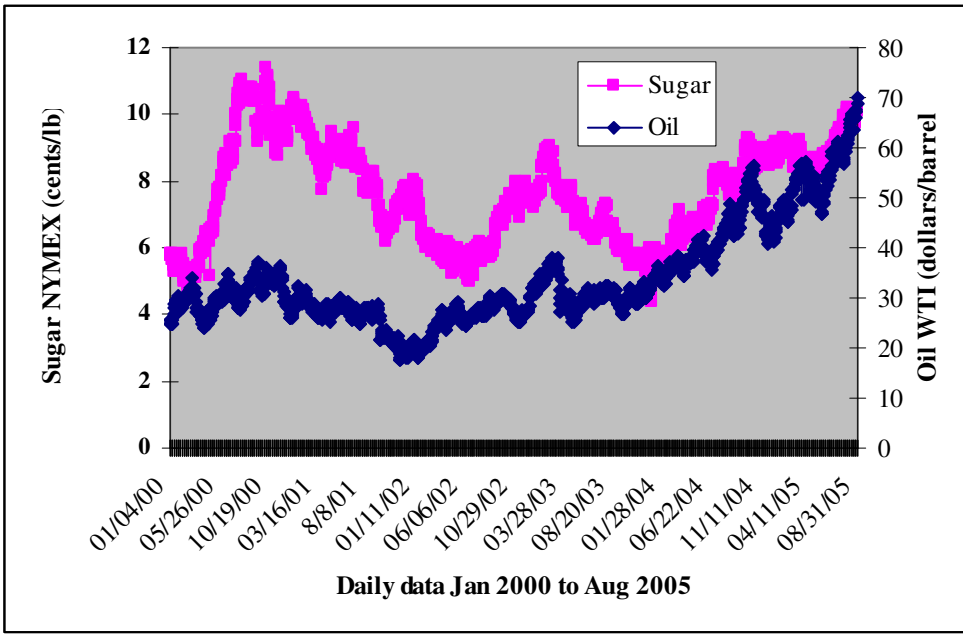
A question which seems to arise naturally is "does the price of oil and energy generally tie long-run agricultural commodity prices to manufactured goods prices"? Modern systems of agricultural production are energy intensive in the forms of machinery, fuels, inorganic fertilisers, pesticides and fungicides, and transport. These inputs represent a significant element of cost in many farming systems, as they do in manufacturing.

If the assumption is that the answer to the above question is that there is a binding influence here then it might be expected that there is evidence of price cointegration. Powell (1991) certainly concluded that "commodity prices and manufactured goods prices are indeed cointegrated" when analysing the Grilli and Yang 1900-1986 data.

Since 1986 with the policy drive towards substituting biofuels for fossil fuels, the linkage between the prices of many field crops and the oil price should have strengthened. Now that sugar, maize, wheat and rapeseed are feedstocks for biofuels there should be a stronger connection to oil prices. "As prices for fossil fuels reach or exceed the energy equivalent of agricultural products, the energy market creates demand for agricultural products …….a *floor price effect* for agricultural products results" (Schmidhuber 2006). Sugar is the most competitive feedstock for ethanol production, particularly in Brazil, and Schmidhuber initially argued for there being a very strong relationship between the price of crude oil and the sugar price over the period January 2000 to January 2007, but subsequently questioned whether this may have broken down in the second half of 2007. As the graph below shows there was indeed

a substantial break between the two prices from Spring 2007 until the end of 2008, when the prices returned to the sort of relationship which persisted over most of the period since 1980[7].

Figure 4. Relationship of the Crude Oil and Sugar Prices, Jan. 1980-Nov. 2008



It may be too early to assert exactly what the degree of linkage between oil and energy prices is to agricultural commodity prices but it seems reasonable to hypothesise that one exists and that it will strengthen if there is increased use of biomass to generate biofuels, electricity and heat. A simulation run with the OECD-FAO Aglink model in September 2008, when crude oil prices were close to their peak, gives some idea of what the linkage might be. The simulation assumed a halving of the crude oil price from $130 per barrel to $65 by 2009, and that price persisting until 2017. The simulated impact of this 50% reduction on a range of commodity prices is shown in the following Table. Unsurprisingly the largest impacts are on the Brazilian ethanol price (-38 and -34%), but the projected impact on crop prices is quite large, particularly by 2017 with projected price reductions of 24% for maize, 19% for wheat, and 25% for soybeans. The projected impacts on livestock prices are relatively small but build up over the years as feed and energy prices work through to produce 2017 price reductions of 12% for steers, 8% for chicken and 17% for hogs.

While there may be large confidence intervals about these values, the simulation does illustrate the possible scale of the linkage from energy to agricultural prices. The logic that there must be such a link certainly appears sound, and the hypothesis put forward, but not fully answered in this paper, is that it should be expected that the price of agricultural commodities should be closely linked to energy and manufactured goods prices in the globalised economy, with appropriate adjustment for any differential in productivity increases between agriculture and manufacturing.

[7] Data very kindly provided by Josef Schmidhuber.

Table 3 Projected Impact of a 50% Oil Price Reduction On Selected Commodity Prices 2009 and 2017

	2009	2017
Yellow maize, US No.2, fob, Gulf	-11	-24
Wheat US No2 HRW fob (ord) Gulf	-9	-17
World sugar price - FOB Caribbean	-17	-19
Brazilian anhydrous ethanol price	-38	-34
Biodiesel Central Europe FOB price.	-24	-28
Soybean seed: Arg. CIF Rott	-19	-25
Soybean cake(pell 44/45%): Arg CIF Rott	-17	-18
Soybean oil: Arg. FOB	-15	-26
Nebraska, direct fed-steer	-3	-12
Chicken, U.S. 12-city wholesale	-4	-8
Hogs, U.S. 51-52% lean equivalent	-5	-17
Cheese, FOB N. Europe	-3	-8
U.S. refiners acquisition oil price	-50	-50

F. Agriculture's Terms of Trade and Factor Productivity.

Whereas commodity terms of trade (CTT) are a form of global measure comparing the price index of one bundle of commodities at international prices to that of another bundle or to that of manufactured goods prices, the trade specificities of countries, sectors in countries and ultimately of individuals working in (say) agriculture are highly variable. To study welfare through trade at these levels requires measures specific to the particular groups concerned. The CTT of primary commodities has been employed as a shortcut, in particular, to considering the TT of developing countries with a high dependence on primary commodity exports. However, in order to consider the diversity of experience it is necessary to turn more specific measures. Unfortunately there is a comparative dearth of recent studies of the net barter (NBTT) or income (ITT) terms of trade of different countries.

The NBTT compares changes in the price index of the export bundle of a country or sector to the price index of its imports or purchases. When multiplied by a quantity index of exports or output it becomes the ITT, which is a measure of the amount of the bundle of imports/purchases which can be acquired for a unit of the export/output bundle. If the export/output index rises (as is generally the case) the ITT indicates that more imports can be acquired than the changing value of the NBTT implies. Whatever the changing values of NBTT or ITT are for a country or group, it is the value change relative to that of other groups which has most bearing as a welfare measure. Roughly assessed, if the NBTT or ITT of country or sector A has risen relative to those of country or sector B the welfare of A can be judged to have improved. Faster increase in these measures is always preferable for the numerator country or group, which is A.

However, as Spraos (1983) has argued, the labour productivity of the workforce under study (the export sector, agriculture or whatever) has a considerable bearing on the welfare outcome of trade. If a particular group of workers has increased productivity then less labour has been used to produce the volume of goods exported, and the NBTT or ITT measure will understate the welfare change of that group insofar as they can buy more of the import/purchase bundle per unit of labour expended than the NBTT or ITT measures imply. Thus Spraos argued for the use of a measure of the single factoral (or factorial) terms of change (SFTT) in which the NBTT is multiplied by the productivity change index of the labour group concerned, such as the export sector of country A. In a further refinement the measure can be

converted into the double factoral terms of trade (DFTT) by dividing the SFTT by the labour productivity change index of those producing the imports or goods purchased. This measure, which is rarely produced, would indicate whether through trade group A is able to acquire more of B's labour time through trade. If the trend is positive it could be read as an indicator that the welfare of group A is improving relative to that of group B.

But the argument for adjusting terms-of-trade measures goes beyond the issues outlined above. A rapid increase in productivity may well be the reason that the price of a product declines. In extension, that is fundamental in explaining the real decline in agricultural prices relative to nominal incomes, and the process of structural economic change whereby agriculture had reduced its labour force, released resources for the expansion of other sectors, and helped fuel the process of economic growth. Decline in the CTT or NBTT cannot be dissociated from total factor and labour productivity improvement. Productivity improvement offsets the impact of any decline in their NBTT for those who remain in agriculture, allowing them to increase their incomes. It is thus interesting to look at studies of the SFTT of agriculture. Two are presented below, one for Australian farmers, and one for sub-Saharan African countries.

F.1. Australian Farmers' Terms of Trade.

Among OECD countries, Australia has been one of the countries highly dependent on primary exports, both agricultural and mineral. That has led to an unusual degree of interest by economists there in measuring Australia's terms of trade. Uniquely, a series on "farmer's terms of trade" is published based on the ratio of an index of prices received by them for goods produced to an index of prices paid.[8]. This is used to produce an NBTT series, which presumably can be interpreted as measured at the farm gate. When multiplied with estimates of the total factor productivity (TFP) of Australian agriculture a series for the single factoral terms of trade (SFTT) is produced. In the Figure below the TFP measure employed is that maintained at the Australian Bureau of Agricultural and Resource Economics, the Kokic series.

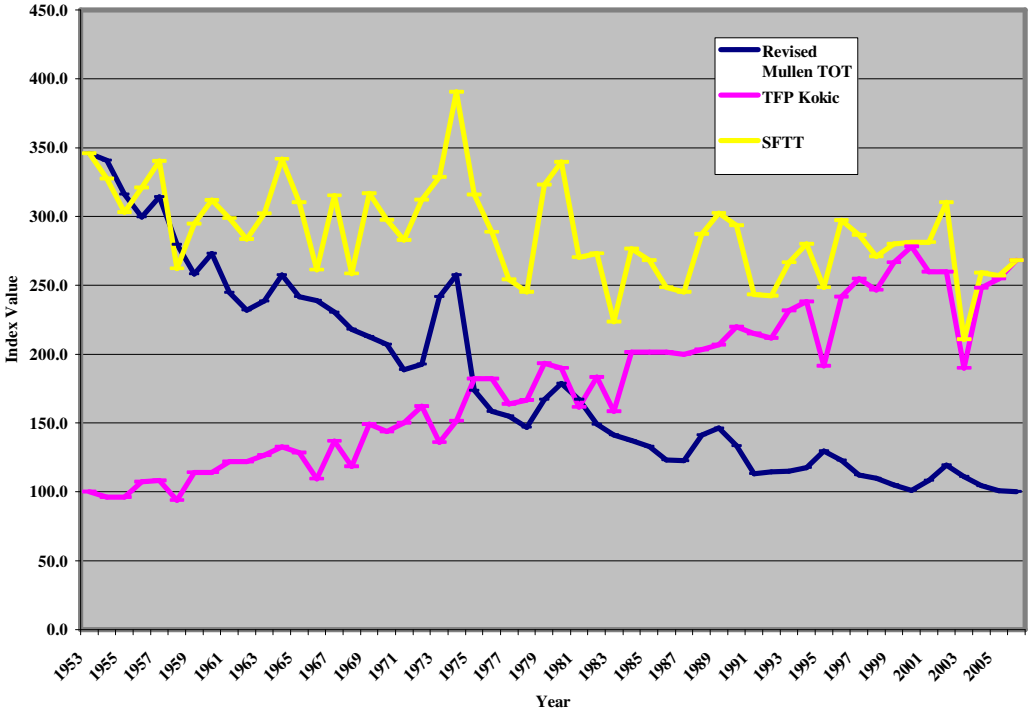
It is apparent that the NBTT series for Australian farmers has shown a large decline over the since 1953, although it is important to note that the early 1950s were a period of very high commodity prices at the end of the war in Korea. After a sharp drop following the commodity price shock of 1974/75 the decline in NBTT has been less marked. Offsetting the decline in NBTT to a significant extent has been a steady rise in TFP, such that since 1980 the SFPP can probably be said to have been more or less stable.

Several important issues attach to the issue of the rate of TFP growth in interpreting agriculture's terms-of-trade and these can be highlighted using Australian data reported by Mullen and Crean (2007) and Mullen (2007). (1)The increase in Australian agriculture's TFP has arisen because the index of output has increased by value at a greater rate than the index of inputs used. According to Mullen and Crean (Table 4) Australian output growth averaged 3.5% per annum from 1953 to 1994 as against input growth averaging only 1.0%. This produced an average 2.5% TFP growth, which slightly more than offset the decline in farmers NBTT and resulted in a positive momentum for agriculture. (2) Moreover (ibid Table 1) estimates suggest that agricultural TFP growth compared favourably to most other sectors of the Australian economy. (3) Mullen (2007, Table 4) also presents results by Bernard and Jones (1996) of estimates of the comparative rates of agriculture's TFP growth relative to non-agriculture for 14 OECD countries over the period 1970-1987. In all cases, except Japan, it was estimated that agriculture's TFP grew faster by an average ratio 0f 2.17. The investment and industry

[8] I am grateful to Euan Fleming for directing me to this work and providing me with data, published in the Australian Farm Institute Report (2007) written by Mullen and Crean. John Mullen has very kindly provided updated data for both the farmers' terms of trade and the alternative TFP indices.

restructuring required to achieve that sort of performance does not suggest a shrinking or failing sector whatever interpretation is placed on the declining CTT or NBTT.

Figure 5. Australian Farmers' NBTT, TFP and SFTT, 1953-2006



F.2. Single Factoral ToT in Sub-Saharan Africa.

As regards the issue of the relative welfare of developing countries, the various alternative measures change the picture comparatively little, insofar as many of the poorest countries remain heavily dependent on primary commodities, and their terms-of-trade however perform relatively poorly, even when adjusted for productivity change. That is illustrated for sub-Saharan Africa by a very interesting paper by Fleming and Fleming (2007) in which they use total factor productivity (TFP) indices[9] to measure the SFTT of a number of African countries over the period 1970-2002, a period in which the CTT for agricultural commodities generally declined. The SFTT for 33 countries is calculated by first constructing an NBTT series for the agricultural sector. This is calculated for each country by deflating an index of domestic agricultural output prices by the consumer price index. For nearly half of the countries TFP was calculated to be negative over the period, and this actually meant a greater decline in the SFTT than in the NBTT. Indeed only six countries, as shown in Table 5, emerged with a positive measure of SFTT; seven showed no significant trend, whilst 20 displayed a negative trend as shown in the Table below.

[9] Spraos (p.71) notes that while some studies have chosen to use employ a total factor productivity measure "… the case for preferring labour to total productivity is strong, not to say overwhelming." For Burundi Fleming and Fleming did employ a labour productivity index in the absence of data for TFP.

Table 4. Trends in the Single Factoral Terms of Trade for Selected African Countries.

Countries with a positive trend in the single factoral terms of trade:		
Central African Republic	Chad	Madagascar
Nigeria	South Africa	Togo
Countries with no significant trend in the single factoral terms of trade:		
Gabon	Malawi	Mali
Mauritania	Mauritius	Mozambique
Swaziland		
Countries with a negative trend in the single factoral terms of trade:		
Botswana	Burkina Faso	Burundi
Cameroon	Congo, Democratic Republic	Côte d'Ivoire
Egypt	Gambia, The	Ghana
Guinea	Guinea-Bissau	Kenya
Liberia	Niger	Rwanda
Senegal	Sierra Leone	Sudan
Zambia	Zimbabwe	

Source: Fleming and Fleming (2007).

Even allowing for the difficulties of estimating terms of trade for these countries, the picture from 1970-2002 is a depressing one, but one made particularly worrying by the failure of TFP to rise in so many of them. For the countries as a whole the average TFP increase was estimated to be only +0.16% over the period, an exceptionally low rate by any international standard. The contrast with Australia and with many other countries is a stark one. A declining NBTT faces many industries world-wide, but is one which successful industries counter by higher rates of productivity increase. Declining terms of trade in themselves are not the key problem, it is the absence of accompanying in creases in productivity which makes them so in countries and industries where it fails to occur.

G. Summary and Conclusions.

At the outset, the objective of the paper was to take issue with the widespread notion that the agricultural sector is inevitably disadvantaged by a secular decline in its terms of trade. Much of the research on the subject has focused on the terms of trade for agricultural commodities measured against the price indices for manufactured, industrial or imported bundles of goods. This focus has been motivated by efforts to test the Prebisch-Singer hypothesis (PSH), which has had such a powerful influence on thinking about structural change in economic development. Testing and re-testing this hypothesis has been facilitated by

the general availability of the continually updated set of data originally created by Grilli and Yang (op. cit.). Tests of the commodity or barter terms of trade for agricultural products cannot be viewed as full tests of agriculture's terms of trade, as it ignores the attendant circumstance flagged up in the quote from Spraos' work in the Introduction to this paper. If factors such as total factor productivity and volume growth of output are ignored, it would not even be axiomatic that an improvement in the commodity terms of trade for agriculture reflects improvement in the welfare of agriculturalists. If there were to be no TFP improvement or output growth, but if the number of people dependent upon agriculture had increased, there could have been a welfare reduction in spite of improving commodity terms of trade. Those conditions may have applied in some countries at some times, and it emphasises that agriculture's terms of trade, as typically measured, are not synonymous with measures of the welfare of agriculturalist. In the opposite direction, a decline in the commodity terms of trade can be offset by TFP improvement and increased output volume to generate an improvement in producer welfare.

It is striking that much of the recent econometric research on agriculture's CTT as reported in this paper, has rejected the PSH. Visual inspection of some of the graphs in the paper might seem to suggest decline, and the Australian farmers' series is unambiguously negative, but the research does not confirm secular decline in a general sense. That may be because the econometrics, in testing for breaks, is revealing the long-run pattern as being one of periods of relatively stable price punctuated by downward breaks. That is, it may be that the downward breaks, following sharp peaks in commodity prices, are acting to disguise a general drift downward in the commodity terms of trade. There have been marked periods of decline in the CTT, markedly so from around 1976 to 2006, but there have been long periods of relative stability as from the mid-1920s to 1973. In other words there were markedly different stages of movement in the CTT in the 20th century, which raise some questions about the appropriateness of analysis repeatedly taking 1900 as the base.

That said, the paper has sought to highlight key weaknesses in the standard analysis of the CTT. Despite the conclusions of Sarkar (1986), there do appear to be strong grounds for arguing that when comparing commodity to manufactured/industrial goods prices adjustment should be made to the latter for quality improvement. Substantial improvements are being made to many manufactured products, which are not fully reflected in their nominal prices, as data reported clearly shows. The implication of this is that the standard tests of the commodity terms of trade miss out a significant part of the comparative welfare story.

Also, the failure to measure agriculture's terms of trade against those of the service sector means that analysis is failing to address a truly fundamental question of the relative welfare of agriculturalists to the largest sector of society. The service sector typically accounts for more than 50% of economic activity. It is true that much poverty is concentrated in rural areas, but some of that is in the service economy. In poor countries much of the informal sector is in providing services, while in developed countries the service sector contains much of the low-wage economy. It is important to recognise that farming as an occupation still provides good opportunities for many. That is something underlined in the current global recession. The majority of job losses are in the service and manufacturing sectors. These sectors adapt to crises by rapidly adjusting the level of activity and employment, whereas in farming things tend to continue much as usual (i.e structurally adjusting steadily), with price changes absorbing much of the shorter-term shocks as markets clear..

The paper has speculated on the question of the extent to which agricultural commodity prices can be expected to diverge from those of energy, manufactured products and from service sector prices. The cost structure of agriculture is driven by the costs of inputs from these sectors and by the price of labour, both hired and family-supplied. The continual processes of restructuring in farming, and investment in new technology are ultimately directed at helping meet the income and capital return aspirations of farmers. These aspirations are in turn linked, now globally rather than locally, to energy and labour costs in the wider economy. The Hekscher-Ohlin theorem applies to bring about a measure of factor price equalisation, and at the heart of that is the price of labour. Given this, agricultural commodity prices should not be expected to decline in such a way that those in farming are losers from the process economic change. Indeed, one thing that we can be sure of is that farming has a very solid future, and those who invest to increase their productivity, and those employed by them, should at least maintain parity in welfare terms to the rest of society. It is highly likely that, given likely future resource constraints, agriculture's terms of trade will improve against some relative comparators, with the situation varying by country and commodity. The big questions for agriculture in the future are not about prices, but are about (1) how many people will adapt to establish successful livelihoods in farming, (2) of how institutions and policy will adapt to reduce the pressures to marginalise many of those living off the land (von Braun 2003), (3) whether satisfactory progress can be made on trade reform to reduce obstacles to agricultural development in poorer countries, and (4), biggest of all, how to combat major displacement effects in agriculture due to climate change.

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