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of the United Nations

# Revisiting Prebisch–Singer: what long–term trends in commodity prices tell us about the future of CDDCs

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Commodities and Development Report 2017  
Commodity markets, economic growth and development

**Revisiting Prebisch–Singer:  
what long-term trends  
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Food and Agriculture Organization of the United Nations  
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## Acronyms

<b>CDDC</b>	Commodity Dependent Developing Country
<b>FAO</b>	Food and Agriculture Organization of The United Nations
<b>IMF</b>	International Monetary Fund
<b>LDC</b>	Least Developed Countries
<b>MUV</b>	manufactures unit value index
<b>OECD</b>	Organisation for Economic Co-operation and Development
<b>UNCTAD</b>	United Nations Conference on Trade and Development



## Abstract

This paper explores the long-term trends in commodity prices and specifically the proposition that there is a secular decline in the terms of trade between commodities and manufactures as predicted by Prebisch and Singer. The paper reviews the data the theoretical basis of the Prebisch–Singer hypothesis and the empirical evidence for its validity or otherwise. Finally, some broad policy implications are drawn. Price volatility is obviously an equally important policy issue that has attracted much attention since 2007 /08 but the focus here is on long-run price trends starting from 1900.

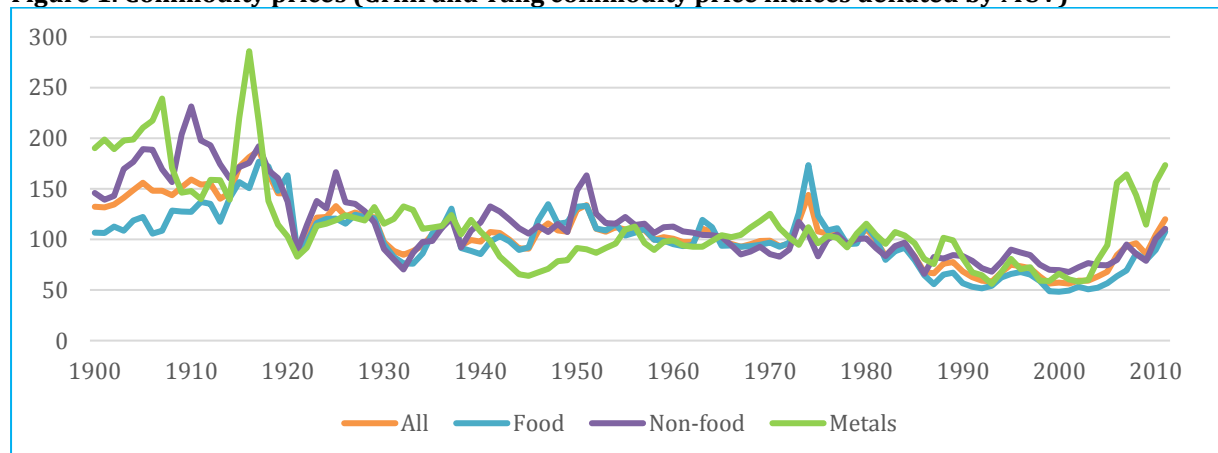


## I. Introduction

Until the price spike of 2007/08, the conventional wisdom concerning agricultural commodity prices was that they followed a secular decline of around 1 percent per year in real terms or relative to the price of manufactures. The decline in relative prices was seen as carrying over more generally into a downward trend in the net barter terms of trade of developing countries dependent on commodity exports. This followed the prediction of Prebisch and Singer from 1950 of a decline in the terms of trade for commodities with income growth. One underlying cause was the working of Engel's Law that the demand for agricultural products rises less than the demand for manufactured goods with economic growth and rising incomes. The resulting sluggish demand for agricultural products and depressed prices, at least until 2007/08, led to a pessimistic view of the economic prospects for the agricultural sector and for commodity exporting developing countries.

A cursory look at the data in Figure 1 on agricultural commodity prices relative to manufactures prices appears to support this view. However, econometric analyses revealed differences of opinion as to the nature of the downward trend and even as to whether a downward trend existed at all. This was in spite of the relatively good commodity price data compared to other economic series and that most analysts have been using, essentially the same basic data series, and had brought to bear a wide set of relevant contemporary dynamic econometric time series techniques. Econometricians debated whether the trend followed a regular "deterministic" decline or irregular "stochastic" trend and whether there had been "structural breaks" – discontinuities in the series due to major exogenous shocks like the 1970s oil price hike or the First World War. Those differences of opinion persist. The significant variability in commodity prices makes it difficult to distinguish long-run from short-run behaviour. Nevertheless, there was a general agreement that prices had fallen in real terms over an extended period. A more recent alternative, though not necessarily inconsistent perspective, was offered by the idea of "super cycles" – very long (up to thirty years or more) upswings and downswings in commodity prices – with the suggestion that the 2007/08 price spike was part of an upswing that would be sustained. Such long cycles would also make it difficult to identify trends.

**Figure 1. Commodity prices (Grilli and Yang commodity price indices deflated by MUV)**



Source: Grilli and Yang (1988) updated.

Figure 1 shows the widely-used Grilli and Yang (1988) data series of real prices for major categories of commodities over the long-term. The history over the twentieth century suggests periodic sharp spikes separated by prolonged slumps. Most recently, after 30 years of depressed prices declining in real terms, there were three price spikes in rapid succession in the five years after 2007. Prices increased between late-2006 and mid-2008 to their highest level in thirty years, fell sharply through 2009 then regained their 2008 peak in late-2010/early-2011. While there has been some retrenchment in international food prices since then, the annual *OECD-FAO Agricultural Outlook*<sup>1</sup> expected prices to remain above their historical trend levels and to continue to be volatile in the medium term.

The three price spikes in international commodity prices in the five years after 2007/08 challenged the received wisdom on commodity price trends and some commentators were quick to suggest that the historic downward trend had been broken. A leader in *The Economist*, for example, asked whether this marked “the end of cheap food”.<sup>2</sup> There are at least three different interpretations of the events of 2007/08 onwards. The first is that the price spikes are entirely consistent with past commodity price behavior and are just the latest in a continuation of the historic pattern of short-lived spikes before the long-run declining trend reasserts itself. The second is that there has been a new structural break in price behavior with a step up in prices as a result of new demands from biofuel production and rapid income growth in emerging economies. A third is that recent high prices reflect the upswing of the latest super cycle that may or may not yet have peaked.

Around 25 percent of world merchandise trade is in primary commodities so commodity price trends are a matter of concern to the world economy. The price spikes, especially in agricultural commodity prices, raised widespread international concern. They were condemned for reducing the access of poor consumers in developing countries to affordable food, increasing food insecurity and in some cases prompting “food riots”. While prices declined in the following years they remain above the levels that characterised the preceding several decades. Those decades had seen persistently depressed prices, declining in real terms, which were also condemned for discouraging investment, perpetuating low rural incomes and rural poverty, and reducing developing country commodity export earnings. The course of commodity prices is therefore of major policy concern for many developing countries.

Clearly, that concern is magnified for those countries dependent upon commodity exports for a significant share of their export earnings. A recent UNCTAD (2015) study defines commodity dependency as follows: “A developing country is considered a Commodity Dependent Developing Country (CDDC) when its commodity export revenues contribute to more than 60 percent of its total good export earnings”. According to this definition, in 2012/13, two out of three of all developing countries were CDDCs with half of these in Africa. The UNCTAD study also indicates that commodity dependence increased between 2009/10 and 2012/13, with half of developing countries having seen their dependence on commodities grow during this period. This “re-commoditization” of

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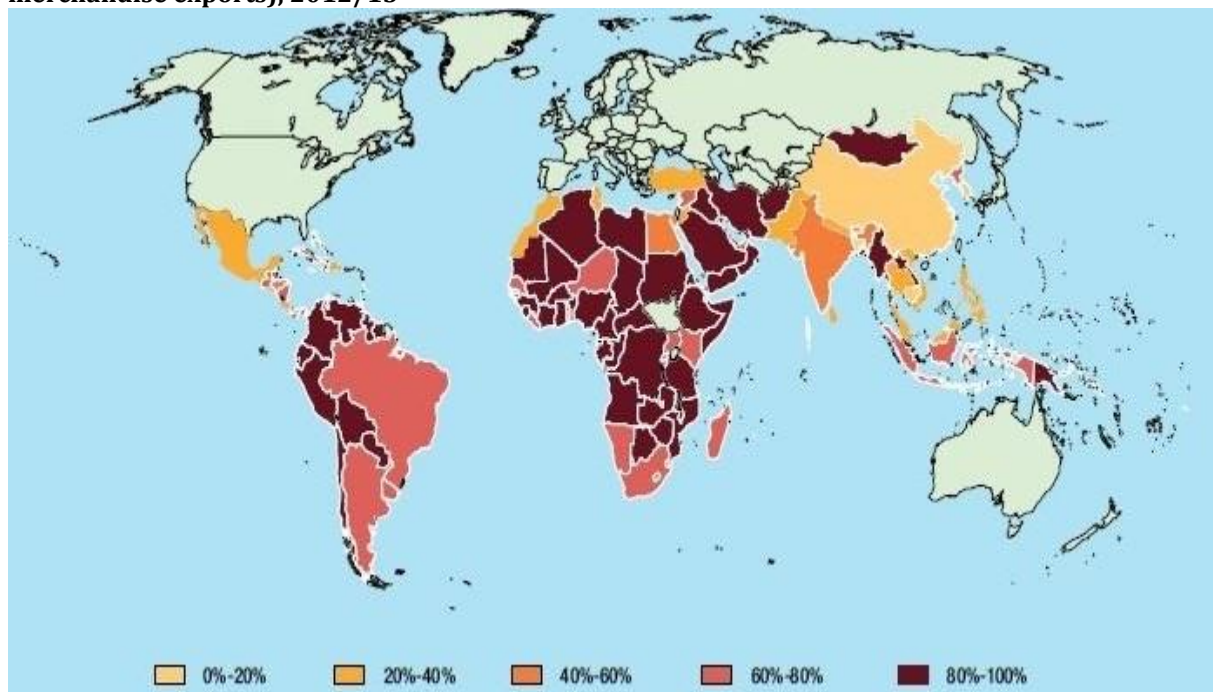
<sup>1</sup> See, for example, OECD/FAO (2011), *OECD-FAO Agricultural Outlook 2011–2020*, OECD, Paris.

<sup>2</sup> *The Economist* December 8, 2007.

exports runs contrary to the trend towards a greater share of value-added products in developing country exports and is at least partly related to China's burgeoning import demand for raw materials. Dependency on commodities is even more severe in the most vulnerable countries, such as the Least Developed Countries (LDCs) group. In 2012/13, 85 percent of LDCs could be considered as CDDCs and a deterioration in their situation can be observed compared to 2009/10.

The UNCTAD definition is quite broad since it would allow quite a diversified exports of a range of commodities which might have different price trends so the implications for developing countries of a given level of commodity dependency are not uniform – depends on structure of commodity exports – so policy implications are not clear. However, there are additional grounds for concern around the narrow range of commodities involved. The data reveal that while developing countries rely heavily on commodities, their commodity exports are in addition highly concentrated and export revenues dependent on a handful of primary products. For instance, the top three commodities exported from any given country contributed for more than 60 percent of merchandise exports in 90 percent of the 45 CDDCs in Africa in 2012/13. The commodities most frequently involved in high levels of dependency according to the UNCTAD study are green coffee and cocoa, bananas, sugar, cotton and jute.

**Figure 2. Developing country commodity dependency (commodity exports as percent of merchandise exports), 2012/13**



Source: UNCTAD (2015).

For commodity dependent developing countries, trends and variability in export prices and hence in export earnings have major macroeconomic and longer-term growth and development impacts through their effects on incomes, employment and government revenues. Since commodity production is typically the work of the poor, commodity prices also impact on poverty. Understanding commodity price trends is therefore fundamental to formulating appropriate macroeconomic, development and sectoral policies and strategies. Each of the three views of recent commodity price behavior

outlined above carries different policy and strategic implications for developing countries dependent to a greater or lesser extent on commodity exports. If the recent price spikes are just the latest in a continuation of the historic pattern of short-lived spikes before the long-run declining trend reasserts itself the crude policy implication is that developing countries need to diversify out of commodities or fall further behind. However, the opposite policy conclusion might be drawn if commodity prices have shifted to a new higher plane or there is more of a super cycle upswing to come. Unfortunately, different interpretations of the same price behavior persist and the econometric evidence does not provide a conclusive basis for discriminating between them. Developing country policy-makers are left in a difficult position.

## II. Commodity prices and terms of trade

Most studies of commodity price trends examine the course of commodity prices relative to the price of manufactures – the commodity (net barter) terms of trade. Based on the crude and perhaps increasingly less relevant assumption that developing countries typically export commodities and import manufactures, the relative price of commodities might be taken to be an indication of the economic situation of commodity exporters. The commodity terms of trade are a convenient and readily available proxy for developing country terms of trade but relative prices are only a partial and imperfect indicator and the interpretation of the commodity terms of trade is not straightforward<sup>3</sup>. Account needs to be taken of changes in freight and insurance costs, trade composition, input costs, quality and productivity. Declining net barter terms of trade may not necessarily be a bad thing in welfare terms if falling commodity prices are accompanied by increasing productivity, for example. In such circumstances, the “income terms of trade” may be a more meaningful indicator. Similarly, improvements in the commodity terms of trade may not be a true improvement if offset by increasing input prices as in 2007/08. An apparent deterioration in the commodity terms of trade is therefore not an unambiguous indicator of developing country trade performance and prospects or welfare so caution is needed in drawing policy conclusions from simple trends in terms of trade.

The commodity terms of trade is the ratio of the price of one or more commodities to the price of other products, usually manufactures. For individual commodities, data are readily available from, amongst others, the World Bank, the IMF, UNCTAD and FAO on representative prices in US dollars (US\$) per tonne. Most studies of the commodity terms of trade have considered the price of a bundle of commodities measured by different commodity price indices. The most widely-used are the indices developed by Grilli and Yang (1988). These are mainly based on World Bank commodity price data. Grilli and Yang consider 24 individual commodities: aluminium, bananas, beef, cocoa, coffee, copper, cotton, hides, jute, lamb, lead, maize, palm oil, rice, rubber, silver, sugar, tea, timber, tin, tobacco, wheat, wool and zinc. They construct an all commodities price index and three sub-indices for agricultural food commodities, non-food agricultural commodities and metals. The indices are base period trade-weighted arithmetic averages of the commodity prices concerned.

While Grilli and Yang’s original series ran from 1900 to 1986, they have been updated by a number of researchers.<sup>4</sup> Long data series are obviously needed for studying long-run price trends. *The Economist* commodity price index goes back even further to 1845. Harvey, *et al.* (2010) assemble some data series back as far as 1650 although ensuring consistency and continuity over such a long period is problematic. The detailed commodity price data from the World Bank and IMF are available from 1960.

As noted above, the commodity terms of trade have typically used an indicator of manufactures values as the deflator with most recent studies following Grilli and Yang in using the World Bank’s manufactures unit value index (MUV). This is a trade-weighted index of the prices of exports of manufactures in US\$ terms. The current version of this

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<sup>3</sup> See, for example, Diakosavvas and Scandizzo (1991) and Colman (2009) for a discussion of these issues.

<sup>4</sup> See, for example, Pfaffenzeller, S., Newbold, P. and Rayner, A. (2007) which also provides a guide to how to update the series. Up-to-date series are available from <http://www.stephan-pfaffenzeller.com/cpi.html>.

index, MUV (15), is a composite index of prices for manufactured exports from the fifteen major developed and emerging economies to low- and middle-income economies. Data up to 1990, are for the MUV (5) which measured the price of manufactures exports from five major developed countries (France, Germany, Japan, United Kingdom and United States) to developing countries. The relevance of the MUV as a deflator has been questioned since it rests on the assumption that it represents the range and value of developing country imports<sup>5</sup>. However, there is no obvious alternative trade-related measure of manufactures prices available for the necessary extended period (Pfaffenzeller *et al.*, 2007). Colman (2009) suggests that given the economic importance of the service sector has surpassed that of manufacturing, commodity terms of trade should be measures against a price index of service sector outputs rather than manufactures.

Obviously, the terms of trade can change as a result of changes in primary commodity prices or manufactures prices or both. The problem of biases as a result of quality changes through time, especially in manufactures was noted above. Primary commodities have remained basically unchanged over time while there has obviously been significant change in the quality of manufactured goods. This being so, the price of manufactures should be adjusted downwards to compensate for that improvement in quality otherwise the terms of trade will be biased downwards. Sarkar (1986) claims it would make little difference although Colman (2009) argues that from the little information available on quality for price improvements the effect is actually potentially significant. What this means is that a decline in the ratio of commodity prices to non-quality adjusted MUV may not signify a decline in the commodity terms of trade if quality of manufactures has increased.

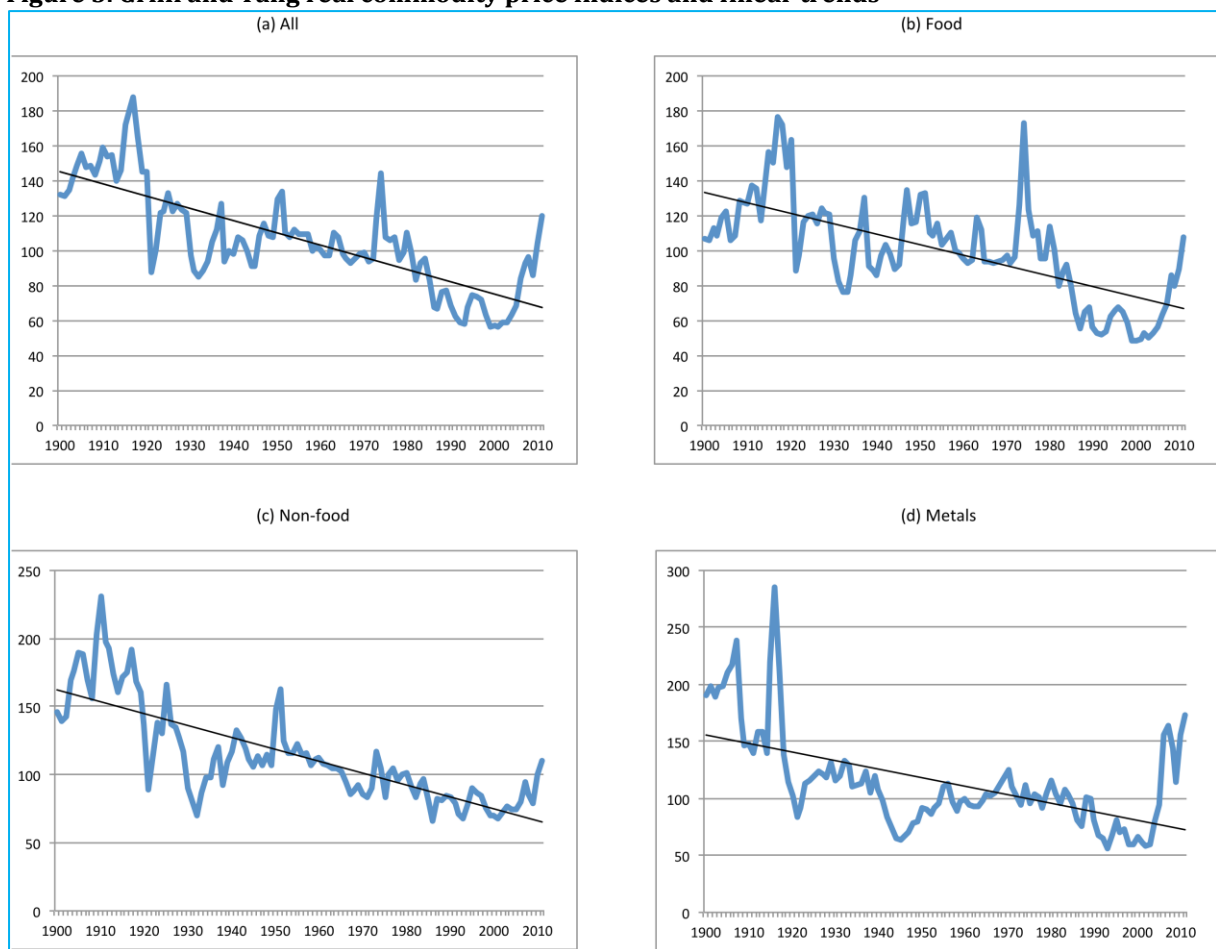
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<sup>5</sup> The deflated Grilli and Yang indices are shown in Figures 1 and 3 in this paper.

### III. Price and terms of trade trends

An examination of real commodity prices since 1900 shown in Figure 1 indicates a downward trend over that whole period. Figure 3 fits linear trends to real prices for all commodities and for each of the three commodity groups individually. However, those trends are not regular and there are extended periods, notably the 60 years after the First World War where there appears to be no trend at all. In fact, the series could be interpreted as a series of major downward steps – structural breaks – at 1921 and 1974, for example, rather than a smooth decline with each episode of high prices followed by a sharp fall to a new lower plane. Episodes of high prices tend to be accompanied by heightened price volatility.

**Figure 3. Grilli and Yang real commodity price indices and linear trends**



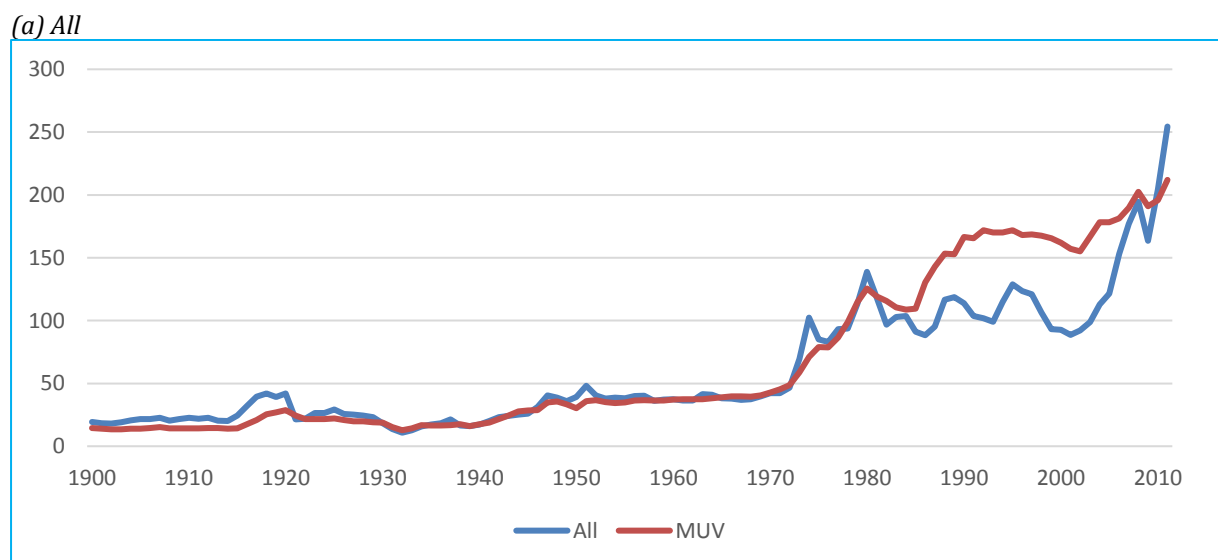
Source: Grilli and Yang (1988) updated.

There are some broad similarities in the pattern for each commodity group which suggests at least some common factors in explaining their price movements (Byrne *et al.*, 2013). The behaviour of the series is driven by market fundamentals of commodity demand and supply. The secular downward trend in real prices reflected a tendency for technical improvements to increase yields and production faster than population and income growth increased demand. Unlike in the case of manufactures, these technical improvements did not typically enhance the quality of the commodities produced and so prices had to adjust downwards.

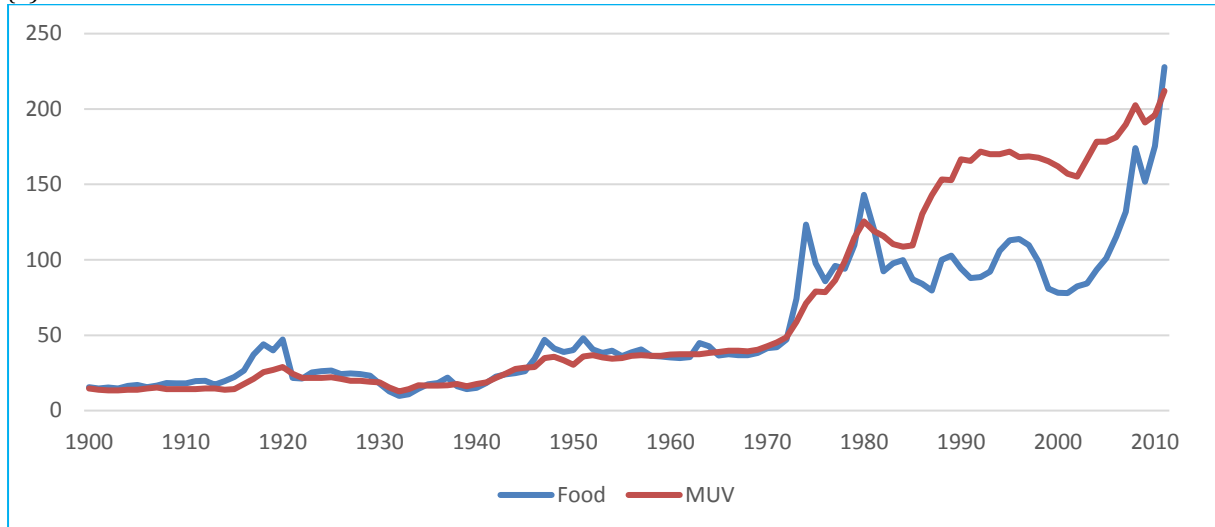
If there is a downward long-run trend in the terms of trade for commodities against manufactures, it would be expected that the time series for commodity prices and manufactures would tend to drift apart through time. Figure 4 shows nominal prices of different commodity groups and the MUV. It seems that for most of the twentieth century commodity prices and manufactures prices moved together but that pattern was disrupted in the 1980s with the series diverging as commodity prices slumped until the upswing in commodity prices in 2007/08.

The price indices for the broad commodity groups obviously mask a great deal of the variation between individual commodities. Figure 5 focuses on a sample of commodities of most interest to commodity dependent developing countries identified in Chapter I. The downward trends apparent in each of the commodity groups are less obvious for the individual commodities. For the tropical beverages, there appears to be little trend in cocoa prices while downward trends for tea and coffee are only evident from the mid-1950s and the mid-1970s respectively. Coffee and cocoa prices also indicate three phases with no apparent trend up until the Second World War, then a step up to a new plateau until a slump from the 1980s onwards. For cotton and jute, downward trends are apparent from around 1950. Sugar and banana prices appear to show little trend although a change in level is evident in sugar prices around 1921. There are clear differences in price behaviour between commodities and between individual commodity prices and aggregated commodity indices, a point echoed by Cuddington's econometric analysis (Cuddington, 1992). Partly this reflects the small weightings given to most of these commodities in the individual indices: 0.2 percent for jute; 0.9 percent for bananas; 1.6 percent for tea; 2.7 percent for cocoa; 4.3 percent for cotton; 7.3 percent for sugar; and 10.3 percent for coffee. Generalised policy recommendations for commodities are therefore likely to be inappropriate.

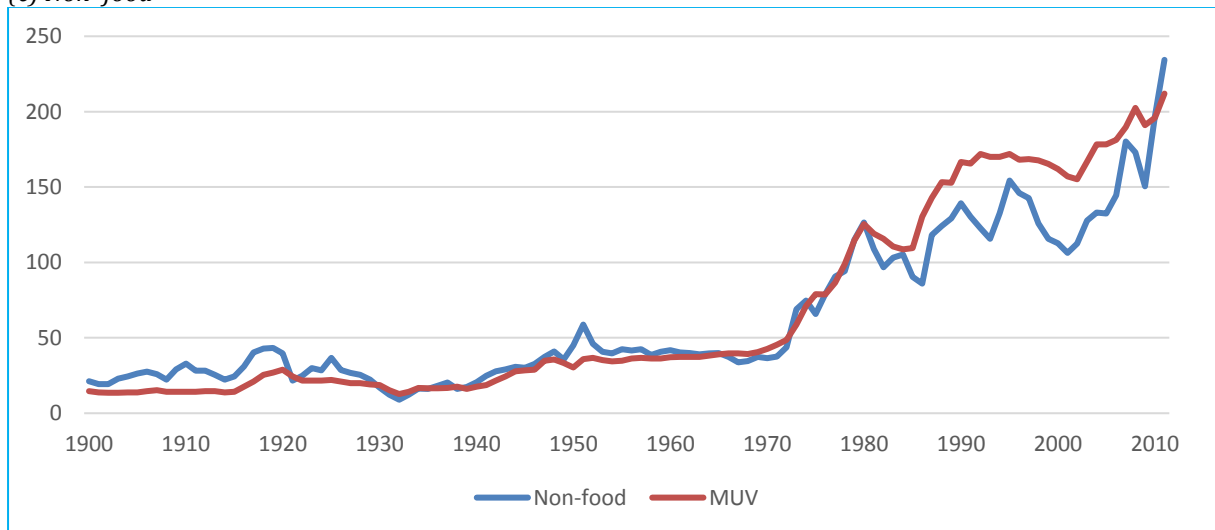
**Figure 4. Nominal commodity prices and MUV**



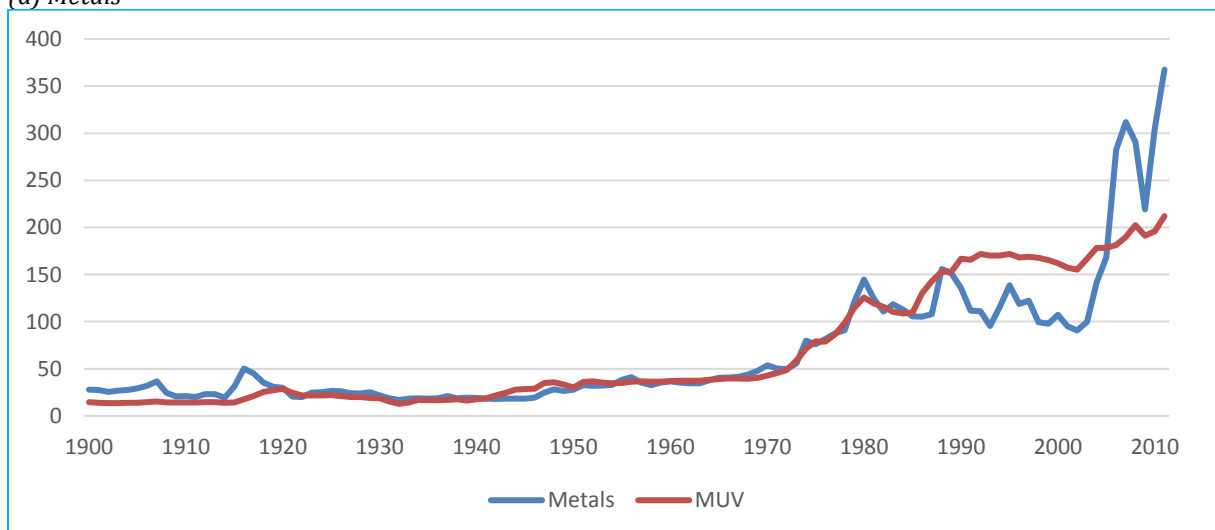
*(b) Food*



*(c) Non-food*



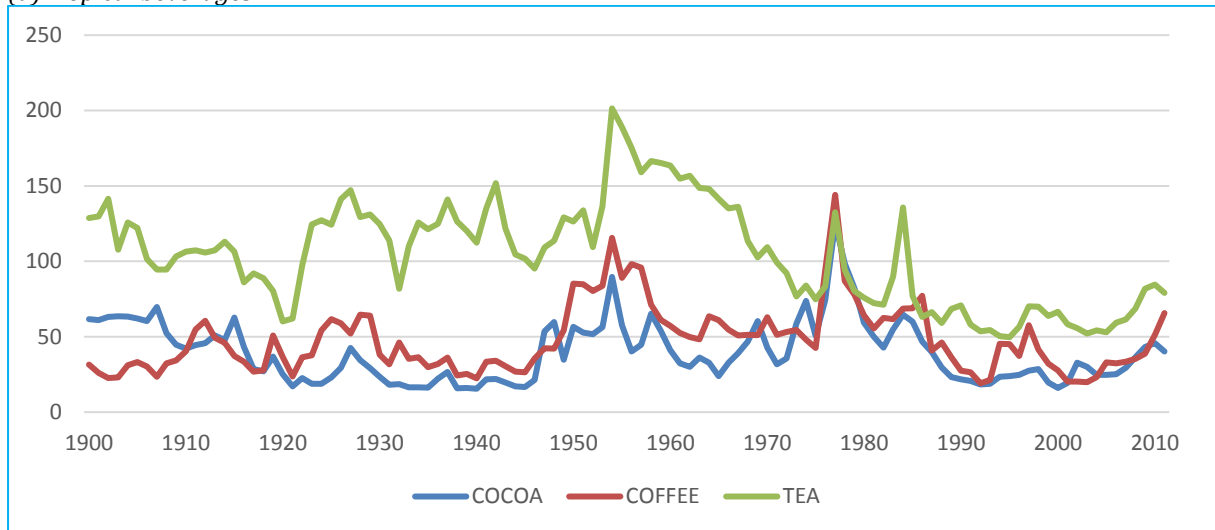
*(d) Metals*



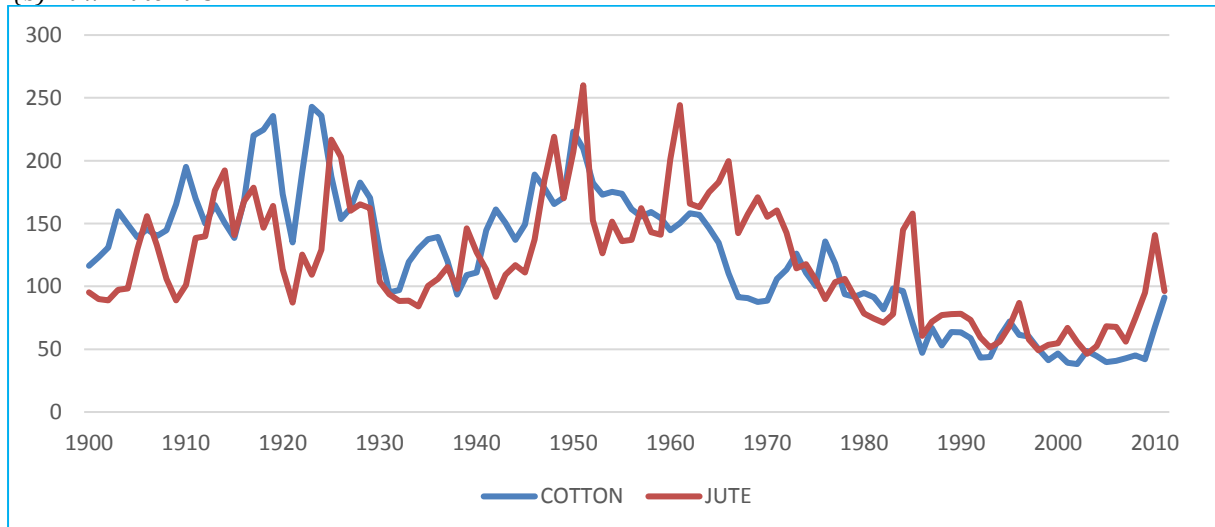
Source: Grilli and Yang (1988) updated.

**Figure 5. Real commodity price indices for individual commodities**

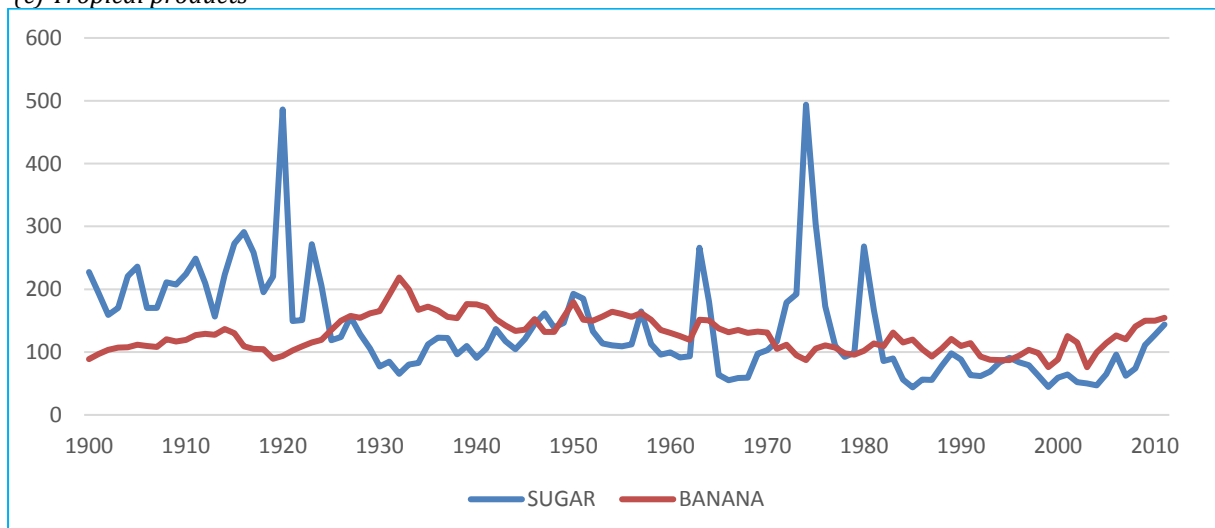
*(a) Tropical beverages*



*(b) Raw materials*



*(c) Tropical products*



Source: Grilli and Yang (1988) updated.

The inherent volatility in commodity prices makes detection of trends difficult. Since demand and supply are inelastic in the short-run, wide price adjustments may be necessary to clear markets, especially where stocks are low. Food commodities show most variability. The recent food price volatility has its origins in such fundamental factors – weather shocks in key producing and exporting countries coinciding with low stock levels. Macroeconomic factors such as exchange rate movements also played a role as did destabilizing policy responses such as export restrictions. The sharp price spikes at the time of the First World War, again in the 1970s and most recently since 2000 are clear. Interestingly, the price spike in the 1970s is much more pronounced for food than for non-food agricultural commodities and metals. As noted above, each price spike to date appears to have been followed by a sharp fall but one view of the upswing in prices since 2000 is that changes in commodity demand will keep them higher than in the past. What happens next clearly has a major bearing on how commodity price behaviour is viewed.

The higher prices since 2000 have been attributed to some slowing of the rate of yield growth while demand has continued to grow rapidly.<sup>6</sup> In the case of agriculture, low levels of investment and in research and development, whether international or national, public or private, have slowed production growth. High rates of economic growth in emerging economies have increased food demand especially for livestock products and hence feed grains. At the same time, there has been increasing demand for certain agricultural products as feedstocks for biofuel production that has expanded significantly as a result of subsidies and mandates. Biofuel production links agricultural prices and markets more closely to energy markets and in particular to oil prices. These demand-side factors might sustain higher price levels and are a key element in the arguments that the historic trend in prices has been reversed or that higher prices since 2000 are the upswing of the latest super-cycle and will continue.<sup>7</sup>

The term “super cycles” was coined by Alan Heap of Citigroup in 2005 who defined a super cycle as “a prolonged (decade or more) trend in real commodity prices driven by urbanization and industrialization of a major economy”. Super cycles are therefore seen as very much demand-driven although it is the interaction of demand with supply and specifically the dynamics of supply adjustment that determine super cycle duration and magnitude. Heap saw upswings as lasting 10–35 years and a whole cycle as up to 70 years. He identified two super cycles in last 150 years – one from the late 1800s to early 1900s associated with United States’ growth and a second one between 1945 and 1957 generated by post-war reconstruction in Europe and Japan. Growth in Chinese demand for raw materials was seen as triggering a new, current super cycle around 2000. Demand-driven booms last until, prompted by the higher prices, supply catches up. Super cycles have “no predetermined historic shape” (Canuto, 2014). In this sense, the idea of super cycles does not provide any new insights (Helm, 2013), except that its advocates perhaps tend to be more pessimistic on supply response. The 2013 McKinsey report, *Resource revolution: tracking global commodities markets*, for example, saw commodity supply as being progressively less able to adjust. Interestingly, analyses of super cycles by Ocampo and Parra (2010) and Erten and Ocampo (2012) showed that the

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<sup>6</sup> See, for example, FAO et al (2011).

<sup>7</sup> See, for example, McKinsey (2013), Canuto (2014).

means of the super cycles identified stepped down to become progressively lower, consistent with the idea of a downward trend in commodity terms of trade.

## IV. The Prebisch–Singer hypothesis

The widely-held perception of a tendency for primary commodity prices to decline relative to the price of manufactures stems from the work of Prebisch and Singer published largely independently in 1950. While their observation that the terms of trade would move against commodities was based on simple scrutiny of price data, their work later spawned a substantial number of econometric studies to test the hypothesis and these have continued ever since. As the next Chapter will show, much of the resulting evidence is inconclusive, but we will explore how convincing was the hypothesis itself.

The view of the classical economists, such as Ricardo, Malthus, Mill and Jevons in the nineteenth century, was exactly the opposite to that of Prebisch and Singer. It predicted a tendency for the price of primary commodities to rise relative to the price of manufactures in the long-run with the implication that the barter terms of trade of commodity producing developing countries should improve. This remained the prevailing view right up to the appearance of Prebisch and Singer's work in 1950. It rested on the belief that primary commodity production, and specifically agriculture, faced diminishing returns to scarce land and other natural resources while production of manufactured goods would face increasing returns. At the same time, faster technical progress would increase manufacturing output, further depressing manufactures prices, and population growth and urbanization would keep manufacturing wages and costs in check. The implication was that commodity producing developing countries would benefit from the faster rate of technical progress in the industrialized countries through trade.

The classical view was challenged by Kindleberger in 1943 on the basis of Engel's Law that the proportion of income spent on food decreases as income rises. Kindleberger concluded that as a result, economic growth would lead to the terms of trade moving against primary commodity exporting countries and in favour of exporters of manufactures. However, it was Prebisch and Singer who popularized the idea that the terms of trade between primary products and manufactured goods tended to decline over time in what has since come to be known as the Prebisch–Singer hypothesis. In fact their contribution was not so much one common hypothesis but rather the same prediction of long-run decline in the terms of trade for commodities relative to manufactures with two different explanations. Singer emphasized the differences in price and income elasticities of demand between primary commodities and manufactures. Prebisch emphasized the differences in market structures and pricing for goods and labour in commodity dependent developing countries – “the periphery” – and the industrialized countries – “the centre”. Ultimately, the interest of both was in the terms of trade for developing country exports for which relative commodity prices provided a convenient proxy. Their prediction was based on a League of Nations report from 1945 and a United Nations report from 1949 which claimed on the basis of United Kingdom trade data that primary product prices had fallen relative to manufactures prices over the previous 50 years. Interestingly, the real commodity price data shown in Figures 1 and 3 above do not entirely support that view. A number of objections might be raised concerning the relevance and accuracy of the data used by Prebisch and Singer.<sup>8</sup>

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<sup>8</sup> See, for example, Spraos (1980).

Nevertheless, their ideas had a major influence on policy-making for commodity dependent developing countries over several decades.

Singer focused on low price and income elasticities of demand for primary commodities as an explanation for the apparent decline in their terms of trade. Demand for food tends to be price inelastic while demand for raw materials is more price inelastic than for final manufactured products. The impact of supply changes is therefore mainly on price and reductions in price do not lead to a proportionate increase in demand. Demand growth for primary commodities will also be less than for manufactures with economic growth. Food demand growth will be restricted by the workings of Engel's Law while technical change in the industrialized countries, notably the development of synthetic substitutes, will slow the growth in demand for primary commodities as raw materials. Slow growth in the export demand for primary commodities weakens the balance of payments of commodity exporting developing countries, leading to currency depreciation and hence further deterioration in the terms of trade. Prebisch focused on differences between commodity exporters in the periphery and industrialized countries in the centre in market structures and the effects of productivity gains. In developing countries, markets were seen as competitive and labour supply as effectively "unlimited" following the Lewis model (Lewis, 1954) and this kept wages low. Productivity gains led to lower prices. In the industrialized countries, on the other hand, market power, cost-plus pricing and strong trade unions meant that productivity gains led to higher wages and profits rather than lower prices. That same market power and strong trade unions meant that profits and wages could be defended in the industrialized countries in the face of slowing demand forcing price adjustment on to the commodity exporting developing countries.

Singer (1987) noted that these explanations are just as much about differences between developing and industrialized economies as about differences between primary commodities and manufactures. As noted above, Prebisch and Singer used the terms of trade for primary commodities as a readily available proxy for the terms of trade of developing countries. One might equally expect deteriorating terms of trade for developing country exports of manufactures which may be of lower quality (Sarkar, 1997). That being so, developing countries would not necessarily benefit from export diversification into manufactures which would be the crude policy implication of the Prebisch-Singer hypothesis. It does appear that terms of trade for developing country exports of manufactures relative to those of developed countries have declined: Sarkar and Singer (1991), for example, found a decline of 20 percent between 1970 and 1987.

The Prebisch-Singer hypothesis was controversial from the start. As noted above, the relevance and accuracy of the data which inspired it were dubious and more recent and better data do not provide unequivocal support. There are also reasons why one might expect relative commodity prices to rise, not fall. Demand shocks, such as income growth in the emerging economies or development of biofuel production, can also cause lasting increases in commodity prices and some countries can mitigate declining commodity prices by differentiating their products (Cashin and McDermott, 2006). Kaplinsky (2006) highlights the positive price impact of Chinese growth on demand for commodities and the negative price impact of its export of manufactures.

He also points to the current "simultaneous process of differentiation within

commodities (with the prices of some commodities increasing) and within manufacturing (with the price of many manufactures falling)” which he argues could reverse the decline in the terms of trade of commodity producers. Explanations of the most recent commodity price increases often echo the Malthusian elements of the classical view that the terms of trade will improve – increasingly binding land and water constraints, aggravated by climate change, and declining agricultural yield growth on the supply side against income growth and urbanization in emerging economies and biofuel production on the demand side. High rates of economic growth in the emerging economies, notably China, are also putting downward pressure on the prices of manufactures. Trade policy reform was expected to raise the general level of agricultural commodity prices, though perhaps not for the tropical products of most interest to developing countries.

The lack of any obvious trend in real commodity prices over long periods prompts the question of whether there should be any trend at all. Deaton and Laroque (2003) developed a model of long-run commodity prices which predicts that prices of primary commodities produced by developing countries should have no trend at all in the long-run. In their model, demand is a function of world income and the world price of commodity. Commodity supply is seen as infinitely elastic in the long-run at the marginal cost of production on marginal land in line with the assumption of unlimited supplies of labour from the Lewis model. The rate of growth of commodity supply depends on the excess of the current price over the constant long-run supply price. Commodity supply and world income will move together (be “co-integrated”) but commodity prices fluctuate around their long-run supply price in response to supply and demand shocks but will have no long-run trend. Colman (2009) also argues that prices of agricultural commodities and manufactures will keep in step because they are both tied to energy prices.

## V. Statistical and econometric evidence

The very basic question of whether there is a downward trend through time in the price of commodities relative to manufactures should in principle be answerable by an appeal to the data and empirical analysis. Yet, in spite of much-improved datasets and increasingly sophisticated econometric time series techniques, controversies remain.

Early work on testing the Prebisch–Singer hypothesis, including that of Prebisch and Singer themselves, relied on visual inspection of time series data that was later much criticized. Certainly, the graphs in Figures 1 and 3 reveal a great deal about commodity price trends and variability, notably that if there is a trend it is not a stable one and that variability is at least as important a characteristic as trend. Identifying secular trends clearly needs long data series but if trends are not stable and no allowance is made for this, long series may give misleading results. What trends are observed are highly dependent on the starting and end points selected. Colman (2009), for example, notes that there was no downward trend in food prices until after 1974/75. Results can also be biased by weaknesses in the definition and measurement of the commodity terms of trade – by such things as quality changes, for example – as noted in Chapter II.

Different statistical/econometric approaches have been followed in studies of the terms of trade and tests of the Prebisch–Singer hypothesis. These include simple trend-fitting, tests for trends and exploration of their nature using modern time series techniques, estimation of the relationship between commodity price and manufactures prices using cointegration analysis and structural modelling of the determinants of real commodity prices<sup>9</sup>. Most of these studies have used the Grilli and Yang data set.

The simplest of these approaches is simple trend fitting from which measurements of the extent to which commodity prices have fallen relative to manufactures each year can be derived. This is a typically estimated ordinary least squares regressions of deterministic trend equations such as:

$$p_t = \alpha + \delta t + \varepsilon_t$$

where  $p$  is the real commodity price in natural logarithms,  $t$  is time, and  $\varepsilon$  is a disturbance assumed to have a constant mean and variance and zero covariance. The estimate of the parameter  $\delta$  measures the annual trend. According to the Prebisch–Singer hypothesis this should be negative and statistically significant. If it is not significantly different from zero then there is no trend.

This approach was the main one used until the advent of more sophisticated econometric methods in the late 1980s which allowed testing for different kinds of trends. Many of these trend analysis appeared to support the Prebisch–Singer hypothesis. Spraos (1980), Sarkar (1986), Scandizzo and Diakosavvas (1987), Grilli and Yang (1988), for example, all found a significant downward trend of between 0.3 and 1 percent per year with a representative estimate of about 0.6 percent per year. Ardeni and Wright (1992) using a different statistical approach also found a linear deterministic trend, again

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<sup>9</sup> Structural modelling of the relationship between commodity prices and economic growth is the subject of another chapter in this publication.

of minus 0.6 percent per year. However, Colman (2009) notes that of 81 studies of the terms of trade for primary products conducted between 1950 and 1985, less than half in fact found a decreasing trend. While some of the data difficulties discussed in Chapter II were addressed by the availability of the Grilli and Yang data set, simple trend fitting faced a number of statistical problems which limited its reliability. Perhaps the most important of these was the instability of apparent trends and the possibility that there had been one or more structural breaks in the series. Trends estimated were therefore sensitive to the particular data period selected for analysis. While many of these studies explored the possibility of structural breaks as discussed further below, more generally they failed to explore the statistical properties of the data and hence the assumptions concerning the stability of the statistical properties of the disturbance were not always valid. The resulting “spurious regressions” of real prices on a time trend would invalidate standard tests of its significance and would misleadingly point to the existence of a trend when there was none (Nelson and Kang, 1984; Cuddington, 1992).

The development of new econometric time series techniques for dealing with non-stationary data series allowed a more thorough analysis of commodity price trends that avoided the risks of spurious regression. In particular, it allowed for the possibility that the real price followed a stochastic rather than a deterministic trend. A simple model of this type is the random walk with drift:

$$p_t = \alpha + p_{t-1} + \varepsilon_t$$

where an estimated negative value of the drift,  $\alpha$  indicates a downward trend in  $p$ , supporting the Prebisch–Singer hypothesis. The implicit coefficient on  $p_{t-1}$  is one, so the series is said to have a “unit root” and since the changes or “differences” in  $p$  will be equal to  $\alpha + \varepsilon_t$ , it is also referred to as a “difference stationary” as opposed to a “trend stationary” in the deterministic trend case.

Most studies since the late 1980s have used a general model to test whether a trend exists and to discriminate between the deterministic and stochastic forms. The simplest combines the two models above:

$$p_t = \alpha + \delta t + \beta p_{t-1} + \varepsilon_t$$

Estimates of  $\alpha$ ,  $\delta$  and  $\beta$  and significance tests on them suggest the nature of the trend in prices. If  $\beta$  is not equal to one and  $\delta$  is not equal to zero, prices have a deterministic trend or are “trend stationary”. Prices will vary in a bounded way around the deterministic trend and shocks to prices will be short-lived. If  $\beta$  equals one – that is if the price series has a “unit root” – there is a stochastic trend which means that shocks to prices have permanent effects. In testing any of these hypotheses, the conventional statistical tests are not valid and appropriate unit root tests such as the Dickey–Fuller or Phillips–Perron tests need to be used. However, such tests have been criticized for their low power which makes it difficult to discriminate between the alternative representations of trends.

The various models described above can be enhanced to allow for structural breaks and different assumptions concerning the behaviour of  $\varepsilon$ . The possibility of structural breaks has attracted the attention of a number of studies and it does appear

from the time series graphs that commodity price trends have not been stable. Inspection of the series suggests breaks following the First World War around 1921 and again in the mid-1970s following the oil price hike. Some researchers have also seen the slump in commodity prices in the 1980s as a structural break and more recently the price spikes beginning in 2007/08. One approach is based on presuming structural breaks and imposing them on the model, most simply by fitting to sub-samples of data and testing for differences in the estimated coefficients or using slope and intercept dummy variables, has been criticized as being too ad hoc. The alternative of testing for structural breaks at each point in the series has been criticized as data mining.

The importance of allowing for possible structural breaks in studies of the Prebisch-Singer hypothesis was recognized early on. It does make a difference to what trends are observed although the evidence is mixed. Sapsford (1988), for example, allowed for shifts in both slopes and intercepts in the simple time trend model by estimating it for the pre- and post-war periods separately. This gave significant and downward trends in both, whereas using data for the whole period up to 1982 found no significant trend. The estimated trend rate was unchanged at minus 1.27 percent per year but there was a significant difference in the intercept. Grilli and Yang (1988) identified a structural break at 1921.

The first of what Sarkar (2001) calls “high tech” studies using the new econometric techniques was by Cuddington and Urzua (1989). They found a “unit root” in the Grilli and Yang index 1900–1983 which implied that the simple deterministic time trend model used in earlier studies would be a spurious regression. They identified a downward shift in 1921, as had Grilli and Yang, but no significant trends on either side of that structural break. This finding of no steady downward trend was echoed by Powell (1991) although he identified three structural breaks at 1921, 1935 and 1974. Cuddington *et al.* (2002) also concluded that the real Grilli and Yang index had a “unit root” with a single level-shift break in 1921 and no significant drift on either side. Ocampo and Parra (2004) also identify discontinuities in the terms of trade in the 1920s and 1980s. Cashin and McDermott (2006) conclude that there is no reliable evidence of a long-term decline in the commodity terms of trade. It could be argued that a stepwise reduction in real commodity prices is not necessarily contradictory to the Prebisch-Singer hypothesis although that is often interpreted as a steady secular decline in the commodity terms of trade (Singer, 1999). Using an alternative test for a one-time structural break with an unknown break point, Cashin and McDermott (2006) also find no statistical evidence of a structural break either in the Grilli and Yang index or in *The Economist* index of commodity prices over the longer period of 1862–1999.

If there are structural breaks, then tests for “unit roots” may be misleading (Perron, 1989) and a number of later studies apply tests which explicitly allow for this possibility. Later studies have also allowed more flexible representations of changes in price behavior than simple shift dummy variables. Balagtas and Holt (2009) allow for non-linearity in price behavior in analysis of the Grilli and Yang data extended up to 2004 and find little support for the Prebisch-Singer hypothesis.

While much of the research has focused on trends in the overall Grilli and Yang commodity price index it is clear from the time series shown in Figure 5 that trends for individual commodities can be quite different. Cuddington (1992) tested the suitability

of trend or difference stationary forms for each of the 26 individual commodities in the Grilli and Yang data set over 1900–1983 and found that each form was appropriate for 13 out of the 26 series. For the trend stationary series, only five showed a significant negative trend, four had positive trends and four no trend. For the difference stationary series, only one (tobacco) had a significant trend and that was positive. Overall therefore, only five of the 26 price series studied (hides, maize, palm oil, rice and wheat) had a significant downward trend. However, the analysis for individual commodities prices did not confirm a structural break in 1921. Leon and Soto (1997) extended the data period up to 1992 which includes the apparent further declines in prices after 1980. They found that out of 24 commodities studied, 17 had negative trends, three were trendless and four were positive. Kim *et al.* (2003) found that commodity prices had a “unit root” behavior and so were best modeled as difference stationary. They found that out of the 24 commodities only five had negative trends. Balagtas and Holt (2009) found that their non-linear model provided virtually no evidence in support of the Prebisch–Singer hypothesis: out of 24 commodity prices analyzed only one (wool) seemed to show a secular decline. Cashin and McDermott (2006) find that out of 44 individual commodity price series analyzed, only nine appeared to follow stochastic trends. Nevertheless, they do find strong evidence that price shocks are long-lasting: they find the half-life of a unit shock to the Grilli and Yang index (the length of time before the response is half its original magnitude) to be 3.5 years. Using more powerful tests for “unit roots”, Ghoshray (2011) finds that 11 out of 24 commodity prices are difference stationary while the remaining 13 prices are trend stationary with one or two structural breaks but no significant trends. Arezki *et al.* (2013) use a historic data set for 25 commodities with some data series going back to 1650. They identify structural breaks and then fit the simple log linear trend model over the intervening periods in “piecewise regressions”. The results vary according to the sub-period studied but looking at 1900–2005, 50 percent of the commodity price trends are negative and significant providing support for the Prebisch–Singer hypothesis. However, 25 percent are positive and significant and the rest are insignificant. It was noted in Chapter III that there appears to be some tendency for prices of different commodities to move together over time – “co-movement” – as a result of some common factor such as economic growth or real interest rates. Such co-movement, if established, can be taken into account in estimating the various models by pooling the data for different commodities into a panel data set (Hadri, 2010; Iregui and Otero, 2013). Iregui and Otero, find co-movement among the 24 commodity prices in the Grilli and Yang dataset over 1900–2010. They find the price series are jointly stationary but with structural breaks, the timing of which varies according to the commodity but also the specific period studied. The results for eight commodities provide some support for the Prebisch–Singer hypothesis.

The apparent differences in behavior of individual commodity prices and the indices led Cuddington and Wei (1992) to suspect that there was some aggregation problem in the construction of the Grilli and Yang index and reformulated it as a geometric rather than an arithmetic index. Using data for 1900–1988, they found that “unit root” tests were inconclusive but there appeared to be no significant trend in the real commodity price index whichever model was used.

An alternative to looking at the univariate behaviour of the ratio of commodity prices to manufactures prices is to look at the long-run relationship between the two using co-integration based on a simple model:

$$pc_t = \gamma pm_t + \varepsilon_t$$

where  $pc$  is the price of commodities and  $pm$  is the price of manufactures. The Prebisch–Singer hypothesis implies that  $\gamma$  will be less than one. If the two prices are cointegrated,  $\gamma$  will be equal to one and the two sets of prices cannot drift apart as the Prebisch–Singer hypothesis suggests. There seem to be relatively few examples of this approach. Von Hagen (1989) and Powell (1991) both found cointegration and so rejected of the Prebisch–Singer hypothesis. Powell, found non–oil commodity prices and manufactures prices were cointegrated with three downward structural shifts in 1921, 1938 and 1975. Lutz (1999) found cointegration but also a significant negative time trend (minus 0.43 percent for food; minus 0.44 percent for non–food; minus 0.88 percent for metals; and minus 0.89 percent for all commodities) in the cointegrating relationship, so supporting the Prebisch–Singer hypothesis.

It is difficult to draw any overall clear conclusions from this brief and selective review of statistical and econometric studies of the Prebisch–Singer hypothesis. The results are sensitive to the time period studied, whether structural breaks are allowed for in the analysis, the model specification and testing procedures used, whether aggregated price indices or individual commodity prices are examined and in the latter case the specific commodity. In view of aggregation problems, the results for individual commodities are probably more reliable and informative although there is no consistency across different studies in the evidence on trends for specific products. In particular, there are no consistent findings regarding deterioration of the terms of trade for those tropical and raw material commodities of most interest to commodity dependent developing countries. In spite of steady improvements in the econometric techniques used there is still little consensus on whether the commodity terms of trade decline or not. On balance, the evidence probably raises more scepticism than support for the idea that there is a steady decline in the terms of trade. Of course, the statistical and econometric studies mentioned above primarily describe the time series behaviour of commodity prices rather than explain them. Structural modelling of the determination of real commodity prices is likely to be more informative. Bloch and Sapsford (2000), for example, point to the important role of manufacturing output growth. This approach is described elsewhere in this publication.

## VI. Policy implications

For commodity dependent developing countries, an understanding of the course of the prices of the primary commodities they export is obviously an essential basis for policy-making and development strategies. The Prebisch–Singer hypothesis provided a widely accepted and highly influential perspective on long-run trends in the commodity terms of trade that carried a clear policy message for commodity dependent developing countries, namely diversify. In the post-Second World War period many developing countries tried to follow the diversification path and set policies accordingly. However, such a path is only appropriate if real primary commodity prices are expected to show a long-term decline (Deaton, 1999). According to the Prebisch–Singer hypothesis, continuing dependency on a limited range of primary commodity exports would risk facing the macroeconomic and growth consequences of deteriorating terms of trade and a worsening trade balance. Diversification was needed to avoid the challenge of increasing export volumes in markets with inelastic demand just to maintain export revenues. This pessimistic view of export prospects implies worsening trade deficits and diminishing ability to pay for imported capital goods and technology and to invest in skills needed to diversify into manufacturing. Even if commodity prices showed a trend decline, their trends are not uniformly downwards and the periodic upswings provide windfall gains that could be managed for strategic development. However, there are few examples of sovereign wealth funds in commodity dependent developing countries outside the oil exporters.

While diversification is the obvious policy response to an anticipated long-term decline in primary commodity prices, it is questioned what type of diversification would be needed. For Prebisch and Singer, manufacturing was the alternative but developing country manufactures often share many of the characteristics of commodities and have also faced falling prices (Kaplinsky, 2006). Manufactures are clearly not the only alternative for commodity dependent developing countries. There are many examples of successful diversification within commodities either through changes in the product mix produced and exported or through capturing of margins and value added through vertical integration.

However, if, as Prebisch and Singer argued, deteriorating terms of trade are more about the economic characteristics of developing countries than of the products they export, it is those structural issues that need to be addressed rather than the choice of products.

The ratio of the prices of primary commodities to manufactures has been taken as a convenient indicator of developing country terms of trade. However, as noted in Chapter II, it is only a partial and imperfect indicator and its interpretation from a policy point of view is not straightforward. Declining commodity terms of trade are not unequivocally a bad thing in welfare terms if falling commodity prices are accompanied by declining production costs or increasing productivity. Policy decisions need to take these other elements into account. Improving productivity remains a central theme of commodity development policy although the fallacy of composition is often invoked to question its eventual benefits if all exporters of a particular commodity seek to raise productivity simultaneously. However, there is obviously no advantage for an individual exporter in combining lack of competitiveness with falling commodity prices. The

question of the distribution of those benefits – between smallholder commodity producers and governments in exporting countries or transnational corporations and developed country consumers, for example – is also important.

In case the primary commodity prices do not show a long-term decline, one of the several interpretations of the three successive price spikes after 2007/08 is that if there was such a secular decline it has now been halted or even reversed as a result of new drivers of market demand originating in emerging economies' growth and biofuel production and a slowdown in supply growth. It could be argued that as more recent price data has been included in time series analysis, support for the Prebisch–Singer conviction that term of trade would move steadily against primary commodities has weakened. If so, the strength of the argument for diversification is correspondingly weakened. However, the case for maximizing revenues from commodity production and export through productivity improvement, product differentiation and upgrading and capturing value added is unchanged. Similarly, whatever the trajectory of real commodity prices, commodity dependent developing countries also need to better manage windfall increases in revenues in the periodic, and possibly short-lived, upturns.

In fact, it is difficult to draw any clear conclusions over any period from the statistical and econometric studies reviewed in Chapter V. The results are sensitive to the time period studied, how structural breaks are treated, the modelling and testing strategies and the commodities concerned. In spite of the application of econometric approaches of ever-increasing generality and sophistication, the evidence to support or refute the hypothesis of long term deterioration in the terms of trade, and in particular for those tropical and raw material commodities of most interest to commodity dependent developing countries, is conflicting. It is difficult now to agree with the opinion of Scandizzo and Diakosavvas (1987) expressed in the middle of the 1980s price depression that evidence for a secular price decline is good enough. Rather, as Chapter V concluded, the evidence today on balance probably raises more scepticism than support. This obviously leaves policy makers in commodity dependent developing countries in a difficult position. They need to know what commodity prices are likely to do in future but the conflicting and inconclusive evidence on even basic issues like whether commodity prices trend downwards or not provides little basis for defining commodity and development policy (Ghoshray, 2011; Balagtas and Holt, 2009; Cashin and McDermott, 2001). What is clear from the evidence is that attention needs to be focused on specific commodities and countries: blanket policy recommendations for all commodity dependent developing countries are inappropriate and unrealistic. Policies need to be based on consideration of the medium-term demand and supply prospects for individual commodities as produced and exported in the country concerned.

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