FAO's Food Price Index Revisited

Introduction

The FAO Food Price Index (FFPI) was introduced in 1996 as a public good to help in monitoring developments in the global agricultural commodity markets. The only major modification made to it – until now – was in 2009, when its base period was updated to 2002-2004. During the significant price hikes in 2008, the FFPI gained in prominence as an indicator of potential food security concerns for vulnerable developing countries. Since then, with the exception of 2009 and 2010, prices of agricultural commodities have remained at relatively high levels compared with those prior to 2008.

In order to determine whether there was a need to revise the base period again to reflect changes in trading patterns post 2007, the FFPI was recalculated based on different reference years. This provided an opportunity also to review commodity coverage and price quotations. It also allowed to make comparisons with other price indices that may have more desirable properties than the Laspeyres form of the FFPI and to assess the relevance of the index as a possible indicator for food security concerns.

The following section describes the method of calculation of the updated FFPI, explains the changes in coverage and assesses its performance with other types of price indices. The two subsequent sections look at how the FFPI was extended back to 1961. They explain how this extension will now contribute to analyzing long-term price developments at the global level and present a different weighting system that, in turn, may allow some assessment of the impact of global price changes on possible food security concerns of vulnerable developing countries at their borders.

Updating the FFPI

The commodity coverage of the new index has not been changed significantly. In the cereals sub–index, the original FFPI wheat index has been replaced by a new index introduced by IGC.[1] In the meat sub-index, two of the existing quotations have been replaced by new series that can be updated every month. The casein prices were dropped from the dairy sub-index because of lack of reliable data, but the geographic coverage of the index has been extended by adding new quotations to butter, whole milk powder and skimmed milk powder.[2] Finally, fish oil and tallow prices were dropped from the oils sub-index, partly due to lack of data and partly to make this group consistent by including only the prices of vegetable oils.

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[1] A new quotation was added, increasing the number to 10 and the index started was rebased to January 2000. (http://www.igc.int/en/grainsupdate/igcgoi.aspx for details). The series was extended back to 1990 in this exercise by splicing the "old" to the "new" index.

[2] The three new quotations correspond to export prices from European ports for these commodities.

New FFPI: 23 commodities, 73 price series

Under the new approach, the index includes the following 23 commodities: wheat (10 price quotations monitored and reported by the IGC), maize (1 quotation) and rice (16 quotations) for cereals; butter, whole milk powder, skimmed milk powder (2 quotations for each) and cheese (1 quotation) for the dairy group; poultry (13 quotations), pig (6 quotations), bovine (7 quotations) and ovine (1 quotation) for the meat dairy group; sugar (1 quotation); the oils group consists of one oil price quotation for soybean, sunflower, rapeseed, groundnut, cotton seed, copra, palm kernel, palm, linseed and castor. This construction, thus, includes the use of 73 price series.

Form of the indices

The general form of the Laspeyres index used for constructing the 'new' FFPI is as follows:

$$1. \qquad 'new' FFPI_{\tau} = LI_{\tau} = \sum_{i=1}^{n} s_{i0} \left\lfloor \frac{P_{i\tau}}{P_{i0}} \right\rfloor,$$

where, $\tau = 1990.1 \ldots 2013.9$, and s_{i0} is the share of ***i***th commodity's global export value in the total export value of all the 23 agricultural commodities included in the index, calculated as an average over the years that are included in the base period; $P_{i\tau}$ is the price quotation for the ***i***th commodity at time τ; and P_{i0} is the three year average of the price quotations for the ***i***th commodity calculated over the base period years.

The Laspeyres index that was used for the 'old' FFPI had the form:

$$2. \qquad 'old' FFPI_{\tau} = LI_{\tau} = \sum_{j=1}^{5} \sigma_{j0} LI_{j\tau}$$

where τ is defined as in Equation 1 and $LI_{j\tau}$ is the Laspeyres sub-index and σ_{j0} is the weight of the *j*th commodity group, each one representing cereals, dairy, meat, vegetable oils and sugar, at time τ. $LI_{j\tau}$'s in Equation 2, however, were calculated differently than Equation 1:

$$3. \qquad LI_{j\tau} = \sum_{k=1}^{m} \sigma_{j0} P_{kj\tau}$$

where τ and σ_{j0} are defined as in Equation 2 and $P_{kj\tau}$ is the *k*th commodity in the *j*th commodity group at time τ.

For the FFPI currently in use, the base period is 2002–2004. Since agricultural commodity prices have significantly increased since 2008 and have remained higher than during the years prior to 2008, an exercise was undertaken to see whether the FFPI is significantly affected when the base period for determining the weights is changed. The selection of the base period is limited by the availability of FAOSTAT trade data, which covers years up to and including 2011. With agricultural prices in 2009 and 2010 being lower than the other years during the post–2007 period, three different bases were chosen in order to assess their impact on the FFPI: 2008–2010, 2009–2010 and 2009–2011.

The three indices are graphed together in the lower part of Chart 1 and show that there are level differences between them, but their movements through time follow each other very closely. In fact, the correlation coefficients between them are not less than 0.9999. The values of the "old" FFPI are well above the others, because the prices during 2002–2004 are much lower than those after 2007. However, the correlation coefficients between the "old" FFPI and the others are above 0.999, indicating that the global export trade shares have not altered a great deal since 2002–2004. Therefore, since the FFPI is usually used to assess global developments of agricultural commodities through time, the change of the base period was deferred to a future period.[3]

It must be noted that because of the differences in the way the prices are treated in Equations 1 and 2 and the coverage of the commodities, the values of the 'old' and 'new' FFPI will be different[4]. The two series are graphed in Chart 2 for comparison.

In addition to using different base periods in the construction of the indices, different formulae of price indices that have more desirable properties than that of Laspeyres price index were also calculated for comparison. The first one uses a fixed base period and is the geometric Laspeyres index:

$$4. \qquad GLI_{\tau} = \prod_{i=1}^{n} \left[\frac{P_{i\tau}}{P_{i0}} \right]^{s_{i0}}$$

where, s_{i0}, τ, $P_{i\tau}$ and P_{i0} are defined as in Equation 1. The others are Paasche, Fisher and Törnqvist–Theil indices that address some of the shortcomings of the Laspeyres index[5]. The last two are aso known as 'ideal' or 'superlative' indices that make equal use of the prices and quantities in both the periods compared and treat them in a symmetric manner.

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[3] The weights used for the commodity sub-indices are:

Cereals	Dairy	Meat	Vegetable Oils	Sugar
0.272	0.173	0.348	0.135	0.072

[4] There are also slight differences in the export shares of the commodities and, thus, of commodity sub-indices, because the data in FAOSTAT get updated on a continuous basis.

[5] One axiomatic approach in index number theory "looks at the properties of alternative descriptive statistics that aggregate the individual price relatives (weighted by their economic importance) into summary measures of price change in an attempt to find the 'best' summary measure of price change." The 'best' here is defined by 17 tests, ranging from constant prices, proportionality in current and base period prices, invariance to proportional changes in current and base period values, time reversal, transitivity in prices with constant weights to monotonicity in current and base prices. The only index that satisfies all the 17 tests is the Törnqvist-Theil index (ILO, *Consumer Price Index Manual. Theory and Practice*, Geneva, 2004, provides the most comprehensive assessment of the index number theory and provides details about the various approaches and describes and assesses the different indices according to the axiomatic criteria indentified).

The Paasche index is the harmonic mean of the relative prices that are weighted with the current period weights and has the following form:

$$5. \qquad PI_{\tau} = \left[\sum_{i=1}^{n} s_{it} [P_{i\tau} / P_{i0}]^{-1} \right]^{-1}$$

where, all are defined as above, but s_{it} is the *i*th commodity's global export value in the total export values of all the 23 agricultural commodities included in the index at year *t*, since trade data are only available on an annual basis.

The Fisher index is simply the geometric mean of Laspeyres (Equation 1) and Paasche (Equation 5) indices:

$$6. \qquad FI_{\tau} = \sqrt{LI_{\tau} \bullet PI_{\tau}}$$

While the Törnqvist-Theil index is the geometric avarage of the price relatives with the average of the current and base period shares used as the weights:

$$7. \qquad TT_{i} = \prod_{i=1}^{n} \left[\frac{P_{i\tau}}{P_{i0}} \right]^{\frac{s_{i0}+s_{it}}{2}}$$

where, $P_{i\tau}$, P_{i0} and s_{i0} are defined as in Equation 1 and s_{it} are the current shares of the export values of the *i*th commodity at year *t*. The three indices are presented along with the FFPI in Chart 3. As can be seen, the differences between the four are not significant. Because the three indices with current weights cannot be calculated for the latest two years, the Laspeyres index remained the preferred one for monitoring and assessing the most recent agricultural market developments at the global level. Moreover, one advantage of the Laspeyres index is that it yields *consistent* results when aggregating to reach annual values through averaging either the monthly indices or the monthly prices. The same results are also obtained whether the index is calculated as an average of the individual prices or as an average of the sub-indices of the five commodity groups.

Extending the annual FFPI back to 1961

In order to facilitate the assessment of long-term price/market developments, the annual FFPI was extended back to 1961. For this purpose, the export unit values of the 23 commodities included in the index were treated in exactly the same way as the monitored prices were treated in Equation 1:

$$8. \qquad LUV_{t} = \sum_{i=1}^{n} s_{i0} \left[\frac{XUV_{it}}{XUV_{i0}} \right]$$

where *t=1961...2013* and $XUV_{i\tau}$ and XUV_{i0} are export unit values of the *i*th commodity at time *t* and average of the unit values of the *i*th commodity over the years included in the base period, respectively.

Since the export trade data are only available on an annual basis, the process of extending the FFPI involves splicing the unit value index to that of the annual averages of the FFPI. Chart 4 contains both series for the period 1990-2011 and shows their closeness to each other. The correlation coefficient between them is 0.99. This is a confirmation that the agricultural commodity prices monitored by

FAO to assess global market developments do capture closely the movements of the "actual unit values" of agricultural commodity exports derived from trade data.

The extended series of the FFPI was deflated by the World Bank's new manufactures unit value (MUV) index, in order to obtain an estimate of real agricultural prices. There are of course other deflators that can be used for this purpose, such as global implicit GDP deflator or global CPI. However, these also include the prices of the agricultural commodities that they are supposed to deflate. The MUV "is a composite index of prices for manufactured exports from the fifteen major developed and emerging economies to low– and middle–income economies,"[6] and, therefore, may be considered a "proxy" representing the rate of exchange between agricultural commodities and manufactured products, especially relevant for developing countries. Regardless, FAO would welcome other suggestions that could result in more "appropriate" real prices.

The two series are displayed in Chart 5. One interesting observation to note in passing is that over at least the past half-century, the only period where real agricultural prices seem to have declined significantly is between the years 1974 and 1987 – a topic that is worthy of further analysis in order to discover the underlying causes.

A global food price index with a focus on vulnerable developing countries

As already noted, FFPI is not an indicator that can be used on its own to assess the food security impact of food prices on food insecure households in vulnerable developing countries. First, the global export shares of the agricultural commodities may not necessarily reflect the structure of the agricultural imports of the developing countries or of household consumption. Second, the international commodity prices used for each agricultural commodity may not represent the unit cost of what the developing countries actually import. And, finally, the actual prices paid by the households may be quite different from the border prices, as their transmission to the local domestic markets could be influenced by many other factors, including changes in exchange rates or trade policies.

In order to determine the extent to which the FFPI is altered when the monitored relative prices are weighted by the value shares of the commodities imported by the food deficit developing countries (FDDCs), another index was calculated:

$$9.\ LI_{(FDDC)i} = \sum_{i=1}^{n} s_{(FDDC)i0} \left[\frac{P_{i\tau}}{P_{i0}} \right]$$

where, $s_{(FDDC)i0}$ is the share of ***i***th commodity's value in the total value of all the 23 agricultural commodities of the imports of the FDDCs, calculated as an average over the years that are included in the base period, and the other variables are as defined in Equation 1.

[6] http://econ.worldbank.org/WBSITE/EXTERNAL/EXTDEC/EXTDECPROSPECTS/0,,contentMDK:20587651~menuPK:5962952~pagePK:64165401~piPK:64165026~theSitePK:476883~isCURL:Y,00.html for more detailed definition of the index.

The results, presented in Chart 6, show that prior to 2007, the FFPI is usually above the index where the monitored prices are weighted by the import shares of the FDDCs. This implies that the basket they had consumed during 2002-2004 would have cost them less than was implied by the FFPI. After 2007, however, their basket would have cost more than that of the basket represented by the export value shares.

However, the significant increases in prices in 2008 may well have led these countries to change not only the composition of the commodities imported, depending on the ease of substitution between them, but also within each commodity – by selecting cheaper forms of the same, where available (e.g. cheaper cuts of meat or less processed forms of the some of the others). In order to assess this, weighted[7] arithmetic means of the actual export prices monitored by FAO and of the unit values of the imports (IUVs) of these commodities by FDDCs were calculated. The results, presented in Chart 7, are surprising in that, not only do the two averages track each other very closely (with the correlation coefficient between them equalling 0.96), but also up to 2004 the mean of the IUVs are above the mean of the export prices, on average by more than 6 percent. From 2004 onwards, however, the position of the two are reversed, with one exception in 2009 when the mean IUV was below that of the export prices. The latter suggests that such large increases in prices may have forced vulnerable countries to change the product composition within the commodities that they imported.

This finding tends to support the discovery above, that had the FDDCs imported the same basket that they had at the export prices monitored, that bundle would have cost more than the basket represented by the export shares at the global level. Thus the FDDCs seem to have altered the pattern of their imports in the face of rapid increases in prices so that their average unit costs fell below the average of the export prices of agricultural commodities monitored by FAO.

So what is new with the 'new' FFPI?

The analysis presented in this Special Feature was designed to discover whether the changes in the global agricultural commodity markets and the improvements in information technology required any revision to the FFPI. Some changes were made to the commodity coverage and to the manner in which the agricultural commodity prices were used in the calculation of the index, but the base period and the form of the index were maintained. The changes introduced, moreover, did not significantly alter the values of the series. The FFPI was extended back to 1961 to allow long-term evaluation of market developments, and a new price index was created to allow determining the possible impact of global price changes on vulnerable developing countries, keeping in mind that far more is needed than monitoring price changes at the global level to assess the impact of such changes on the food security of food insecure households.

[7] The weights used are the three-year averages of the import shares of each of the 23 agricultural commodities for the food deficit developing countries.

Charts

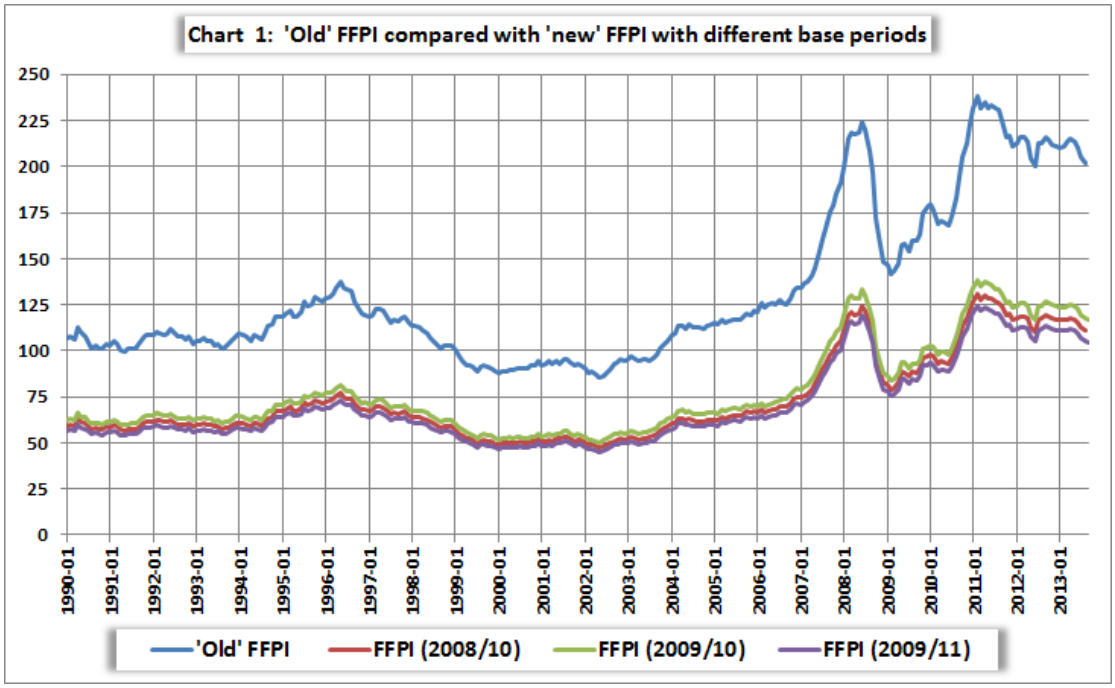
Chart 1: 'Old' FFPI compared with 'new' FFPI with different base periods
250
225
200
175
150
125
100
75
50
25
0
1990-01
1991-01
1992-01
1993-01
1994-01
1995-01
1996-01
1997-01
1998-01
1999-01
2000-01
2001-01
2002-01
2003-01
2004-01
2005-01
2006-01
2007-01
2008-01
2009-01
2010-01
2011-01
2012-01
2013-01
'Old' FFPI
FFPI (2008/10)
FFPI (2009/10)
FFPI (2009/11)

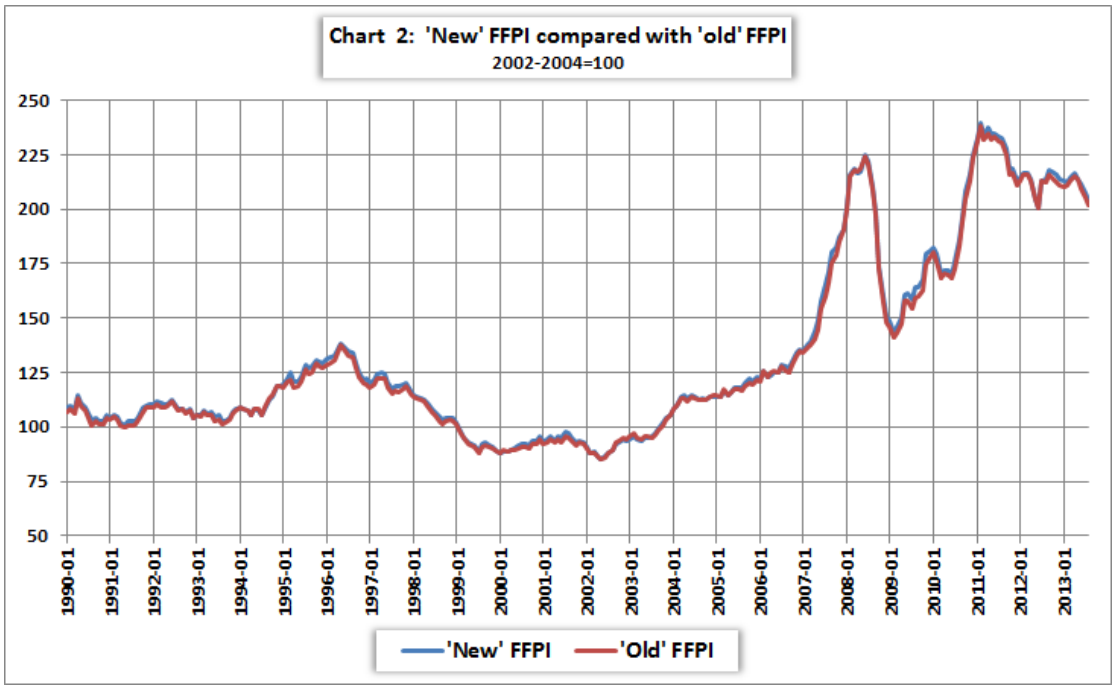
Chart 2: 'New' FFPI compared with 'old' FFPI
2002-2004=100
250
225
200
175
150
125
100
75
50
1990-01
1991-01
1992-01
1993-01
1994-01
1995-01
1996-01
1997-01
1998-01
1999-01
2000-01
2001-01
2002-01
2003-01
2004-01
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2009-01
2010-01
2011-01
2012-01
2013-01
'New' FFPI
'Old' FFPI

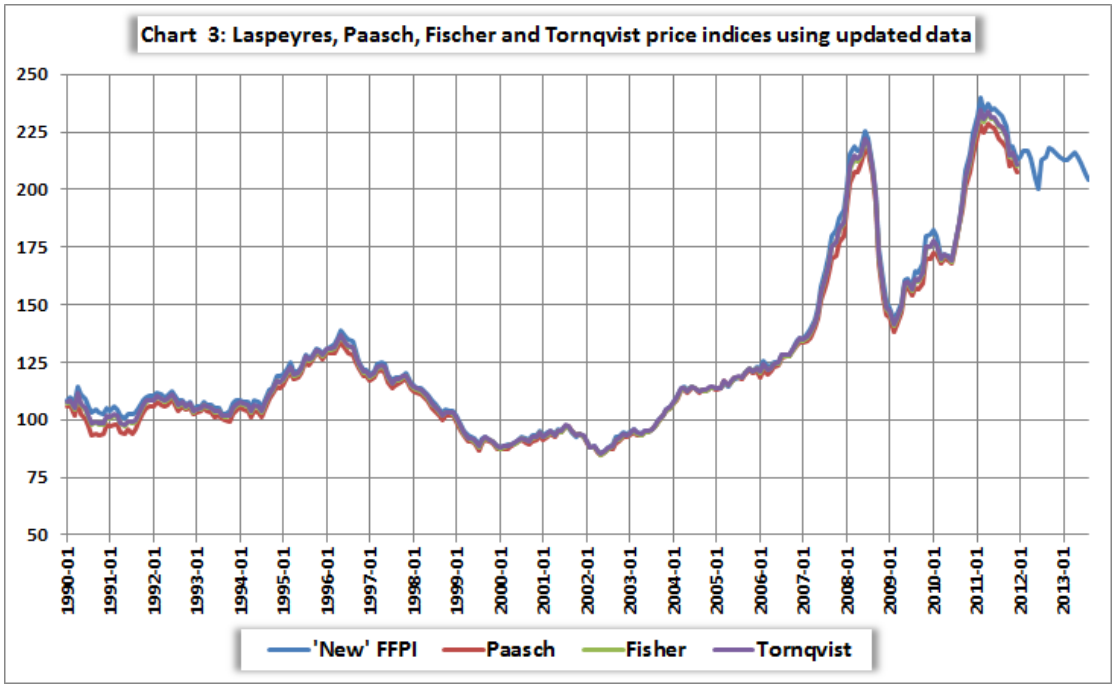
Chart 3: Laspeyres, Paasch, Fischer and Tornqvist price indices using updated data
250
225
200
175
150
125
100
75
50
1990-01
1991-01
1992-01
1993-01
1994-01
1995-01
1996-01
1997-01
1998-01
1999-01
2000-01
2001-01
2002-01
2003-01
2004-01
2005-01
2006-01
2007-01
2008-01
2009-01
2010-01
2011-01
2012-01
2013-01
'New' FFPI
Paasch
Fisher
Tornqvist

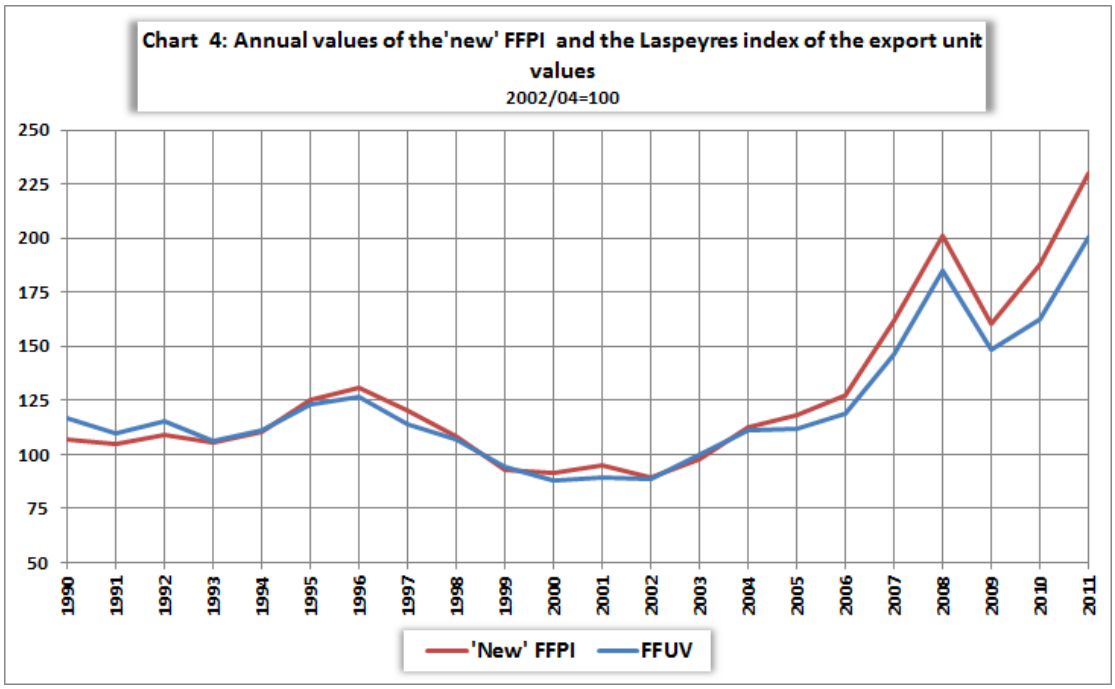
Chart 4: Annual values of the'new' FFPI and the Laspeyres index of the export unit values
2002/04=100
250
225
200
175
150
125
100
75
50
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
'New' FFPI
FFUV

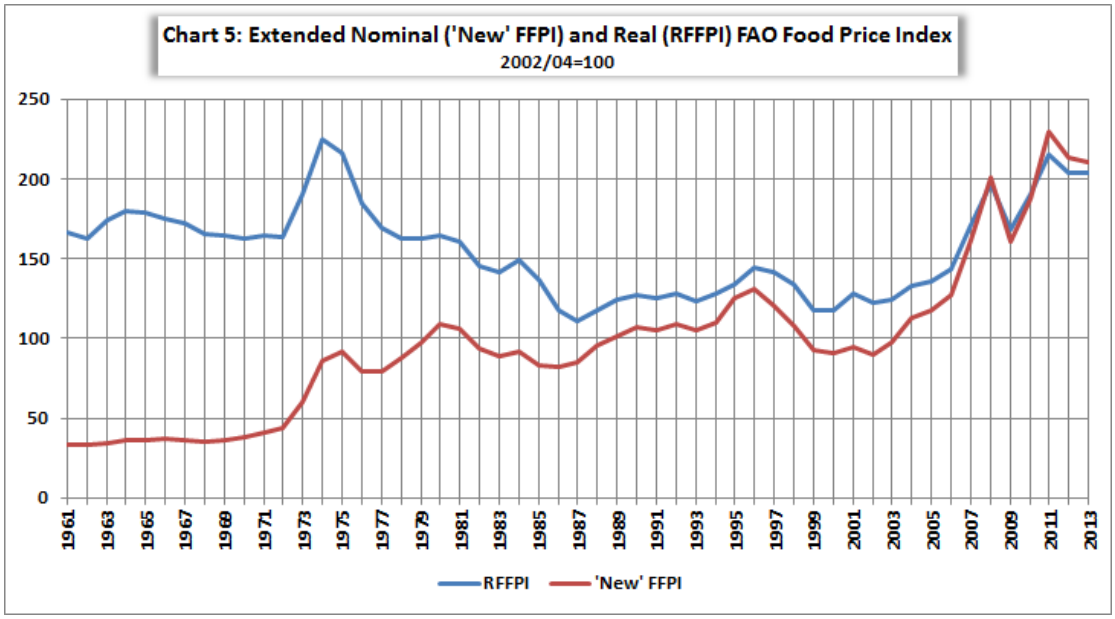
Chart 5: Extended Nominal ('New' FFPI) and Real (RFFPI) FAO Food Price Index
2002/04=100
250
200
150
100
50
0
1961
1963
1965
1967
1969
1971
1973
1975
1977
1979
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
2007
2009
2011
2013
RFFPI
'New' FFPI

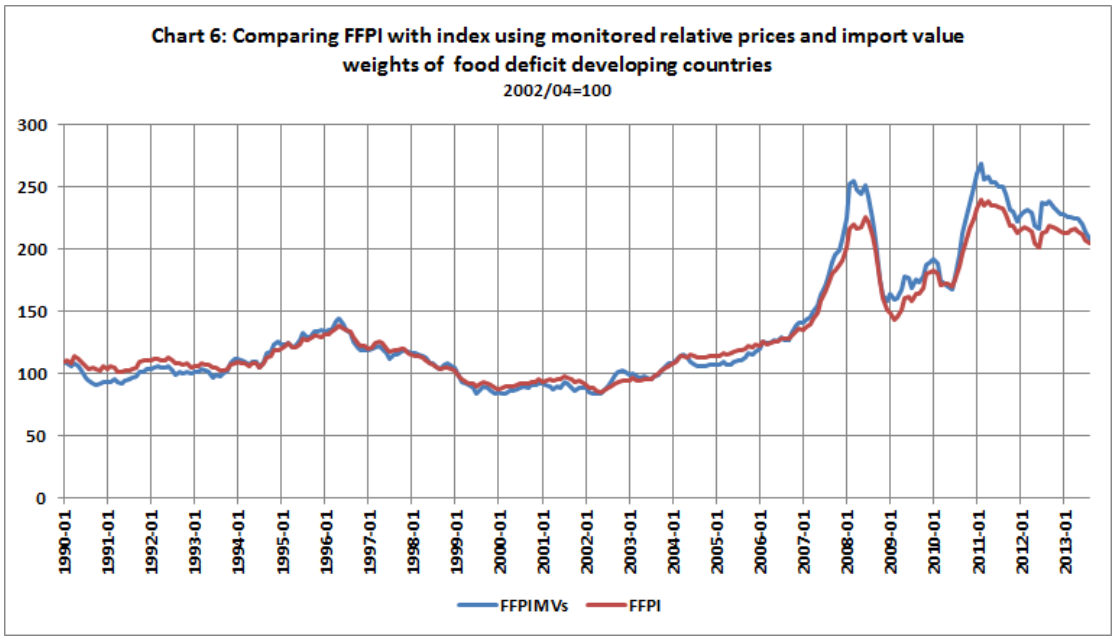
Chart 6: Comparing FFPI with index using monitored relative prices and import value weights of food deficit developing countries
2002/04=100
300
250
200
150
100
50
0
1990-01
1991-01
1992-01
1993-01
1994-01
1995-01
1996-01
1997-01
1998-01
1999-01
2000-01
2001-01
2002-01
2003-01
2004-01
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2006-01
2007-01
2008-01
2009-01
2010-01
2011-01
2012-01
2013-01
FFPIMVs
FFPI

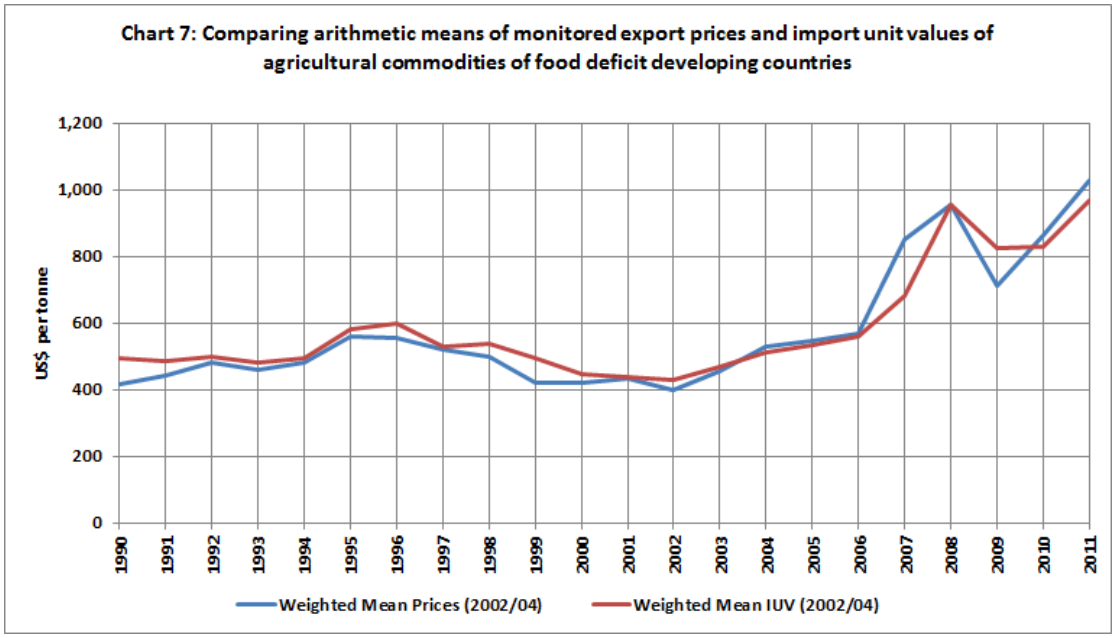
Chart 7: Comparing arithmetic means of monitored export prices and import unit values of agricultural commodities of food deficit developing countries
US$ per tonne
1,200
1,000
800
600
400
200
0
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
Weighted Mean Prices (2002/04)
Weighted Mean IUV (2002/04)