

Exact and Inexact Decompositions of International Price Indices

Pal Boug
Statistics Norway
pboug@outlook.com

Classical index number theory generally advocates the use of superlative price index number formulae, including the Fisher, Walsh and Törnqvist price indices. These are good approximations of the true inflationary effects of international trade given the central assumptions that the importing countries are free to choose between all goods and services and that changes in country composition of imports follow from changes in relative prices. In practice, however, import patterns have changed over time as a result of a gradual liberalization of international trade and often large initial price level differences between exporting countries. Thus, aggregating international prices by means of classical index number formulae may produce significant biased estimates of the “true” price index by failing to capture the deflationary effects of imports increasingly originating from low-cost countries, China in particular.

In this paper, we argue that these deflationary effects are closely related to what the Boskin Commission calls the outlet substitution bias, which occurs in classical index number formulae due to failure to adequately account for situations where discount outlets capture market shares from high-cost retailers. Building on Diewert (1998) and White (2000) among others, who point out that a reasonable concept for the “true” price index in such situations is the average price paid by consumers over all outlets, we propose using the geometric average of price levels as the underlying aggregator formula so as also to capture the deflationary effects of changes in country composition of imports due to trade liberalization and price level differences between exporting countries.

Some few studies also seek to include the deflationary effects of shifts of imports towards low-cost countries by employing either a geometric or an arithmetic average of price levels; see for example Nickell (2005), Wheeler (2008) and Coille (2008) who analyze the evolution of inflation in the United Kingdom, Pain et al. (2006) who study the impact of imports from emerging countries on inflation in OECD countries, and Kamin et al. (2006) who analyze the impact of Chinese exports on global import prices. However, because a first-order Taylor series approximation is used, the aggregation of international prices in Nickell (2005) among others is inexact in the sense that the underlying aggregator formula is not exactly reproduced.

Applying the so-called quadratic approximation lemma by Diewert (1976), we show analytically

that the (logarithmic) difference in the geometric average of price levels is exactly equal to the sum of inflationary effects from the Törnqvist price index and deflationary effects from the differences between the arithmetic mean of price levels times the changes in the country composition of imports. We also show analytically an expression for the bias in aggregate inflation when applying the first-order Taylor series approximation and not the quadratic approximation lemma, which is equivalent to a second-order Taylor series approximation when the underlying aggregator formula is quadratic. The bias in aggregate inflation is equal to zero only in the special and unrealistic cases when the inflation rates are equal across exporting countries and when no switching occurs from high-cost to low-cost countries. Accordingly, the bias in aggregate inflation may be significant in practice when applying a first-order Taylor series approximation to a geometric mean of price levels.

As an empirical illustration, we provide estimates of the bias in aggregate inflation using data from the Norwegian clothing industry which has experienced massive trade liberalization and increasing imports from China and other low-cost countries since the Uruguay Round in the mid-1980s. Applying yearly data from 1997 to 2013, our calculations reveal that the average annual bias in aggregate inflation is close to 0.2 percentage points when a first-order Taylor series approximation is used. In some years the bias in aggregate inflation is as high as 0.6 percentage points. We therefore conclude that the quadratic approximation lemma is preferable to the first-order Taylor series approximation when aggregating international prices by means of the geometric average of price levels. Admittedly though, as the deflationary effects are driven by trade liberalization and price level differences between countries rather than by changes in relative prices, the ratio of a geometric average (like any other average) of price levels must deviate from classical index number theory and violate the identity axiom that a price index should not change if underlying prices do not change. Otherwise, neglecting the price level differences between countries is likely to lead to even more significant bias in aggregate inflation than the bias from applying the first-order Taylor series approximation and not the quadratic approximation lemma.