

Double deflation: theory and practice

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The fundamental identity in national income accounting is that total final expenditure (consumption plus investment plus government expenditure plus exports) *less* imports *less* taxes net of subsidies on expenditure should equal total value added in all industries. This identity holds in current prices in the absence of errors and omissions in the data. In other words, GDP from the expenditure side, GDP(E), must equal GDP from the output side, GDP(O). In the national accounts of many countries including the UK this identity is enforced through a balancing process carried out within the framework of the supply and use tables.

There is a corresponding identity which holds in real terms (constant prices): the growth of aggregate *real* final expenditure (net of imports and taxes) must equal the growth of aggregate *real* value added. Or, the growth of *real* GDP(E) must equal the growth of *real* GDP(O). It has long been known that, for this identity to hold, real value added in each industry must be measured by what is called double deflation. Double deflation means that an industry's real value added must be measured by its real gross output less its real intermediate inputs, i.e. output and inputs must be deflated separately using appropriate deflators for each. At the moment in the UK, double deflation is not used and real value added is estimated by a form of *single* deflation: the growth of real value added in each industry is assumed to equal the growth of real gross output in that industry. Consequently, the growth of real GDP(O) is not equal to the growth of real GDP(E), even in principle.

In practice, the Office for National Statistics publishes GDP(O) estimates at the industry level which in aggregate do match very closely those from the expenditure side. But this is only achieved by adding so-called "coherence adjustments" to the value added of the private service industries. That is, GDP(O) is adjusted to match GDP(E), and not the other way round, because GDP(E) is considered to be more reliable, mainly because the deflators on the expenditure side are more reliable than those on the output side. This situation is clearly not satisfactory. Since the Great Recession began in 2008 there have been many attempts to drill down and see what is going on at the industry level. But what reliance can we place on these analyses if the story on the industry side does not add up to the generally accepted figure for GDP, except through these arbitrary coherence adjustments?

Double deflation is the internationally recommended best practice, consequently, the ONS is planning to implement double deflation in the UK's national accounts from 2019 onwards. But there is more than one way of implementing it. In this paper we set out the theory of double deflation using a matrix algebra treatment based on the framework of the supply and use tables. Initially we use simplified assumptions about prices: a given domestically-produced product is sold at the same price whichever industry produces it and whatever the use to which it is put. Later we introduce more realistic assumptions. We analyse the conditions on prices under which real GDP(O) equals real GDP(E). When this is the case we say that the price indices are consistent. We consider three alternative methods of implementing double deflation. The preferred method makes use of all the price indices which the Office for National Statistics currently collects: Producer Price Indices, Services Producer Price Indices, Consumer Price Indices, Export Price Indices and Import Price Indices.

To illustrate some of these issues, we implement a simplified version of double deflation, using the same data as in the latest vintage of the national accounts. Our deflators are the same as those used to produce the official GDP(O) estimates and incorporate the coherence adjustments. In this version the same price index is used for each product regardless of whether the product is an output or an input. We compare our estimates with the official ones for GDP(O). Despite using the same deflators, we find that double-deflated industry growth rates are consistently and significantly lower than the official single-deflated ones over 1997- 2015; our estimate of the growth of GDP is also significantly lower. This finding certainly does not show that our estimates are better than the official ones, given that the latter are based on GDP(E) and use the best available deflators. Rather, we interpret this finding as reinforcing the case for careful selection of the set of deflators to use for double deflation and with the need for consistency in the deflators. We also find that industry real value added is considerably more variable year-to-year under double deflation than under single. We expect this finding to be a general feature of double deflation.