

# *Double Deflation*

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## *Theory and Practice*

**Nicholas Oulton (CFM, NIESR & ESCoE)**

**Ana Rincon-Aznar (NIESR & ESCoE)**

**Lea Samek (NIESR & ESCoE)**

**and**

**Sylaja Srinivasan (NIESR & ESCoE)**

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# ROADMAP

- Double deflation versus single deflation: basic motivation and concepts
- How the ONS estimates GDP at the moment using single deflation
- How double deflation can be implemented in the framework of the Supply Use Tables (SUTs)
- Doing it properly: the challenges ahead.

# Advantages of double deflation

- Greater coherence in the national accounts: growth of *real* GDP(O) = growth of *real* GDP(E)
- Better estimates of real value added at the industry level. E.g. under single deflation the effects of outsourcing on productivity are hard to trace.
- Better measures of labour productivity and TFP growth at the industry level. So we are better able to see what is happening to innovation at the industry level (Oulton 2016).

## Double deflation: the issues

- Will the new estimates of real value added at the industry level tell a very different story from the present ones?
- Will they be implausible, maybe because they are too volatile?
- Will double deflation change the past by generating a very different path for real GDP?
- Could double deflation even make the productivity puzzle disappear?

# Double deflation: why bother?

- *Real* GDP can be calculated either from the expenditure side or from the output side. *In principle*, i.e. in the absence of errors and omissions, we want the two calculations to give the same answer.
- It has been known for a long time that this is *not* the case under single deflation. Only double deflation can guarantee that this is the case.

# Double deflation and the national accounts

- To calculate real GDP from the output side, GDP(O), the ONS has to calculate real value added in each industry.
- “Single deflation” is shorthand for the way in which the ONS calculates real value added at the moment.
- “Double deflation” is shorthand for a different way of calculating real value added. It is the method recommended in the most recent System of National Accounts (SNA 2008) and is mandated by Eurostat (ESA 2010). Also recommended by the Bean Review (2016).
- 10 of the G20 countries already use double deflation (Alexander et al. 2017).
- The ONS is committed to switching over to double deflation (Daniel et al. 2017).

# How does *single* deflation work in the UK?

- In practice, GDP(E) is paramount. The ONS adjusts the growth of GDP(O) so that it equals that of GDP(E) to within a small tolerance (0.1 % pa)
- This is done by “coherence adjustments” which are applied to the estimates of real value added in private services. No adjustments are made to government output or to the production sector.
- These coherence adjustments are not usually published (Lee 2011).
- Why is GDP(E) paramount? Answer: the price indices are more reliable than on the output side. (E.g. the CPI covers two thirds of GDP(E))

# Real value added: single deflation

Currently, the ONS measures real value added by single deflation. The growth rate of real value added is set equal to the growth rate of real gross output:

$$\frac{V_{it}^{SD}}{V_{i,t-1}^{SD}} = \frac{Y_{it}}{Y_{i,t-1}}$$

$Y_{it}$  : Real gross output, i.e. nominal gross output  
deflated by an appropriate price index  
(but subject to "coherence adjustments")

This is simple to calculate. But it does *not* assure that growth of GDP(O) = growth of GDP(E).

# Real value added: double deflation

With annual chain-linking and a Laspeyres formula:

Growth of real GDP(O) =

$$\frac{\text{Value added in year } t \text{ at prices of year } t-1}{\text{Value added in year } t-1 \text{ at prices of year } t-1} - 1$$

*NB: Denominator is the same as for real GDP(E).*

# Real value added: double deflation

Under double deflation, output is deflated separately from the inputs:

$$\left( \frac{V_{it}^{DD}}{V_{i,t-1}^{DD}} \right) = \frac{1}{v_{i,t-1}} \left[ \left( \frac{Y_{it}}{Y_{i,t-1}} \right) - \sum_j w_{ij,t-1} \left( \frac{X_{ijt}}{X_{ij,t-1}} \right) \right]$$

$V_{it}^{DD}$  : double-deflated real value added in  $i$ -th industry

$X_{ijt}$  :  $j$ -th intermediate input into  $i$ -th industry, real

$v_{i,t-1}$  : share of value added in nominal gross output in  $t-1$

$w_{ij,t-1}$  : share of  $j$ -th intermediate input in nominal gross output in  $t-1$

This is harder to calculate since knowledge of input-output coefficients is required as well as price indices for all inputs.

[Note: real value added could be negative on the Laspeyres approach]

# Basic national income accounting relationships

In *current* (basic) prices, GDP can be measured from the output, expenditure or income sides:

- $GDP(E) = C + I + G + X - M = TFE$  minus imports
- $GDP(O) =$  Sum across industries of value added
- $GDP(I) =$  Labour income + Gross operating surplus
- And  $GDP(O) = GDP(E) = GDP(I)$

These relationships are true *by definition*. If they are not true in practice, we know that there must be errors or omissions in the underlying data.

... and this relationship must hold for  
each product/industry

Supply=Use:

$$S_{it} = IC_{it} + C_{it} + I_{it} + G_{it} + EX_{it}, \quad i = 1, 2, \dots, N$$

$S_{it}$  : total domestic supply;  $IC_{it}$  : intermediate consumption

$C_{it}$  : household consumption;  $I_{it}$  : investment

$G_{it}$  : government spending;  $EX_{it}$  : exports

This equality is enforced by the balancing process,  
done through the SUTs

## Supply = Use must hold at previous year's prices (PYP) as well as at current prices

$$P_{i,t-1}^S \cdot S_{it} = P_{i,t-1}^{IC} \cdot IC_{it} + P_{i,t-1}^C \cdot C_{it} + P_{i,t-1}^I \cdot I_{it} + P_{i,t-1}^G \cdot G_{it} + P_{i,t-1}^{EX} \cdot EX_{it}$$

If this is *not* the case, then the growth of GDP(O) will *not* equal that of GDP(E).

But how shall we pick price indices so that this relationship holds?

# Consistency of price indices (1)

Suppose that for each product there is just one price for all uses.  
Then revaluing at PYP:

$$P_{i,t-1}S_{it} = P_{i,t-1} [IC_{it} + C_{it} + I_{it} + G_{it} + EX_{it}], \quad i = 1, 2, \dots, N$$

*So if the table is balanced in CP, then it is still balanced at PYP.*

## Consistency of price indices (2)

But this is unrealistic. So let each use have its own price. Then at PYP the  $i$ -th row of the use table is

$$P_{i,t-1}^S \cdot S_{it} = P_{i,t-1}^{IC} \cdot IC_{it} + P_{i,t-1}^C \cdot C_{it} + P_{i,t-1}^I \cdot I_{it} + P_{i,t-1}^G \cdot G_{it} + P_{i,t-1}^{EX} \cdot EX_{it}$$

But if these 6 price indices are all picked independently of each other, then there is no reason to expect this equation to hold.

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One way to ensure balance is if the supply price on the left hand side is made a weighted average of the prices on the right hand side:

$$P_{i,t-1}^S = \left( \frac{IC_{it}}{S_{it}} \right) P_{i,t-1}^{IC} + \left( \frac{C_{it}}{S_{it}} \right) P_{i,t-1}^C + \left( \frac{I_{it}}{S_{it}} \right) P_{i,t-1}^I + \left( \frac{G_{it}}{S_{it}} \right) P_{i,t-1}^G + \left( \frac{EX_{it}}{S_{it}} \right) P_{i,t-1}^{EX}$$

# Price indices available in practice

- In practice the ONS collects 5 sets of price indices:
  1. Producer Price Indices (PPIs) (basic prices)
  2. Services Producer Price Indices (SPPIs) (basic prices)
  3. Export price indices (EPIs) (basic prices)
  4. Import price indices (IPIs) (basic prices)
  5. Consumer price indices (CPIs) (purchasers' prices)
- So how shall we choose which prices to use for double deflation?

# Two possible ways of doing double deflation

- Case A: PPIs (or SPPIs) applied to all uses except EPIs are assigned to exports. IPIs assigned to imports.
- Case B: PPIs (or SPPIs) used for intermediate sales and for investment; EPIs used for exports; CPIs (adjusted for taxes, margins and imports) used for consumption. IPIs assigned to imports.

# Two possible ways of doing double deflation

- Case A: PPIs (or SPPIs) applied to all uses except EPIs assigned to exports

*Case A is close to current GDP(O) methodology. But it would produce different estimates of GDP from the current methodology. I.e. it will change the past.*

- Case B: PPIs used for intermediate sales and for investment; EPIs used for exports; CPIs (adjusted for taxes, margins and imports) used for consumption.

*Case B should produce the same estimates of GDP as the current methodology. But there may still be inconsistencies between PPIs and CPIs (even after adjusting for taxes, margins and imports).*

# A preliminary analysis

- We have implemented a simplified version of Case A using the implicit deflators from the GDP(O) programme (real and nominal value added) and the SUTs, 1997-2015. *NB: coherence adjustments have been added to these deflators.*
- We apply this set of prices to calculate double-deflated real value added, using both chained Törnqvist and chained Laspeyres. [Data source: low level aggregates spreadsheet].
- Of course, this isn't right! Export and import price indices and CPIs ignored.
- We compare the *official* single-deflated (SD) estimates with *our* double-deflated (DD) estimates at industry level (79 industries).

*NB: the official (SD) estimates aggregate to official GDP.*

# Growth rates of real value added: methods compared

Cross-industry means (79 industries, 1997-2015, % pa)

Method	Mean growth rate	S.D. of growth rate
Single (Official)	<b>1.23</b>	<b>7.40</b>
Double (Törnqvist)	<b>0.52</b>	<b>20.12</b>
Double (Laspeyres)	<b>-0.16</b>	<b>20.14</b>

*Double-deflated grows more slowly than single and is much more variable year-to-year*

## Mean growth rates by broad sector, 1997-2015, % p.a.

	SD (Official)	DD (Laspeyres)	DD (Törnqvist)
Production + utilities	<b>-0.59</b>	<b>-1.59</b>	<b>-2.28</b>
Market services	<b>2.46</b>	<b>2.32</b>	<b>1.65</b>
Public services	<b>1.86</b>	<b>0.03</b>	<b>-0.12</b>
Whole economy	<b>1.34</b>	<b>0.52</b>	<b>0.16</b>

Sources: SUTS and low level aggregates spreadsheet

# Conclusions

- Double deflation might change the past but it doesn't have to. It all depends on how it is implemented. One way (Case B above) would leave real GDP unchanged.
- But double deflation will still change the growth path of individual industries. A preliminary analysis (similar to Case A above) suggests this could be quite significant, also that industry growth rates become more volatile.
- The exclusive use of the official GDP(O) deflators produces radically different estimates of GDP over 1997-2015 when applied in a double deflation framework.

# THE END

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