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MEASURING HOLDING GAINS IN INVENTORIES

Invited Paper submitted by OECD*

Introduction

1. The value created by the process of transforming inputs into outputs is measured by the "value added". Technically speaking, it is the difference between the value of the outputs of goods and services produced and the value of the goods and services consumed in the process of production.
2. For value added to be measured correctly the outputs and inputs must be valued consistently with each other. In other words, they must be valued at the prices ruling at the time that production takes place. If inputs and outputs are produced in the same accounting period then there are generally no major problems involved in consistently measuring the prices of the outputs and inputs (except under conditions of high inflation).
3. However, inputs may be produced at some earlier time and then held in inventories until they are finally used in production. Generally, the prices of the inputs will change between the time they are produced and enter into

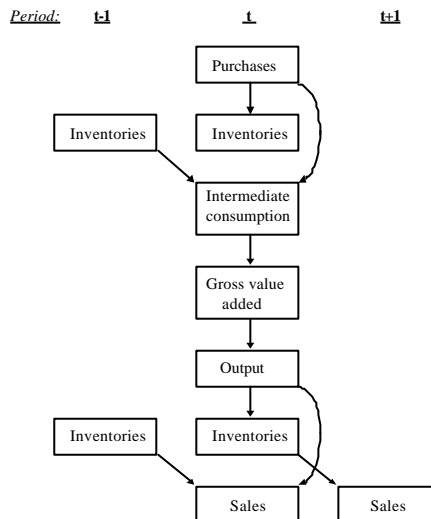
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inventories and the time at which they are taken out of inventories and used in production. The change in price over that time is not due to production - it is simply a change in value for doing nothing other than sitting in storage, i.e. it is a "holding gain" (or loss if prices have fallen).

4. Similarly, any outputs from production that are not sold in the same period in which they are produced will go into inventories to be sold at a later date. If prices change during the time they are held in inventories then, for calculating value added, they must be valued at the prices prevailing at the time they were produced rather than those at which they were sold.

5. Any "holding gains" due to price increases while goods are held in inventories may benefit the business but they do not represent value created by the productive process (i.e. by transforming inputs into outputs).

Flows into and out of inventories



6. Even with relatively moderate inflation, holding gains can be quite significant. While the holding gains are a genuine phenomenon in practice, they must be removed from the estimates of gross value added otherwise the estimates of production will be distorted. In such a situation, other related variables in the accounts will also be measured incorrectly (e.g. operating surplus). The extent of the distortion will vary over time, largely depending on the rate of

inflation. If the distortion is significant then it could seriously compromise the usefulness of the accounts for policy purposes.

Measurement of output and intermediate consumption

7. Paragraph 6.43 of SNA93 defines the value of output as "the value of total sales or other uses of goods or services produced as outputs + the value of changes in the inventories of goods produced as outputs".

8. The item "other uses of goods or services produced as outputs" includes outputs used for own final consumption or own gross fixed capital formation. The value of changes in inventories is a net figure which consists of additions to inventories less withdrawals from inventories. It can be further refined by deducting any inventories which are "written off" because of damage, obsolescence etc. However, for simplicity, this aspect will be ignored throughout the rest of this paper.

9. The critical issue is that a good which enters inventories is counted as output in the period in which it was produced and added to inventories. When it is taken out of inventories at a later date and sold, for example, no output is recorded at that time because the value at which it is sold is offset by the corresponding negative change in inventories when calculating value added.

10. The treatment of intermediate inputs is symmetrical to that of output. The value of intermediate inputs transformed into outputs by the production process is equal to the value of materials, supplies and services purchased less the value of the change in inventories of materials and supplies (for simplicity, referred to in the rest of this paper as "materials"). Intermediate inputs must be valued at their market prices at the time at which they are used.

Valuing inventories

11. When the price of a good changes while it is being held in inventories, by definition its price recorded at the time it leaves inventories is different from that at which it entered. Therefore, the value of the withdrawal from inventories does not cancel out the value of its (earlier) entry into inventories.

12. Paragraph 1.62 of SNA93 summarises the situation regarding the valuation of inventories: "A fundamental principle underlying the measurement of gross value added, and hence GDP, is that output and intermediate consumption must be valued at the prices current at the time the production takes place. This implies that goods withdrawn from inventories by producers must be valued at the prices

prevailing at the times the goods are withdrawn and not at the prices at which they entered inventories. This method of recording changes in inventories is not commonly used in business accounting, however, and may sometimes give very different results.....".

13. Let us consider an example where a single good is added into inventories precisely at the start of an accounting period and is still there at the end of the period but the price of this good changes between the beginning and end of the accounting period from P_B to P_E . Because the same single good is held in inventories at the beginning and end of the accounting period the physical change in inventories is zero. However, the value (at historic cost) of the total change in inventories during the accounting period is not zero; in fact, it is the value given by $(P_E Q - P_B Q)$, which is positive when prices are rising.

Holding gains

14. Paragraph 12.104 of SNA93 states that:

"..... internal transactions should be valued at the prices prevailing at the times they take place in the same way as transactions in any other kind of asset. When the transactions are properly valued in this way, nominal holding gains on inventories are given as follows:

(a) The value of the closing inventories at end-of-the-period prices;

minus

(b) The value of the opening inventories at beginning-of-the-period prices;

minus

(c) The value of entries minus the value of withdrawals and recurrent losses, valued at the prices prevailing at the times the entries and withdrawals take place.....".

15. In practice, the difficult part of this calculation is part (c) because statistical collections cannot identify all the entries into and withdrawals from inventories at the time they take place. In the simplified case described in the previous paragraph, the nominal holding gain is $(P_E - P_B)$ which is positive when prices are rising. However, because this example was simplified so much, part (c) was able to be ignored. In practice, the method adopted to calculate holding gains in inventories depends on the data available to compile the national accounts inventories estimates.

Measuring holding gains in inventories

16. Businesses do not keep details of flows through inventories. A common approach for businesses is to measure the levels of inventories at particular points of time, typically at the beginning and end of each accounting period. A "stocktake" generally involves counting the numbers of each type of item held in inventories and then placing a value on them by applying an appropriate price. In practice, the opening inventory levels are normally valued at the prices prevailing at the beginning of the accounting period while closing inventory levels are valued at the prices prevailing at the end of the accounting period (in other words, "historic cost" accounting). Statistical collections from businesses will have these different prices embodied in the values of inventories reported for the beginning and end of each accounting period.

17. National accountants have to make a number of assumptions when using these values of inventory levels reported by businesses as the starting point for calculating the holding gains and thus the "change in inventories" required for national accounts purposes (it should be noted that the term "stock appreciation" is often used as an alternative for "holding gains").

18. An important assumption relates to the ways in which goods flow through inventories. A common method is the "first-in-first-out" (FIFO) method which assumes that the good which is withdrawn is always the one which has been held in inventories for the longest time. A variety of other methods can be used but in the following example, FIFO will be used for simplicity.

19. The next step is to identify the prices which are applicable to the goods held in inventories and to weight them together using weights which reflect each different good's relative importance in inventories. Often these weights have to be estimated using values of output and assumptions about the length of time each type of good is held in inventories, on average. The price indexes required from this process relate to the beginning of the accounting period, the end of the accounting period and the average price through the accounting period (which is not necessarily just the simple average of the beginning and end of period prices). Note that the values of the beginning of period levels reported by businesses are generally based on historic costs rather than on average costs for the period or on current costs (i.e. the end of period prices).

20. The following nomenclature is used in the formulas below, with some illustrative numbers shown down the right-hand side to make the example clearer (the shaded numbers are those that are being calculated below, while the

unshaded ones are those that have to be available in the National Statistical Office from surveys to enable these calculations to be made).

V_E	value of inventory levels at the end of the accounting period (at end of period prices)	1155
V_B	value of inventory levels at the beginning of the accounting period (at beginning of period prices)	1071
V_{E-B}	change in value of inventories during the accounting period (based on historic cost as recorded in business' accounts)	84
P_E	price index at the end of the accounting period	1.050
P_B	price index at the beginning of the accounting period	1.020
P_{Av}	average price index for the accounting period	1.040
KV_E	constant price value of inventory levels at the end of the accounting period	1100
KV_B	constant price value of inventory levels at the beginning of the accounting period	1050
KV_{E-B}	change in constant price value of inventories during the accounting period	50
CI_{E-B}	change in inventories during the accounting period current prices, national accounts basis)	52
HG_{E-B}	holding gains during the accounting period (national accounts basis)	32

21. The first step is to take the values of inventory levels reported by businesses and deflate them using the beginning and end of period price deflators.

$$KV_E = V_E / P_E \quad (= 1155 / 1.050 = 1100)$$

$$KV_B = V_B / P_B \quad (= 1071 / 1.020 = 1050)$$

22. The second step is to calculate the change in inventory values at both current and constant prices during the accounting period (i.e. the end of period values less the beginning of period values).

$$V_{E-B} = V_E - V_B \quad (= 1155 - 1071 = 84)$$

$$KV_{E-B} = KV_E - KV_B \quad (= 1100 - 1050 = 50)$$

23. The third step is to calculate the change in inventories on a national accounts basis by "reflating" the constant price change in the value of inventories during the period to the level of the average prices during the period. It should be noted that this estimation method provides only a proxy to the desired result of measuring the change in inventories in the period because it is based on data only at the beginning and end of the period rather than on all the additions and withdrawals through the period. In other words, this is an approximation to the definition in paragraph 14(c), but it is generally the only practical approach that can be adopted.

$$CI_{E-B} = KV_{E-B} \times P_{AV} \quad (= 50 \times 1.040 = 52)$$

24. The final step is to estimate the holding gains by deducting the change in inventories on a national accounts basis from the change in values (based on historic costs) reported by businesses.

$$HG_{E-B} = V_{E-B} - CI_{E-B} \quad (= 84 - 52 = 32).$$

25. A couple of points to note in the above calculations are that the sign of the holding gains is dependent on whether prices are rising or falling. In practice, positive holding gains will arise when prices are rising and negative holding gains will occur when prices are falling. In the above example, the change in values reported by businesses is positive (+84). However, the holding gains would still be positive in this example even if this change in (historic cost based) values was negative given that prices were rising during the period. The size of the holding gains is dependent on two factors - the value of the level of inventories at the beginning and end of the period and the rate of price change. However, in practice the most significant factor is the rate of price change.

26. In some cases, particularly for agriculture, changes in quantities of inventories can be observed directly. In such cases, the change in stocks can be calculated by multiplying the change in physical quantities held in inventories by the average price in the accounting period rather than "reflating" the estimated volume change, as described above. However, the overall principles involved in estimating the holding gains are the same as those shown above. An additional point is that, in circumstances of strong changes in the levels of inventories and of prices, the results obtained would be different from those obtained by directly measuring all additions to and

withdrawals from inventories within the period. In fact, in such a situation, it can be possible for the change in inventories to be counterintuitive with negative values of inventory change being associated with positive changes in quantities, or vice versa.

Assumptions made in measuring holding gains in inventories

27. Two assumptions have already been noted above - namely, that businesses use the "first-in-first-out" (FIFO) approach to the flows of goods through inventories and that they value the goods at "historic cost".

28. There are several other assumptions which are made, even if some of these are often not shown explicitly.

- The prices for goods held in inventories can be estimated accurately using the selling prices of similar goods (these prices are collected by NSOs for their CPI, PPIs etc).
- The turnover period (i.e. the ratio of the level of inventories to sales) for each good held in inventories is fixed over time (it is possible to handle changing turnover periods in the calculations but it is very costly to obtain the data needed to do so).
- The rate of change (either increase or decrease) in inventories at the level at which the estimation is carried out is constant between the beginning and end of the accounting period. This can be a troublesome assumption, particularly if the accounting period being used is a lengthy one (such as a year). For example, in the case of crops, it is possible to have a very small or even zero change in inventories between the beginning and end of the year even though there has been a huge buildup in inventories as crops are brought in and then a corresponding rundown as they are used up or exported. In such a situation, if prices for the goods involved rise significantly through the year then there could be some significant holding gains arising because of the pattern of the buildup in inventories early in the year followed by the rundown of the total holdings later in the year. In such a case, if there are price increases during the year, the withdrawals from inventories can be valued at a much higher price than the entries into inventories.

Conclusion

29. Holding gains occur because of differences between the original prices paid for goods entering into inventories and the prices received when they leave

inventories. The economic interpretation of holding gains is not simple. They are not part of value added but they are important and have an economic significance because they do result in an actual monetary gain to producers. However, the costs of holding inventories are also opportunity costs (e.g. foregoing interest on the money tied up in inventories or the interest costs of money borrowed to pay for the inventories).

30. It is necessary to remove the effects of holding gains from inventories reported by businesses in statistical surveys when estimating change in inventories on a national accounts basis. A number of assumptions must be made in this process. The accuracy of the estimates of holding gains and the national accounts estimates of change in inventories are highly dependent on the validity of those assumptions.

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