Annex to chapter 6: Separating storage production from holding gains and losses

A.   Introduction

6A.1.   Paragraphs 6.139 to 6.142 recommend that in some cases, the increase in value of goods held in inventories may be regarded as production due to storage rather than to holding gains. This annex explores the topic further and gives examples of when it is appropriate to treat any of the increase in value of a product as due to production or income and how this may be separated from any remaining holding gains and losses.

1.   Normal storage costs

6A.2.   Holding products in inventories always involves costs. These costs include those associated with providing the physical storage capacity, maintaining information on levels and types of inventories, costs of supplying withdrawals to customers and costs associated with renewing the level of inventories by acquiring replacement goods (other than the cost of the goods themselves). These costs are recovered by the producer in the margins charged by wholesalers and retailers or form part of the basic price charged by a manufacturer. The costs incurred are included in the total costs for intermediate consumption and compensation of employees. It may also be the case that specialist storage producers provide a service to other producers and again their costs are included in intermediate consumption.

6A.3.   For most products, designated type I products, this is the only aspect of storage that is relevant. Because all the costs associated with storage are included in production costs, the value of the goods as they enter and leave inventories are valued at the costs of producing or acquiring replacement items. The change in value of the item while it is in storage is treated as a holding gain or loss, as illustrated in the following example.

6A.4.   Suppose a wholesaler buys and sells 100 packets of washing powder every period and in order to allow for marginal variations in demand keeps an inventory of 10. At the beginning of a period the cost per packet is 1, so the value of his inventories is 10. During the period the price increases to 1.05. Although these ten packets can be sold for 10.5, the increase of 0.5 is not production but simply a holding gain. When the wholesaler withdraws them for sale he must replace them with another 10 now costing 10.5. Thus the 0.5 increase is eliminated from measures of production and appears only in the revaluation account explaining how the initial stock of 10 increases to 10.5 by the end of the period.

B.   Goods whose real value changes over time

6A.5.   There are three specific cases where the treatment described above is unsatisfactory because the other factors intervene in the time while the goods are held in storage. Goods where this is the case are described as type II products. The three specific circumstances are the following:

1. Goods that have a very long production process;

2. Goods that change their physical characteristics while in inventories;

3. Goods that have seasonal patterns of supply or demand but not both.

Each of these is discussed in turn below

1. Goods with a long production period

6A.6.   When a product is held in inventories for an extended period of time because of the length of the production process, in principle discount factors should be used when calculating the value of work put in place each period before the delivery date. For example, if a construction project ultimately worth 200 is put in place steadily over four years, it is unrealistic to count 50 as the contribution to production in the first year. Any purchaser would take account of the fact that he would not be able to realise the value of this production for another three years and discount the value accordingly. As time passes, there is income arising to the unit holding the products as the discount factor unwinds. This case is described in chapter 20, with the full numerical example.

6A.7.   It is suggested that in practice it is only necessary to make an allowance for the discount factor for goods of a significantly high value and significantly long production process, where goods are recorded as work-in-progress or capital work done on own account for many periods before completion.

2. Goods whose physical characteristics change

6A.8.   The second set of circumstances relates to goods whose physical characteristics change during storage because maturing is part of the production process. Examples are fermentation affecting food products and the ageing of wine and spirits. When the product is withdrawn from storage, it is physically different from a new item entering the maturing phase and so it is not appropriate to use the cost of the new entry into inventories as the value of the product being withdrawn. The question is how to separate the increase in value due to maturing from the overall price increases of the goods concerned.

6A.9.   Suppose a product takes three years to reach a sufficient maturity to be sold and there is final demand for the product until it reaches this state. If the good is traded, even in its immature state, then prices will exist for the immature, newly manufactured product, for the one year old product, the two year old product and the mature product. Supposing the product is well-established, at any point in time there will be a mix of newly manufactured items and those of maturities of one, two and three years. If prices exist for these different maturities, separating the value of storage is not difficult. In the first year the new product is transformed into a product of one year's maturity. The increase in price is due to two factors, the increase in the price of the new product made last year to the price of a similar new product made this year and the difference between the price of a similar new product made this year and the price of the one year mature product this year. The first difference is a holding gain; the second is the value of storage. As with type I products, there will be some intermediate and other costs associated with storage, so the value added from storage will be less than the full value of storage output, but this is the normal way a production account is formulated. In the second year the increase in price between the one year mature product at the beginning of the year and the price of a one year mature product at the end of the year is a holding gain and the difference in price between a one year mature product at the end of the year and the two year mature product made two years ago is the value of storage, and so on.

6A.10.   In this perfect information scenario, the nominal holding gain is eliminated from the increase in price by means of an observed price index specific to the product at different stages of its maturity. All the remaining price increase is attributed to the production of storage. The nominal holding gain can be separated into a real holding gain and a neutral holding gain using a general measure of price change.

6A.11.   In practice it is very likely that robust time series of prices at different points in the maturing process do not exist. It is possible that some close equivalent might be available but even this is not very likely. How should storage be separated from holding gains in the absence these prices?

6A.12.   The producer, from long experience, expects that the price after three years will be, say two and a half times the cost of producing the new product. If the new product is worth 100, the three year old, mature, product is worth 250. This suggests that storage production is 50 in each of the next three years. Like the long construction product discussed above, a discount factor should be applied to the initial 100 and the first two tranches of 50 because the product is not ready for sale until the end of the third year. Further, the expectation of the price increase from 100 to 250 is in real terms, and takes no account of the general rate of inflation. This leads to the recommendation that, when more precise estimates are not available, storage may be estimated as the expected real holding gain over a given period.

6A.13.   Suppose that in the event the real price of the mature product in a given year is not 250 but is 256 or 243. In this case, the difference between the expected real price increase and the actual real price increase is treated as a real holding gain (of 6 in the first instance) or loss (7 in the second case). As compared with the perfect information situation, the neutral holding gain is eliminated from the price increase and the remaining increase is partitioned between the expected part, treated as output of storage, and the unexpected part, treated as real holding gains.

6A.14. It is not ideal that the output of storage is assumed to be invariant to fluctuations in relative prices, but in circumstances where most of the price increase will be expected and better basic data are not available, this approach gives a pragmatic estimate of storage that is superior to the assumption that the whole of the price increase is simply a holding gain.

3. Goods with seasonal patterns of supply and demand

6A.15. The third case where there is a change in value that is not attributable solely to holding gains and losses is when goods are placed in storage to take advantage of changes in the pattern of supply and demand over a year. The most common case is storage of a staple crop, such as maize, where there is a relatively short harvest period but demand is fairly constant throughout the year, with the consequence that the price rises as inventories decrease until the next harvest when an increase in supply causes the price to fall again. It is possible to envisage the opposite case where demand is seasonal but it is cost effective for producers to produce the good for the whole, or most, of the year, even though for much of that time the production goes straight into inventories and stays there until demand peaks.

6A.16. The reason that this type of product is different from a type I product is that, as with the goods that change characteristics due to maturing, the producer has an incentive to hold the item in inventories because the price increases, relative to the general level of inflation, in a more or less predictable way. This is a quite different motivation from holding items in store for purely speculative reasons when there is no pattern established for the probable increase in prices and no predetermined time over which the goods might be held.

6A.17. The ideal situation is one where there are well established prices for the product on a monthly or quarterly basis and it is possible to establish robust seasonal patterns for the expected price changes. In such a case, the seasonal pattern of the prices can be used to establish the output of storage and nominal holding gains can be determined residually as the difference between the observed prices and ones determined by the seasonal pattern.

6A.18. However, given that the total level of a harvest can be quite different year on year and the actual time of harvest may vary slightly from year to year depending on climatic conditions, establishing robust seasonal factors may not be easy. In such a case, the pragmatic suggestion is to first eliminate neutral holding gains by the use of the general price index. Then storage is estimated using the expected increase in seasonal price. Even in the absence of robust seasonally adjusted price indices, past experience and judgement informed by the ratio of prices throughout the year relative to the price at harvest time over a number of years, an estimate of expected price increases over the year can be made and attributed to the output of storage. The remaining price increase is treated as a real holding gain or loss.

4. Who produces storage?

6A.19. The fact that type II products give rise to production of storage depends only on the type of product, not on the producer. If a farmer produces a seasonal crop and then stores most of it to sell bit by bit throughout the year, he produces storage. However, if he sells all of his crop at harvest time to another unit and that unit puts it in inventories and sells it continuously throughout the year, that unit produces the storage that would otherwise have been produced by the farmer. However many times a type II good changes hands between its production and sale, the value of storage will be the same. It is likely that every time it changes hands, the associated intermediate consumption will increase so that value added will decrease but the level of output will not be affected.

5. When is storage produced?

6A.20. Storage is produced on a continuous basis. In order to have an articulated set of information on production and inventories, storage must be calculated period by period. If the goods that are changing value remain in inventories, the owner of the goods has production equal to the value of storage and this value is treated as an increase in inventories. Even though the quantity of the inventories may not change, the quality-adjusted measures do change to reflect the increase in price not treated as a holding gain.

6. Some examples

6A.21. These simple examples show how the approximate approach to calculating storage works under different assumptions.

Example 1:

6A.22. A purchases goods to the value of 100 in year 1 expecting them to rise in value to 110 by the middle of year 2. At the end of the year the value of the goods is 108. There is no general inflation in the period.

6A.23. In year 1, A records output of 8 and acquisition of inventories of 108 in total. In year 2, A records output of 2, acquisition of inventories of 2 and sales of inventories of 110.

Example 2:

6A.24. The goods bought in example 1 increase in line with inflation so that they are worth 115 by the end of year 1 and 120 on disposal.

6A.25. The recordings in year 1 are complemented by holding gains of 7 in year 1. At the end of year 1, it is necessary to re-estimate the expected price level on disposal. If this is estimated to be 117, showing the same absolute increase as previously expected, for example, then a holding gain of 3 will be recorded in year 2.

Example 3:

6A.26. The goods in example 1 are sold to B for ~~for~~ 105 part way through the year. B then holds the goods until selling them at the same point in time in year 2 for 110.

6A.27. In year 1, A has output of 5 and acquisition of inventories of 105. A withdraws inventories of 105 and sells them to B. B has output in year 1 of 3, which is recorded as an increase in inventories. B's total increase in inventories in year 1 is thus 108. In year 2 B has output of 2, and increase in inventories of 2 and sales from inventories of 110.