X Work-in-Progress

A. Introduction

10.1. Work-in-progress concerns production that goes beyond one period. Measurement of such production poses the problem that a single process has to be split into separate periods. Because of the shorter accounting period, these difficulties are relatively more significant for quarterly national accounts (QNA) than for annual national accounts (ANA).

10.2. The general national accounting principle is that production should be measured at the time it takes place and be valued at the prices of that time. In most cases, this treatment presents no problems, because the production process is short and thus output can be measured from the value of the finished product. When the production process transcends a single accounting period, however, production needs to be shown in two or more periods. This production results in output of unfinished products, which is called work-in-progress in both business and national accounting. As stated in the *1993 SNA*, "it would distort economic reality to treat output as if it were all produced at the moment of time when the process of production happens to terminate" (paragraph 6.39). Also, where prices have changed during the production process, the price paid at the end will include holding gains (or possibly losses) that need to be excluded in order to have a correct measure of production.

10.3. There are many activities in which production cycles go outside a single period. Even with very short processes, there can be work-in-progress. Some activities have quite long production cycles and so work-in-progress is particularly important. These activities include the following:

- Agriculture, animal husbandry, forestry, and fishing. In agriculture, crops may grow over several seasons. Similarly, growing livestock, cultivating timber, cultivating fruit, viticulture, and fish farming are all cases where production occurs over more than one period before the final output is marketed. Also, wool is usually collected only once a year.
- Manufacturing. Ships, submarines, airplanes, and some heavy equipment have long production cycles.
- Construction. The production cycle is often quite lengthy, varying from a few months for a house to many years in the case of a civil engineering project.
- Services. Examples in this category are movies, architectural services, and large sport events.

10.4. This chapter first explores the general reasons why work on unfinished products is considered output. Subsequently, the principles of measurement and some practical solutions are discussed. Briefly, the solution for measuring of work-in-progress is to use output measures based on quarterly input costs in conjunction with values or markups for the whole process. Where such costs are not available, proxies such as fixed proportions can be used.[1]

10.5. Recording work-in-progress poses special difficulties for agriculture and related industries because of the uncertainties intrinsic to the dependence of the production process on forces of nature and because of the volatility of prices. Also, because the concept of work-in-progress is not generally applied in these industries, its application in national accounts is exposed to criticism denouncing it as artificial.[2] It has been suggested that most of the problems involved in applying work-in-progress concepts to agriculture could be solved through the application of seasonal

[1] As well as its direct effect on measuring output, work-in-progress also has consequential effects on income accounts, capital accounts, and balance sheets. These effects are discussed in the annex.

[2] Although examples can be mentioned in which prices do reflect the value of work-in-progress. One such example is keeping sheep for wool, where the price of sheep reflects the harvestable amount of wool (prices plunge immediately after harvesting).

adjustment, but it should be emphasized that recording work-in-progress and seasonal adjustments are unrelated issues and that recording work-in-progress affects the unadjusted estimates. These issues are discussed in Section D.

10.6. Inclusion of work-in-progress affects many components of the accounts, but in a consistent way, so that it does not create discrepancies. In addition to the effect on output, there is an equal effect on operating surplus/mixed income and other income aggregates. On the expenditure side, output in the form of work on unfinished products is classified either as fixed capital formation or as changes in inventories of work-in-progress. It is part of fixed capital formation if it consists of construction work done on contract and put in place in stages or if it consists of capital goods produced on own account by their eventual final user. In all other cases, including speculative construction (that is, without a contract and not for own final use) and most agricultural production, work-in-progress is included in changes in inventories. Financial transactions are unaffected, except in the case of construction work on contract, because resulting changes in estimates on saving are fully absorbed in the estimates on fixed capital formation or changes in inventories for the same institutional unit. In the case of production of a capital good under contract, however, the full effect on savings for the producer will be carried over to the financial account in the form of payments received from installments and other accounts receivable accrued.

10.7. Proper recording of work-in-progress has the added advantage of removing production-related holding gains and losses from the estimates, which should also be done in ANA. The potential danger of leaving holding gains and losses in the estimates can be large, especially if inflation is substantial. If production processes do not exceed the accounting period for the ANA, the holding gains and losses involved in work-in-progress risk being ignored in the compilation of these accounts. An important message to the compilers of ANA is that they should also remove holding gains and losses from their estimates on subannual production processes, not only to ensure consistency between ANA and QNA, but also to achieve correct ANA estimates.

B. Why Should Work-in-Progress Be Treated as Output?

10.8. Production is "an *activity* in which an enterprise uses inputs to produce outputs" (*1993 SNA* paragraph 6.6, italics added). Thus, production is a process that leads to a distinct product, but the recording of inputs and outputs in the accounts is not determined by the time that the finished product becomes available for use. Paragraph 6.39 of the *1993 SNA* explains this further as follows:

> For simplicity, the output of most goods or services is usually recorded when their production is finished. However, when it takes a long time to produce a unit of output, it becomes necessary to recognize that output is being produced continuously and to record it as work-in-progress.

10.9. While it is useful to emphasize that production is a process rather than the resulting product, the definitions are circular to the extent that the recognition and measurement of production depend on the meaning of output. In the *1993 SNA*, output does not mean finished products but can be any goods or services that "can be sold on markets or at least be capable of being provided by one unit to another ..." (*1993 SNA* paragraph 1.20). For instance, an unfinished construction project or a crop growing in the field both have the quality of having value that can, at least potentially, be provided to another unit, and, hence, output can be recognized and measured.

10.10. In the absence of recognition of work on unfinished products as output, inputs would appear in different periods from the corresponding output. As a result, value added could be negative in some periods and disproportionally large in other periods. Thus, the meaning of value added for the affected periods would be open for debate.[3]

10.11. An objection is sometimes made that recording work on unfinished products as output brings intransparency to the accounts. That is, it involves unnecessary complexity and artificiality and distorts the view of income generation and saving, because output does not generate money inflows before it is sold. Two arguments counter this view. First, transactions in the national accounts need not necessarily involve actual money flows; well-known examples are barter transactions and wages in kind. Second, one could also argue

[3]Note that negative value added can legitimately occur (where no marketable product appears at the end—for instance, an internal research project that failed—or where the marketable product is small in relation to inputs—for instance, the start-up phase of a business or other loss-making situations). However, it is not desirable that negative value added appears simply because of failure to recognize that a productive process was occurring.

that disregard of work-in-progress results in artificiality because outlays on production would show up without any apparent link to output.

10.12. It is sometimes suggested that recording work-in-progress is relevant on the level of individual units, but for the total economy, or even specific industries, aggregation would cancel out the effects of not recording work-in-progress. This would only apply in the situation of very stable period-to-period production processes, however, which is highly unlikely to reflect real conditions, particularly in the context of QNA.

C. Measurement of Work-in-Progress

1. Economic Concepts

10.13. The starting point for the theoretical and practical issues in measurement of production is economic theory. The general principle of valuation in economics is use of the transaction price. In a very few cases, an incomplete project may be marketed, such as when an unfinished building project or a farm with crops in the field changes hands. It is far more common, however, that products are not sold until finished, so transaction prices are not available for the unfinished product. It is, therefore, necessary to adopt a convention to value the production in each period.

10.14. The usual principle to value an item when there is no transaction is the market-equivalent price. The market equivalent is what buyers would be prepared to pay if they wished to obtain the unfinished product or what suppliers would need to be paid to produce it. This value is equivalent to the total input costs for each period plus a markup. Because there is no separate markup for each quarter, the markup must be the ratio of output to costs for the whole production cycle. In other words, the net operating surplus is estimated as earned over the production cycle in proportion to costs in each period.

10.15. In the rest of this section, the application of the convention of valuing work-in-progress carried out in a certain quarter as input costs plus a markup is discussed in a business and national accounting context. The section also discusses methods to use when data are incomplete and how to account for the effects of changes in prices during the production period.

2. Business Accounting Treatment of Work-in-Progress

10.16. Business accountants face the same problem of splitting incomplete production cycles into accounting periods. Estimation of the value of work put in place is part of an accrual accounting system. Businesses seeking to measure their own performance need to value the work put in place to match output with expenses and avoid lumpiness in their accounts. In the absence of observable prices, business accounts must also depend on input costs, with or without some markup.

10.17. However, there are two areas of difference between business accounting practice and economic concepts. First, business measures of income do not distinguish between holding gains and production, whereas this difference is fundamental in economic analysis. Second, because of the doctrine of prudence in business accounting, work may be valued at less than the expected price (i.e., without a markup or with an underestimated markup), so that profits are not counted fully or at all until they are realized. This delay in recognition of profits causes lumpiness at the completion of the work, but time-series consistency is less important to business accounting.

10.18. There are three alternative arrangements for work on products with long production cycles:
- own final use,
- contract, and
- speculative basis (i.e., the final client is not known).

10.19. For work for own final use, the producer is the final user; for example, an electricity company builds its own generating plant or distribution network. In this situation, there is no transaction price, even on completion. Accordingly, output is measured by the enterprise itself, ideally at a market-equivalent price or, more typically, on the basis of input costs, including capital costs and overhead. If measured from costs, the data are already recorded on an ongoing basis by the producer, and there is no more difficulty in measuring production in each period than there is in measuring the total project.

10.20. For contract work, there are different possible payment arrangements. A price may be fixed in advance or variable; or paid by installments or at the end of the job. Progress payments are installments that relate to the amount of work done. To the extent that progress payments closely match work done, they already measure output on an ongoing basis.

However, if payments are infrequent, delayed, or have a substantial bonus component at the end, they give a misleading time series, and a cost-based measure would provide a better measure of production.

10.21. For work done on a speculative basis, there are no ongoing receipts, and usually the final value of the product is unknown until after completion. This situation is common in manufacturing and construction. In addition, many agricultural products resemble speculative manufacturing or construction in that there is no sale or identified buyer until after the product is completed. In contrast to manufacturing and construction, however, estimates of work-in-progress are not normally made by farmers in their own accounts.

10.22. Measures of work-in-progress are often available, particularly from larger and more sophisticated producers. Such estimates have the advantage that the data are transparent and estimation is done at a detailed level with specific information. However, such data are not automatically suitable. For example, progress payments or installments may not match work done because of long lags or because there is a large component of bonus for the completion of the job. Or it may also be too costly to collect business data quarterly, for example, if building work is done by many small operators who are reluctant to complete statistical questionnaires. Or the quarterly data may be too lumpy if the profit is only included at the time of sale. In these circumstances, it is necessary to derive estimates for national accounts by making adjustments to business estimates.

3. Measurement in a National Accounts Context

10.23. The *1993 SNA*'s recommendations on the valuation of incomplete products follow from the economic concepts discussed in Subsection 1 of this section and are partly compatible with the business practices discussed in Subsection 2. The *1993 SNA* recommends following the businesses' own estimates if they approximate production, mentioning progress payments on a contract (paragraph 6.74) and capital goods for own final use (paragraph 6.85). When no acceptable quarterly output data are available from businesses, the *1993 SNA* principle is to measure production of incomplete products from costs for each period, raised by a markup that relates to the whole production cycle. The *1993 SNA* considers two situations for markup data: whether an estimate of the value of the finished product is available (paragraph 6.77) or not (paragraph 6.78).

10.24. Changes in prices during the production cycle affect the measurement of production. When prices are changing, the eventual value at the time of completion will differ from the sum of the value of work-in-progress carried out in the production quarters, because the prices of that kind of product have changed between the time of production and the time of completion. The difference represents holding gains or losses. In order to measure production, price changes between the time of production and the time of sale must be removed from selling prices. These problems can be avoided by compiling constant price estimates first (to put all the flows on a consistent basis) and subsequently deriving the current price estimates on the basis of the constant price estimates. (This deflate-then-reflate method is found in related areas of inventory valuation and capital stock measurement where valuation also includes prices from different periods.)

10.25. The measure of input costs should be as complete as possible. The input costs should include compensation of employees, intermediate consumption, taxes on production, and costs of using land and capital (rent, consumption of fixed capital, and interest). In cases where owners and unpaid family members are an important source of labor, it is desirable to derive a value for these inputs as well. In practice, the data on costs may be incomplete, and so the markup needs to be adjusted accordingly. Obviously, parts of these input costs are part of value added (for instance, compensation of employees) and some are included in operating surplus/mixed income (for instance rent and interest). This does not preclude them, however, from being costs of production that must be taken into account when estimating output from the cost side.

10.26. Allocation of output on the basis of costs does not always apply in full. From the rationale for work-in-progress—namely, allocating output to periods in which production is occurring—it logically follows that no output should be allocated to periods in which there is no ongoing production process, even if there are ongoing costs. This applies in particular to the cost of using land and capital, which may not correspond to the actual production process. For instance, interest on a loan financing a piece of equipment accrues over the period of the loan, no matter whether the equipment is used. An example of a situation in which this may apply is agriculture, where production may stop completely during certain periods. Food-processing

Example 10.1. Ex Post Estimation of Work-in-Progress with
(a) Total Value of Project
(b) Quarterly Costs

Objectives of example:
(a) To illustrate the allocation of a total on the basis of costs.
(b) To illustrate the inclusion of holding gains in the total value.

Consider a speculative construction project taking place between January and December 1999. It is completed and sold at the end of December 1999 for 5800. The objective is to produce output estimates for each quarter and exclude holding gains from the output estimates. A high rate of price increases is assumed in order to highlight the effect of holding gains.

Primary Data

	q1 1999	q2 1999	q3 1999	q4 1999	q1 2000
Output/input price index (average 1998 = 100)	110.0	120.0	130.0	140.0	150.0
Production costs at current prices:					
Intermediate consumption	160	340	530	300	
+ Compensation of employees	300	310	340	400	
+ User-costs for use of land and capital, etc.	200	250	300	350	
=Total production costs at current prices	660	900	1170	1050	

To simplify the calculations, the same price index is used for inputs and outputs; in principle, separate price measures should be used.

Step 1. Derive value of the project at average 1998 prices

Deflator value at the end of q4 1999	1/2(q4 1999 +q1 2000) =145.0
Value at average 1998 prices	5800/1.45=4000

The value of the project at average 1998 prices is estimated by deflating the sales value with a price deflator that reflects changes in prices of similar projects from average 1998 to the end of q4 1999. The price index given measures the average price level in each period of similar construction products relative to their average price in 1998. Assuming a smooth change in prices over time, the deflator value at the end of q4 1999 can be estimated as approximately (140+150)/2=145.

industries that are dependent on harvests coming in are also an example. In these cases, it is important to clearly define the production periods (for instance, in Nordic climates the agricultural production periods may include fall when land preparation takes place, exclude winter when no activities take place, and commence again in spring with seeding, fertilizing, etc.).

10.27. Example 10.1 brings together the measurement issues discussed so far. It covers an ex post situation, that is, after the completion of the product when the final price is known. Data on input costs are also available. In the example, the final price and cost data are used to derive a markup ratio for the whole project. The example shows the derivation of output estimates and, from that, the calculation of holding gains.[4]

[4]This example is designed to show concepts and may not be realistic from the point of view of data availability.

10.28. From the example, it is important to note that holding gains are excluded from production measures. Hence, the output is 5040 in the example, not 5800. A substantial rate of price increases is assumed, so the holding gains are quite large in the example. It should also be noted that the cost/markup ratio is derived at constant prices (i.e., 4000/3000) and not at transaction prices (i.e., 5800/3780), because the latter include holding gains. It is also worth noting that the quarterly estimates of output, by definition, follow the same quarterly pattern as the costs. It can be seen that the recognition of work-in-progress results in a less lumpy series for output. It is not a substitute for seasonal adjustment or calculation of a trend-cycle series, however, because the series will still be subject to any seasonality or irregularity in the cost series.

10.29. Having established the general principles of measurement, we will now consider some of the permutations arising from different data situations. The situations covered include deriving the markup when

Example 10.1 *(continued)*

Step 2. Derive costs at constant prices

	q1 1999	q2 1999	q3 1999	q4 1999	Total
Production costs at 1998 prices	600	750	900	750	3000

In step 2, input estimates at constant prices are derived by deflating the current price values.

Step 3. Derive the output/cost ratio

Output to cost ratio at average 1998 prices—the markup ratio—(1.333) is derived as the value of the project (4000)/total costs (3000). The output/cost markup ratio is calculated for the project. It has to be derived at constant prices to exclude holding gains.

Step 4. Derive output at constant and current prices

	q1 1999	q2 1999	q3 1999	q4 1999	Total
Output at average 1998 prices	800	1000	1200	1000	4000
Output at current prices	880	1200	1560	1400	5040

Quarterly output at 1998 prices is derived by raising the value of costs at 1998 prices by the output/cost ratio. Quarterly output at current prices is derived by reflating the estimates of output at 1998 prices.

Step 5. Derive value of the stock of work-in-progress at current prices

	Value of work put in place current prices	Holding gains in subsequent quarters				Value at time of sale
		q1 1999	q2 1999	q3 1999	q4 1999	Dec . 1999
q1 1999	880	40	80	80	80	1,160
q2 1999	1,200		50	100	100	1,450
q3 1999	1,560			60	120	1,740
q4 1999	1,400				50	1,450
Total	5,040	40	130	240	350	5,800
		<----------760 ---------->				

The derivation of holding gains is shown in this step. In this example, the output price index shows that the prices of similar construction projects increased continuously during 1999. Thus, the prices are higher at the end of each quarter than in the beginning or middle of the quarter. As a result, the total cumulated value of work put in place (5040) differs from the project sales value (5800), because prices have risen between the time of construction and time of sale; that is, the sales price includes both output and holding gains.

For example, the work put in place in q1 is worth 800 at 1998 prices, but 880 at average q1 prices (i.e., 800•1.1); 920 at the end of q1 (i.e., 800•(1.1+1.2)/2); 1000 at the end of q2 (i.e., 800•(1.2+1.3)/2); 1080 at the end of q3 (i.e., 800•(1.3+1.4)/2); and 1160 at the end of q4 (i.e., 800•(1.4+1.5)/2).

there are (a) other payment times; (b) quantities available but not values; and (c) forecasts available instead of actual prices for the final product. When markups for a particular period are not available, other sources of markups are considered. Where cost data are not available, the use of a cost profile is proposed.

10.30. In some cases, payment is not made at the completion of the product. It may be made at the beginning of work or in several installments. An advance payment reflects prices of the beginning of the period. If the price is paid in installments, such as progress payments for construction work, the payments are from several different periods and, hence, different price levels. In each case, by converting the payments to constant prices (using the price index of the time of payment), the measurement can be put on a consistent basis, and the calculations can be made accordingly. (As discussed earlier in this section, if progress payments closely match production costs and timing, they should be used directly to estimate output.)

10.31. In some cases, the data available on the final product are in quantity terms, for instance, a house measured in square meters or a crop in tons. The principles of measurement are the same as in Example 10.1, except that the constant price values are derived by multiplying the volume measure by a price per unit in the base year. Current price values can be derived by multiplying the volume measure by a price per unit in the current period. In the case of some crops, there are special problems in measuring prices in periods between harvests; these issues are discussed in Section D of this chapter.

10.32. Forecasts may need to be used for incomplete work if the value of the final product is not yet known. While national accountants do not normally use forecasts, unfinished production may require forecasts, and such forecasts are often available. For example, builders often forecast a value of a project at the time of seeking building approval. Also, in many countries the ministry of agriculture (or another government agency)

Example 10.2. Ex Ante Estimation of Work-in-Progress with (a) Quarterly Costs (b) Markup Ratio

Objective of example: To illustrate the calculation of work on the basis of costs and markup.

Primary Data

	q1 1999	q2 1999	q3 1999	q4 1999
Output/input price index (average 1998 = 100)	110.0	120.0	..	..
Production costs at current prices	660	900	..	..
(wages and salaries, raw materials, etc.)			..	..
Industry standard average markup over costs, 33.3% after excluding holding gains		1.333 (in ratio form)		

Step 1. Derive output at current and constant prices

	q1 1999	q2 1999	q3 1999	q4 1999
Production costs at average 1998 prices	600	750	..	..
Output at average 1998 prices	800	1,000	..	..
Output at current prices	880	1,200	..	..

The data are the same as for the first two quarters in Example 10.1.
Production costs at constant prices are derived by deflating the current price value (e.g., for 1999 q1, 660/110*100).
Output at average 1998 prices is derived by multiplying the production costs at 1998 prices by the markup ratio (e.g., for 1999 q1, 600*1.333=800).
Output at current prices is derived by reflating the constant price value (e.g., for 1999 q1, 800*110/100).

makes crop forecasts based on an estimate of the output of a certain crop. (These usually are in volume terms, but sometimes also in value terms.) These crop estimates are typically based on an estimate of the acreage under cultivation combined with yield estimates. Estimates of acreage under cultivation could be based on surveys or on aerial and satellite photography; yield estimates could be based on average crop yields and revised on the basis of expert views and trends. It may be surmised that in many agricultural countries, this kind of information is available. In some cases, it may be necessary for the national accounts compilers to make forecasts themselves. While forecast values differ in being more uncertain and more subject to revision, the method for calculation of quarterly output is the same as the ex post situation. Of course, when actual data become available, the data should be revised and the difference between the forecast and actual value assessed for accuracy and signs of bias.

10.33. When there is no actual or forecast estimate of the finished value, the *1993 SNA* recommends estimation of output on the basis of costs plus an estimate of a markup from another source. The *1993 SNA* does not elaborate how this markup is to be derived; possible sources are studies on standard margins used in a particular industry, a previous year's data, or comparable recently completed projects. Example 10.2 demonstrates how such methods could work in practice.

10.34. The concept and measurement of quarterly production are the same in Examples 10.1 and 10.2. Only the source of the markup ratio is different; in Example 10.1, a markup ratio for the particular project is derived in steps 1 to 3; in Example 10.2, it is taken from previous data. The estimates made ex ante, as in Example 10.2, would need to be revised when actual prices and volumes became available.[5] The technique shown in Example 10.1 could then be used, so that the markup ratio assumed in advance could be replaced by the actual one. If markup ratios vary substantially from year to year, as is often the case for agriculture, the revisions may be quite large. This danger looms large in situations in which output depends on exogenous factors, as is the case for agriculture and related industries (for instance, if a locust plague necessitates an extraordinary use of pesticides for a certain crop). In such cases, a markup based on a forecast of the annual crop should be preferred to markups based on previous data.

10.35. Another common data situation is that quarterly cost data are unavailable; in that case, a cost profile can be used instead. Actual data on input costs may not be available because of collection costs or because businesses do not keep separate records of costs for each project. An alternative in

[5]In some cases, such as the production of movies, no actual market price is available at the end of the production process, and the value has to be derived through an estimate of discounted future receipts.

such situations is to make an estimate for each quarter's share of total costs, that is, a cost profile. It could be based on statistical observations on input intensities in recent periods or on expert views. Statistical observations could be obtained through small-scale surveys, because cost patterns in industries of concern are often fairly standard between units and also fairly stable. For instance, in agriculture the cost pattern is strongly dependent on the growth phases of crops, and in construction the pace of production is strongly dictated by an inherent sequence of activities. If a production process is strongly dictated by physical or biological factors, expert opinions may suffice to establish a cost profile. If stable, the same profile could be used for all periods. If all of this is not available, a very simple production profile, such as an equal distribution over time, could be used as a default. The cost profile should be calculated from the constant price data on production costs.

10.36. Use of a cost/production profile is shown in Example 10.3. A cost profile is derived from the data in Example 10.1—the production cycle lasts four quarters, with 20 percent in q1 (i.e., 600/3000), 25 percent in q2, 30 percent in q3, and 25 percent in q4. By definition, the cost profile has the same pattern as the resulting production estimate at constant prices.

10.37. The cost profile method is often used for construction in conjunction with data on building permits. In cases where only volume indicators such as square meters are available, the values are derived by average prices per unit obtained from a benchmark survey or expert assessment. If value data are available, the value concept needs to be identified—current prices or forecast end-of-period prices. The cost profile should take into account the lags between approval, commencement, and completion. It may also account for low work periods such as monsoons and holiday/vacation periods. The expected value should be adjusted for projects that are approved but not implemented. Also, it might be desirable to estimate work-in-progress on individual large projects on a case-by-case basis; compilers of source statistics might be best placed to do this.

Example 10.3. Estimation of Work-in-Progress with
(a) Estimate of Output Quantities
(b) Cost Profile

Consider a crop that takes four quarters to grow, from preparation of the cultivation area beginning in the first quarter of 1999 to harvesting in the fourth quarter of 1999.

Primary Data

	q1 1999	q2 1999	q3 1999	q4 1999	q1 2000
Output price index (average 1998 = 100)	110.00	112.00	114.00	116.00	118.00
Cost profile	0.20	0.25	0.30	0.25	

Total estimated crop	1000 tons
Average value per ton for similar crops in 1998	5.0

Step 1. Derive total output at constant prices

Value at average 1998 prices **1000*5.0=5000**

Step 2. Derive quarterly output at current and constant prices

	q1 1999	q2 1999	q3 1999	q4 1999	Total
Output at average 1998 prices	1,000	1,250	1,500	1,250	5,000
Output at current prices	1,100	1,400	1,710	1,450	5,660

First, the value of the crop at average 1998 prices is estimated by multiplying the physical data on the volume of the crop by the obtained data on average value per ton in 1998, that is, 1000• 5 = 5000.

Second, output estimates at constant prices are derived by distributing the estimated value of the crop at average 1998 prices over the quarters in proportion to the assumed production intensity. For instance, the constant price estimate for q1 1999 is derived as 0.2• 5000 = 1000.

Third, output estimates at current prices are derived by inflating with the output price index. For instance, the estimate for q1 1999 is derived as 1000• 1.1 = 1100.

Note that the harvest value (at end-of-production prices) could be derived as 1000• 5• (1.16+1.18)/2=5850. The difference between the harvest value and the estimate of output at current prices is holding gains (5850–5660 = 190). (One of the difficulties surrounding the inclusion of agricultural work-in-progress is that output differs from harvest value, which may seem counterintuitive to many users.)

D. Special Issues for Agriculture

10.38. The general principles of recording production on an ongoing basis also apply to agriculture. Usually, it would be feasible to use one of the methods discussed in the previous section, typically a cost profile in conjunction with actual totals (for previous years) or forecasts (for the current year).

10.39. However, the degree of uncertainty about the eventual output makes the treatment somewhat more problematic for agriculture and related industries, both for practical and conceptual reasons. This has caused many countries not to apply the work-in-progress concepts in the case of agriculture. While supporting the allocation of agricultural output to nonharvest periods in principle, the *1993 SNA* recognizes the specific problems involved. It states the following in paragraph 6.100:

> There may be circumstances in which the uncertainties attached to the estimation of the value of work-in-progress in advance of the harvest are so great that no useful analytical or policy purpose is served by compiling such estimates.

10.40. Weather is obviously the major component of uncertainty in agriculture. There are variations in temperature, rainfall, and sunlight, with droughts, hurricanes, and floods being the extremes. Also, in some cases, insect or other animal plagues may be important. The degree of uncertainty varies significantly among countries.

10.41. One aspect of uncertainty is that estimates made before the harvest need to be based on forecasts. This is particularly the case in the QNA, where the emphasis on timeliness implies that the estimates for preharvest quarters will have to be made well in advance of harvest time. If the value is uncertain, there are concerns about potentially large revisions in the national accounts.

10.42. Another aspect of uncertainty concerns catastrophic events. The treatment of output losses in the national accounts is quite different between normal events and catastrophes. For normal events, the losses are reflected in reduced output because only the output that materialized is recorded. For catastrophes, output is measured as if nothing happened and the losses are recorded on the other changes in volume of assets account. Recording a crop that never materialized in output because it was hit by a catastrophe is counterintuitive.

10.43. The *1993 SNA* restricts catastrophic events to singular events of a general nature, for example, major earthquakes, volcanic eruptions, tidal waves, exceptionally severe hurricanes, drought, and other natural disasters (paragraph 12.36). Limitation of catastrophic events to singular events of a general nature means, among other things, that losses of crops through frequent floods and droughts should not be regarded as catastrophic losses, no matter how devastating they are for crops under cultivation. The *1993 SNA*'s definition of catastrophic events leaves room for interpretation, however, which may hamper international comparability.

10.44. A further aspect of uncertainty concerns the prices to assign production in nonharvest periods. This issue of price uncertainty arises in both ex post and, even more, ex ante data. There may be no or only a very limited market for crops in the nonharvest periods, so that the prices are more uncertain and have to be extrapolated (ex ante) or interpolated (ex post). The prices of crops[6] in nonharvest periods may be available but may be misleading to the extent that they also include storage and holding costs or the off-season scarcity of fresh produce. In such cases, the observed prices would not be relevant for valuing the harvest. As a solution, some downward adjustment based on past years' off-season patterns may be derived, or the observed prices could be replaced by interpolation or extrapolation of harvest prices. In addition, prices of subsequent years' crops may be quite unrelated, so estimation of the work-in-progress on the new harvest with prices of the old may be misleading. The supply-and-demand situation often differs considerably among crops, so that the prices may be completely different. For instance, if an abundant crop is followed by a meager one, the price of the second crop at harvest time may jump compared with the price of the first crop. Obviously, in such a case, the current price estimates need to be revised, but the price development of the first crop is not valid for the revision of the quarterly estimates. A relatively simple solution to this problem would be to derive new indices relevant for the production quarters of the new crop by an interpolation between the price of the previous crop at harvest time and the price of the present crop at harvest time.

[6]If no local prices are available, world-market prices could be considered; however, these prices may not be indicative for local supply in a particular country.

10.45. Consideration of behavioral aspects is relevant to the inclusion of agricultural work-in-progress in national accounts estimates. If the economic agents themselves react to the uncertainty of prices and volumes by behaving as if the work-in-progress carried out were not output (and thus not generating income), then the estimates will not help in understanding economic developments. For instance, the imputations needed to record subsistence farming may impede the usefulness of QNA data for monetary policies.[7]

10.46. By measuring production before the producers do, statisticians may be exposed to the accusation of counting the chickens before they hatch. Unlike many other producers, farmers do not normally record their own work-in-progress. One singular aspect of this would be the imputation of income flows before they are realized, and possibly even in cases in which they are not realized. As a result, the concerns about artificiality and complexity of methods made in the Section B of this chapter are particularly strong in the case of agriculture. For that reason, in the case of agriculture, recording production simply as the harvest value may be considered.[8]

10.47. Whether a harvest or work-in-progress approach is used for agriculture, the resulting output series will often be lumpy. In the case of the harvest approach, the output will often be concentrated in one or two quarters while the others may have little or no output. In the case of the work-in-progress approach, discontinuities will occur between crop years, effectively because of the change in the output/cost markup ratio. With either approach, the lumpiness is the valid and necessary result of the production concept adopted in conjunction with the intrinsic limitations of presenting an annual process in a quarterly form. It would be feasible to smooth out the lumpiness in the series by mathematical techniques, but, in the context of non-seasonally adjusted data, this would not be justified by the economic concept of production and would just cover up the issue. Users, however, may prefer the seasonally adjusted or trend-cycle series for some purposes.

10.48. Because of their special features, quarterly data on agricultural production need to be interpreted carefully. The data are necessarily artificial when a yearly or multiquarter process is split into quarters. The quarter-to-quarter movements are driven by the cost profile used rather than by new information on output. Because the cost profile is a seasonal pattern, it will be removed by the seasonal adjustment process.[9]

10.49. Techniques of presentation of the data may help users deal with the difficulties associated with measurement of quarterly output from agriculture. In view of the multiple uses of quarterly accounts, there may be alternative solutions to the conceptual and practical problems. In this respect, three recommendations can be made. First, document the methodology carefully so users are able to form their own opinions. Although this will not enhance the quality of the figures, it will at least enable a view on whether they are suitable for particular purposes. Second, to serve users who deem the allocations unsuitable or do not care for allocations anyway, specify and quantify the allocations. Third, present the data with sufficient details to allow users to exclude the work in progress if they wish.

10.50. In conclusion, as a general principle, the *1993 SNA* states that agricultural work-in-progress should be included in output. As mentioned in paragraph 6.100 of that manual, however, the uncertainty and data issues associated with agricultural work-in-progress are often more severe than in other cases, so the decision on whether to include it needs to take into account the circumstances and analytical benefits in each country.

[7]In the revision process in preparation of the *1993 SNA*, the case was made for presenting a version of the accounts excluding *all* nonmonetary imputations. This case seems particularly relevant for imputations relating to the allocating of output from agriculture to nonharvest quarters.

[8]An alternative treatment that has been proposed is to measure output for nonharvest quarters as equal to cost without any markup and for the harvest quarter as equal to the difference between cumulated costs and harvest value. While this would have the advantage of avoiding the need to revise the back series at the time the crop is harvested, it would also imply that all operating surplus/mixed income would be allocated to the harvest quarter. The latter has no economic rationale (it is difficult to see why operating surplus/mixed income would be generated only in the harvest quarter). Also, if output is lower than costs, this method would imply recording positive output in preharvest quarters and negative output in the harvest quarter. Such an outcome seems artificial.

[9]If there are zero-production periods, a nonmultiplicative method of seasonal adjustment must be used. See Chapter VII for a discussion of seasonal adjustment techniques.

Annex 10.1. Recording Work-in-Progress in the *1993 SNA* Sequence of Accounts

10.A1.1. Although estimation of work-in-progress primarily concerns output, in the context of a consistent system such as the national accounts we will also have to consider other transactions that relate to work-in-progress, as well as balances (such as value added). In this annex we will explain which other transactions and balances are affected. A numerical illustration of the effects of work-in-progress on main aggregates in the *1993 SNA*'s sequence of accounts and balance sheets is provided in Example 10.A.1. The example demonstrates that significant effects can be found throughout the full sequence of accounts.

10.A1.2. In the general case, where work-in-progress is not sold until the product is finished, the two initial entries in the accounts are (a) output and (b) changes in inventories (increases) in the case of agriculture, manufacturing, services, and speculative construction, and capital formation in the case of own-account capital formation. After the product is finished and sold, two further transactions are (a) changes in inventories (decreases) and (b) changes in financial assets. In the case of production of a capital good under contract, four entries have to be recorded: (a) output for the producer, (b) fixed capital formation for the user, (c) increase in financial assets for the producer, and (d) decrease in financial assets for the user.

10.A1.3. In the production account of the producer, besides output, the only entry that is affected by work-in-progress is value added; the other entries—intermediate consumption, taxes and subsidies on production, and consumption of fixed capital—are not. Because inputs are actually made, there is no conceptual problem in allocating them to relevant periods. Value added is derived as a balance and, thus, estimates will result automatically once the problem of measuring output is resolved. Consumption of fixed capital is not an issue in this context because, per axiom, it is assumed to take place on a continuous basis (for a discussion of consumption of fixed capital in a QNA context, see Chapter IV). Taxes and subsidies on production are not affected because these are to be recorded at the time the output is sold, transferred, or used (see *1993 SNA*, paragraph 8.49).

10.A1.4. In the generation of income account of the producer, the effect on value added in the production account will be carried over to operating surplus/mixed income, because wages as such are not affected by work-in-progress. Similarly, in the allocation of primary income account, the impact on operating surplus/mixed income will directly carry over to the closing balance, primary income, because none of the transactions on this account are affected by work-in-progress. The same applies to transactions on the secondary distribution of income account in that, again, only the closing balance of this account, disposable income, will be affected.

10.A1.5. On the use of income account of the producer, the changes in disposable income would be fully absorbed by savings because consumption is not affected. The effect on saving for the producer would, in the case of work undertaken on own-account, not carry over to the financial account because increased savings would be absorbed by offsetting changes in inventories or capital formation on the capital account for the same institutional unit. In the case of production of a capital good under contract, however, the full effect on savings for the producer will be carried over to the financial account in the form of payments received from installments and other accounts receivable accrued.

10.A1.6. The other changes in assets accounts can be affected in two ways. First, because prices of the goods in inventories change over time, the resulting holding gains or losses have to be recorded on the revaluation account. second, if work-in-progress is lost because of catastrophic events, this has to be recorded on the other changes in volume of assets account.

10.A1.7. Finally, the balance sheets of the system show the stocks resulting from the changes on the current and accumulation accounts. The output of unfinished products is recorded as inventories of work-in-progress unless it is sold. At the time the product is finished, a reclassification has to be made from inventories of work-in-progress to inventories of finished goods, and at the time the product is eventually sold, this sale will be reflected on the balance sheets through lower inventories, with a concomitant effect on financial assets and liabilities.

Example 10.A.1 Effects of Work-in-Progress on Main Aggregates in the *1993 SNA* Sequence of Accounts and Balance Sheets

(Data in bold refer to treatment *with* work-in-progress)

In this Example, the results obtained in Example 10.1 are presented in the format of *1993 SNA* sequence of accounts. The accounts show how, with work-in-progress recorded, each quarter would have had a positive value added; whereas, without work-in-progress recorded, the first three quarters would have had a negative value added and only the fourth would have had a positive value added. The accounts also show that without recording work-in-progress, a holding gain (caused by inflation) would have been included in output and value added. Furthermore, the example demonstrates that the increased saving is fully absorbed by increased inventories, so that the financial transactions (in this example, loans) are unaffected. (This example concerns an economic activity for which no installment payments are made that would affect the financial accounts.)

Current Accounts

	Intermediate Consumption		Output	
q1	160	**160**	0	**880**
q2	340	**340**	0	**1,200**
q3	530	**530**	0	**1,560**
q4	300	**300**	5,800	**1,400**
The year	1,330	**1,330**	5,800	**5,040**
	Value Added			
q1	–160	720		
q2	–340	860		
q3	–530	1,030		
q4	5,500	1,100		
The year	4,470	3,710		
	Compensation of Employees			
q1	300	**300**		
q2	310	**310**		
q3	340	**340**		
q4	400	**400**		
The year	1,350	**1,350**		
	Saving			
q1	–460	**420**		
q2	–650	**550**		
q3	–870	**690**		
q4	5,100	**700**		
The year	3,120	**2,360**		

Capital Transactions, Financial Transactions and Balance Sheets

Opening Balance Sheet			Transactions: Additions		Transactions: Withdrawals		Holding Gains		Closing Balance Sheet	
Nonfinancial Assets (Inventories)										
Quarterly Data										
q1	0	**0**	0	**880**	0	**0**	0	**40**	0	**920**
q2	0	**920**	0	**1,200**	0	**0**	0	**130**	0	**2,250**
q3	0	**2,250**	0	**1,560**	0	**0**	0	**240**	0	**4,050**
q4	0	**4,050**	5800	**1,400**	0	**0**	0	**350**	5,800	**5,800**
Annual Data	0	0	5800	**5,040**	0	**0**	0	**760**	5,800	**5,800**
Financial Liabilities (Loans)										
Quarterly Data										
q1	0	**0**	460	**460**	0	**0**	0	**0**	460	**460**
q2	460	**460**	650	**650**	0	**0**	0	**0**	1,110	**1,110**
q3	1,110	**1,110**	870	**870**	0	**0**	0	**0**	1,980	**1,980**
q4	1,980	**1,980**	700	**700**	0	**0**	0	**0**	2,680	**2,680**
Annual Data	0	**0**	2,680	**2,680**	0	**0**	0	**0**	2,680	**2,680**
Net worth										
q1	0	**0**	–460	**420**	0	**0**	0	**40**	–460	**460**
q2	–460	**460**	–650	**550**	0	**0**	0	**130**	–1,110	**1,140**
q3	–1,110	**1,140**	–870	**690**	0	**0**	0	**240**	–1,980	**2,070**
q4	–1,980	**2,070**	5,100	**700**	0	**0**	0	**350**	3,120	**3,120**
Annual Data	0	**0**	3,120	**2,360**	0	**0**	0	**760**	3,120	**3,120**