II Strategic Issues in Quarterly National Accounts

A. Introduction

2.1. Strategic statistical and managerial issues have to be dealt with to facilitate a smooth and efficient operation of quarterly national accounts (QNA). These issues arise when QNA are being set up, and it could be useful to revisit them from time to time once the QNA are fully operational. The most important statistical issues to be considered are the relationship of the QNA to the annual national accounts (ANA), coverage of the QNA, assessment of quarterly source data, and statistical compilation processes. Important managerial aspects concern the release cycle, the timing of the compilation process, and organizing the staff involved in the compilation. In this chapter, both statistical and managerial issues are examined from a strategic perspective, without much detail (statistical issues will be discussed in more detail in later chapters).

2.2. When considering these strategic issues, it is essential to have a broad understanding of the overall process. The main steps in establishing and maintaining QNA are summarized in Box 2.1. In this box, two related phases are distinguished, namely, an establishing phase and an operational phase. In the establishing phase, the compilation approach is decided, source data are selected and assessed, compilation processes are developed and assessed, and the whole compilation system is used to establish time series of QNA data on past years ("back series"). An important first step in this phase is to consult with potential users to see what kind of use they could make of QNA data. Obviously, consulting users should not be restricted to the first phase, because user wishes will probably evolve as the QNA develop.

2.3. In the operational phase, the compilation system is used to compile estimates for the current quarters; these estimates are subsequently revised when new quarterly and annual information becomes available. The sources, statistical techniques, and compilation system used for establishing the back series in the establishing phase and for updating the series in the operational phase should be identical. In contrast, managing the work on QNA may differ between the preparatory and the operational phase, and the alternatives countries have developed are discussed in this chapter.

B. Statistical Issues

1. The Link between Quarterly and Annual National Accounts

2.4. It is generally agreed that QNA estimates should be kept consistent with ANA estimates (that is, the non-seasonally adjusted QNA estimates). Reasons for this were discussed in Chapter I and include aspects of quality and transparency. Ideally, the QNA should be based on the same data sources and methods as the ANA and compiled using the same system. However, in practice, this ideal is generally not achievable. To achieve both timeliness and accuracy within resource constraints, it is common to collect detailed and comprehensive source statistics only annually or less frequently, and to compile a more limited set of short-term indicators on a monthly and quarterly basis using smaller sample surveys. For the same reasons, it is common to compile a detailed and more comprehensive system of national accounts only annually, and to compile a simplified and aggregated set of QNA estimates immediately after each quarter based on less comprehensive source data.

2.5. A QNA compilation system may be separate from the ANA compilation system or integrated with it. *Separate systems* are commonly found in countries with a comprehensive and detailed ANA system, including a supply and use (SU) table. Applying an SU framework implies an extensive cross-sectional reconciliation that these countries do not find feasible on a quarterly basis, at least not on the same level of detail. This implies that some of the transformation to

Box 2.1. Main Steps to Establish and Maintain Quarterly National Accounts

To Establish QNA

1. **Consult potential users**
   - Concerning possible uses
   - Concerning required coverage, detail, and so on
2. **Take inventory**
   - Of annual compilation methods
   - Of available quarterly and annual source data
3. **Design compilation methods and procedures**
   - Consider relationship to sources and methods used in the annual accounts
   - Decide coverage of QNA, including which parts of the 1993 SNA are to be implemented
   - Determine compilation level
   - Choose integrated or separate ANA-QNA compilation system
   - Make compilation schedule, including timeliness of first estimates and revision policy
4. **Review the quality of source data and compilation procedures**
   - Study correlation between annual and quarterly source data
   - Study revisions to main aggregates based on historic data (historic simulation of the compilation system)
     - ► Revisions to the quarterly compilation system
5. **Generate time series of QNA data for past years ("back series")**
   - Benchmark the time series of quarterly source data to the time series of annual data (using methods such as the enhanced proportional Denton method)
     - ► To be done for a sufficiently long time series
     - ► To be done at the most detailed compilation level
6. **Perform real-time test runs and update the quarterly time-series with estimates for the quarters of the current year (year *y*)**
   - Link monthly and quarterly source data for the current quarters with estimates for the back series
     - ► Extrapolation with indicators—Benchmark the time series of quarterly source data to the time series of annual data (using methods such as the enhanced proportional Denton method)
   - Fill information gaps
7. **First release**

To Maintain QNA

8. **Revise the quarterly estimates for the current year when new quarterly data become available**
   - Link monthly and quarterly source data for the current quarters with estimates for the back series
     - ► Extrapolation with indicators—Benchmark the time series of quarterly source data to the time
9. **Revise the quarterly estimates when new annual data become available**
   - Revise the quarterly estimates for year *y* (and preceding years) to incorporate new benchmark data without introducing steps in the series
     - ► Benchmark the time series of quarterly source data to the new series of annual data
     - ► To be done at the most detailed compilation level
10. **Update the quarterly time series with estimates for the next current year (year y+1)**
    - Compile quarterly estimates for year *y*+1 by linking monthly and quarterly source data for the quarters of year *y*+1 with the revised and benchmarked QNA estimates for year 1 to year *y*
      - ► Extrapolation with indicators—Benchmark the time series of quarterly source data to the time series of annual data
      - ► To be done at the most detailed compilation level.

which the annual source data are subjected cannot be performed quarterly. As a result, the QNA sources have to be benchmarked to ANA estimates derived from the transformation that takes place in the ANA compilation process. *Integrated ANA-QNA systems* are typically found in countries not using an SU framework for their ANA, which makes it easier to use the same system for QNA as for ANA. In an integrated system, the data storage and calculation functions for both ANA and QNA are carried out within the same processing system, although the level of detail may differ. In this situation, QNA sources may be benchmarked to annual source data,[1] rather than to

[1]These may have been pre-benchmarked to more comprehensive and detailed surveys and censuses that are performed only every few years.

ANA estimates. A variant is the situation in which a perfect one-to-one correspondence exists between the *annual levels* and *annual movements* in the quarterly data and the corresponding annual data; in such cases, the annual data may even be derived from the QNA data. However, this situation occurs for only a few components.

2.6. The choice between these alternative compilation styles depends on circumstances in each country. One factor is whether the annual data are subject to a detailed reconciliation process that cannot be applied each quarter. Another factor is whether the existing annual system has a time-series dimension or a year-by-year style of calculation, as the time-series focus is a requirement for QNA. A third factor is whether revisions of annual data sources tend to arrive at the same time of year or spread throughout the year, because in a separate ANA-QNA system, revised annual source data cannot be taken into account in the QNA until after the ANA are revised. It is important that QNA system designers think about these issues explicitly and do not choose one style without considering the alternatives.

2.7. Consequently, QNA are commonly compiled by benchmarking the quarterly source data to annual source data or to ANA estimates derived from a separate ANA system. In the benchmarking procedure, the quarterly source data serve only to determine the short-term movements in the series, while the annual data determine the overall level and long-term movements in the series (see Chapter VI for a detailed discussion of benchmarking). Thus, the quarterly source data are used as **indicators** to

- split ANA estimates into quarters for years for which ANA estimates are available; and
- update the QNA series by using the short-term movements in the QNA source data to generate QNA estimates for the most current period that are consistent with the QNA estimates for years for which ANA are available.

As shown in Chapter VI, the level and movements in the final QNA estimates will depend on the following:

- the movements, but not the level, of the short-term indicators;
- the level of the ANA estimates for the current year; and
- the level of the ANA estimates for several preceding and following years.

2. Coverage of QNA

a. General issues

2.8. When establishing QNA, one of the first choices that has to be made is which parts of the *1993 SNA* should be implemented initially. The choice will depend on availability of quarterly source data, the ANA system in place, available capacity, and user requirements. As mentioned in the introduction to this chapter, an important first step is to consult with potential users to see what kind of use they could make of QNA data. This implies assessing what kind of detail, coverage, and so on users would find desirable. Because potential users may not be aware of the possible benefits of QNA, statistical leadership is needed in this phase, and statisticians may have to set the stage by anticipating future needs.

2.9. When establishing QNA, ANA are usually already in place, along with supporting source data. Also, countries considering establishing QNA usually have some monthly or quarterly source data available. The next step in designing QNA is to take an inventory of available source data to decide which parts of the ANA can be implemented on a quarterly basis. The initial design of QNA should be based on the ANA as much as possible, although it is usually simpler and more aggregated.

2.10. In the initial stage of implementation, only estimates of GDP with corresponding components from the production or expenditure side as well as GNI and savings may be derived. Over time, it may be useful to revisit the extent of coverage of the QNA in view of changes in the availability of source data and changes in the coverage of the ANA. As the QNA become more established and as problems and gaps are identified, users needs for additional data may guide future extension. Experience has shown that once QNA are well-established, users become more sophisticated and may promote providing increased resources to extend the QNA to include supply-use reconciliation, institutional sector accounts, and balance sheets.

2.11. Extending the QNA beyond basic compilation of GDP has several advantages. It provides users with a more comprehensive picture of the various aspects of the current economic developments organized in an integrated framework for analyzing the data. Also, the extended accounting framework enables cross-checking of the data.

2.12. Because, as argued above, QNA should be anchored on ANA, the coverage of the QNA should

be consistent with the coverage of the ANA, which means that it should either be the same as the ANA or constitute a subset of the ANA. For instance, if the ANA covers only compilation of GDP estimates, with components from the production and the expenditure sides, the initial coverage of the QNA will have to be restricted to compilation of GDP from the same sides or at least one of them.

2.13. Obviously, establishing QNA requires that human resources and equipment should be available. If no extra capacity is forthcoming and it is not possible to realize efficiency gains, reprioritizing will be needed with ANA or other statistical tasks. If the capacity needed for the development of the QNA has to be found from the resources currently used for the ANA, this may imply cutting back on developments; for instance, this may imply that the *1993 SNA* cannot be fully implemented as rapidly as otherwise would have been possible. In a more dire scenario, generating capacity for the development of QNA may necessitate cutting back on the existing ANA program; the alternative of decreasing accuracy should be avoided. Rather, capacity should be generated by discontinuing marginal activities or by discontinuing parts of the ANA that have not been in demand. It is important to consult users on the choices to be made in such a situation.

2.14. The introduction of a QNA system is similar for both developing and developed countries. The need for the type of information provided through QNA may be as urgent in developing as in developed countries, although more efforts may be needed to convince users of the importance of QNA data and inform them about the limitations of QNA data. Countries now starting QNA have the advantage that software supporting the implementation of the required techniques (such as benchmarking) is now widely available.

b. Measurement of GDP and its components

2.15. Measurement of GDP constitutes a core part of almost all national accounts systems, and a breakdown of GDP into its components is usually one of the first QNA results available. Traditionally, a distinction is made among three approaches[2] to GDP measurement, namely, (a) the production approach, (b) the expenditure approach, and the (c) the income approach. This distinction is somewhat artificial because these three approaches often use the same source data. For instance, government output and government consumption estimates are often based on the same source data; the estimates of fixed capital formation for the expenditure approach are partly based on output estimates of construction and production of machinery, which are also used in the production approach; and the wages and salaries estimates used in the income approach are often derived from the same statistics that provide the data on industry output and value added that are used in the production approach. However, the various approaches also use specific source data and allow a distinct perspective on development and level of GDP. Although, as argued, these approaches are not fully independent, applying various approaches facilitates cross-checking of data. Therefore, this manual recommends that countries should aspire to estimate GDP from at least two of the three sides. Because of their relative strength, it would be particularly useful to apply both the production and the expenditure approach.

2.16. Another important reason to apply at least the production and expenditure approaches is that they provide different breakdowns of GDP. To the extent that demand is driving short-term changes in the economy, the expenditure split provides particularly useful data for business cycle and macroeconomic policy analysis and for forecasting. The industry composition of growth provides a useful but less important supplementary perspective.

2.17. The production approach is the most widely used in the QNA for measuring GDP, probably because of a traditional focus in many countries on short-term statistics on manufacturing industries as major indicators. The production approach involves calculating output, intermediate consumption, and value added at current prices as well as in volume terms by industry. However, the available source data are usually restricted to either output or intermediate consumption, and the situation in which both types of source data are available is relatively rare. In most countries, output data are reasonably well covered for manufacturing industries, but the coverage of construction and services is usually less comprehensive. Components missing from output, intermediate consumption, and value added are estimated using ratios that reflect fixed input-output (IO) coefficients. Single-indicator-based estimates will be biased to the extent that the ratios vary with

[2]A distinction is made between a compilation approach (which leads to a GDP total) and production of splits (in which a GDP total is derived from one approach, but some components of another approach are derived, so the remaining item can be derived as a residual).

factors such as seasonal effects, capacity utilization, change in composition, technological change, and productivity trends.

2.18. The expenditure approach for measuring GDP is less common than the production approach among QNA-compiling countries. This is because of problems in availability, timing, valuation, and coverage in expenditure source data. The expenditure side usually has two strong pillars of quarterly data, namely, foreign trade and government consumption; the other categories are often less well covered. The major components of external transactions are usually available from the balance of payments and through merchandise trade statistics that often have a strong basis in comprehensive data collection for customs purposes. Data on government consumption can usually be derived from government administrative data. Other expenditure components (namely, household final consumption, parts of fixed capital formation, and changes in inventories) are usually covered less well. Directly observed data on fixed capital formation and changes in inventories may in many cases be lacking.

2.19. If expenditure data are incomplete, it may still be possible to derive a useful split of GDP by type of expenditure. For example, if total GDP is derived by the production approach and the available source data allow some of the key expenditure components to be estimated, the missing items may be derived as a residual. This situation can arise because data on changes in inventories are incomplete or inadequate. Although not an independent check of the GDP estimates, use of incomplete expenditure data in this way provides benefits for analysis in addition to plausibility checks of GDP.

2.20. The expenditure split is, in some ways, the most practical to measure in constant price or volume terms because there is a relatively clear concept of price and valuation for each demand category. In contrast, the price and volume dimensions of value added are more complex because value added cannot be directly observed, and the income approach is not suited for price and volume measures. As mentioned, the expenditure split also provides particularly useful data for business cycle and macroeconomic policy analysis and for forecasting. Also, this split is most useful for policy reasons because, over the short-term, demand can be more easily influenced than supply.

2.21. The income approach is the least commonly used of the three approaches but is potentially useful as an alternative measure of GDP. The income approach avoids some of the problems the production and expenditure approaches may have, such as the reliance on fixed IO ratios in production data; however, it lacks a constant price dimension. Also, it requires that businesses have quarterly data on profits and some expenses. The income approach may have a sound underpinning in wage statistics or in administrative data on wages (for instance, for social security purposes), but quarterly observations of operating surplus/mixed income are often unavailable, particularly for unincorporated enterprises.

2.22. Even if income data are incomplete, it may still be possible to derive an income split of GDP where one of the categories (usually gross operating surplus) is derived residually. The distribution of income from GDP provides a useful alternative perspective on economic development. For a country interested in issues such as profitability and wage bargaining, this could be an important economic statistic. It also shows the link between business accounting and the national accounts, particularly if a bridge table from profits to operating surplus/mixed income is provided.

2.23. The weaknesses of the various methods for compiling GDP can be mitigated by combining several of them. Production and expenditure data can be combined using the commodity flow method. This method is based on the fundamental national accounting identity shown in the goods and services account and SU tables, namely, that total supply (by product) must equal total use. The commodity flow method can be applied on different levels, for instance, for groups of commodities or for individual commodities. The more detailed the level at which the method is applied, the more accurate the result (detailed information requires fewer assumptions on origin and use). This method is particularly strong if applied in an SU[3] framework, even one of limited dimensions (see next section). Production and income data can be checked if both are classified by industry, which is particularly meaningful if the value added data for industries can be broken down into compensation of employees, operating surplus, and mixed income (for a discussion on reconciliation issues, see Chapter V).

c. Quarterly GDP by the supply and use approach

2.24. Several countries have developed quarterly SU tables as the basis for their quarterly compilation of

[3]Input-output tables may also be used. For simplicity, we will refer to this whole area as supply and use (SU).

the GDP-related part of the national accounts. Compilation of SU tables is basically a commonsense method of compiling the GDP-related part of the overall national accounts system. For each individual product—at a more or less detailed level—SU tables show the sources of supply (production and imports) and the uses (intermediate consumption, households and nonprofit institutions serving households final consumption, government final consumption, and gross capital formation and exports). If supply and use for each individual product is balanced, the aggregated goods and services accounts for the total economy will also be balanced.

2.25. Application of an SU framework may seem daunting in a quarterly context, but it has proved feasible.[4] In particular, if SU tables are used as a compilation tool without being published, less rigor may be applied in balancing conflicting data and removing discrepancies. For instance, it may not be necessary to remove minor discrepancies that remain after major imbalances have been solved, as is usually done if SU tables are to be published.

2.26. SU tables provide an instrument to make maximum use of whatever information is available. SU tables are particularly suitable for filling gaps and reconciliation of data. With problems of data gaps caused by unrecorded economic activities and errors in the reported data, it is particularly desirable to use the SU framework to organize and coordinate the compilation work. The SU framework is, therefore, suitable for good data systems as well where the data sources are limited in coverage or are of poor quality.

2.27. The SU framework also allows the generation of more detailed data; for instance, retail sales may be available only for broad product groups, but the reconciliation with detailed production and external trade data can enable the production of detailed data on household consumption. Such detailed data can be useful to some users and can also help improve the quality of deflation. Making calculations at a more detailed level reduces the dependence on the fixed weights used in Laspeyres price indices, resulting in aggregate implicit deflators that are closer approximates to the preferred Paasche deflators. The SU framework also provides the ideal basis for making separate volume measures for output and intermediate consumption, and thus for value added, using the double indicator method.

2.28. A few advanced countries compile both current and constant price SU tables. SU tables at current prices alone are more common. However, many of the assumptions about relationships are more likely to hold in constant price data. Having both current and constant price tables also makes it possible to separate price and volume aspects and to balance price, volume, and value (current price) data simultaneously.

2.29. The production of components of a quarterly SU system is broadly the same as for the equivalent components in the other approaches, as already discussed. However, there is an extra element of overall balancing and reconciliation. In effect, the use of the other approaches often involves elements of the SU approach. For example, the production approach often involves using fixed ratios on partial data, and commodity balances are often used to derive estimates. Each of these is a typical element of the SU approach. Using them is like using the SU approach for particular industries or products, but without the benefits of using the overall accounting framework for checking the aggregates. For all these reasons, countries that have a developed system of annual SU tables should consider using them systematically as a basis for QNA estimation.

3. Compilation Level

2.30. QNA are almost always compiled at a lesser level of detail than the annual estimates. Of course, it is not easy to draw the line on the level of detail required, but it should maintain separate data for items that are large, of interest to data users, or behave in atypical ways. Less detail does not always mean making the compilation process simpler, faster, and less resource demanding, because sometimes a more detailed level of compilation makes it easier to eliminate differences between indicators. For instance, when balancing supply and use of vehicles, having more details about different types of vehicles (such as trucks and passenger cars) makes balancing of supply and use easier (the use of trucks is mostly for fixed capital formation, while use of passenger cars can be both for fixed capital formation and for household consumption). Also, in automated compilation processes, more detail need not make much of a difference in compilation speed and resource needs. Finally, as mentioned above, making the calculations at a more detailed level reduces the dependence on fixed IO assumptions or

[4]For instance, these methods are being used in the QNA context in Denmark, France, the Netherlands, and Norway.

the fixed weights used in Laspeyres price indices, resulting in improved estimates.

4. Assessing Source Data and the Compilation System

2.31. Before commencing publication of QNA estimates, it is important to review the quality of both source data and the proposed compilation procedures. Because of the general demand for long time series, this review should go back as many years as feasible. The main purpose of the review is to identify weaknesses in the quarterly compilation system and possibilities for improvements to minimize future revisions of the main aggregates. It is important to establish whether source statistics properly indicate the direction and overall size of the changes and whether they enable catching turning points. The review also gives an indication of the quality of the estimates and the degree of revisions that can be expected in the future. Because of resource constraints and lack of sufficiently accurate and detailed source statistics, weaknesses will remain and revisions are inevitable; for some series, the revisions may be large. Thus, upon release of the first quarterly estimates, it is vital that the users are well informed of the accuracy and the reliability of the estimates and the degree of revisions that can be expected in the future.

2.32. In the national accounts context, the term "accuracy" is used to mean "closeness to the truth," while "reliability" is used to mean "degree of revisions the series is subject to." Because QNA are anchored to the ANA, the accuracy of the ANA sets a ceiling on the accuracy of the QNA; the reliability of the QNA is also thus determined because the extent of revisions depends on the closeness of the initial QNA estimates to the ANA estimates and the extent of revisions to the ANA estimates (for a more comprehensive discussion of revisions, see Chapter XI).

2.33. It is essential that decisions about sources and methods be well documented. The documentation is useful for compilers when problems arise or when there is staff turnover or absence. It also provides the basis for documentation for users, who often wish to know more about the data.

2.34. Assessing the source data and the compilation system involves conducting the following three tracking exercises:

(a) To assess the ability of the quarterly source data for individual series to track the annual estimates.

(b) To assess preliminary quarterly source data for the individual series to track the final quarterly source data.

(c) To assess the ability of the overall compilation system to track the annual estimates for major aggregates.

The overall tracking exercise will also, on an ex ante basis, provide a measure of the reliability of the QNA in the sense discussed in paragraph 2.31. Assessing the source data and the compilation system should be seen as a continuous process that should also be conducted regularly in the operational phase (in the operational phase this concerns ex post revision studies). The main aspects of assessing the source data and the compilation system are summarized in Box 2.2.

a. Assessing individual source data

2.35. Source data should be assessed for accuracy, reliability, and timeliness. Such an assessment is important for several reasons. First, it will reveal whether a specific series of source data is suitable for QNA purposes; second, where more than one data source is available for a particular variable, it will aid

Box 2.2. Review: Assessment of Indicators and Compilation Methods

1. Relationship to the sources and methods used in the annual estimates
   - Are the same sources available quarterly?
   - Are other sources/indicators available quarterly?
   - Are several alternative sources/indicators available for the same item?
2. Compilation level
   - As detailed as possible?
   - At the level of the main aggregates?
3. Coverage
   - What parts of the ANA can be covered?
4. Assessment of sources and methods
   - Accuracy in predicting annual changes
   - Systematic bias or noise
   - Individual and aggregated tracking exercises
   - Definitions of source data
     - Coverage
     - Units
     - Classifications
   - Reliability (revision of indicators)
     - Systematic bias
     - Noise
   - Timeliness
     - Reliability of preliminary estimates
     - Amount of gap filling and guess estimation
5. Do the annual sources and methods need to be changed?

in choosing among them; third, when source data are conflicting, it will facilitate a choice on where to adjust; fourth, it will help to identify areas for improvement; and fifth, it will facilitate informing users about the quality of the estimates and expected future revisions to the individual series. Of course, in many cases, there will be little or no choice about the source to be used—in particular, in the short term. However, it is still necessary to assess indicators that could possibly be used. These assessments should be discussed with the data providers, who may be able to give additional background information. (In addition, national accountants are sometimes able to identify problems that the data collectors had not discerned.)

2.36. The main criterion for the accuracy of quarterly source data is to what extent they are successful in indicating annual movements. This follows from the need to keep QNA consistent with ANA and the assumed higher quality of the annual source data. The accuracy of the short-term source statistics as indicators for the annual movements depends on definitions and specification of the variables and on issues such as coverage, units, and classifications.

2.37. The ability of the quarterly source data to track the annual estimates should be assessed by *comparing the growth rates* in the annual sum of the quarterly source data with growth rates in the corresponding ANA estimates (this is the first of the three tracking exercises listed in paragraph 2.34). Large differences in the rates of change indicate inconsistencies between the quarterly and annual source data for that series and potential weaknesses in the quality of either the quarterly or the annual source data. Large differences in the annual rates of change in the quarterly and annual source data for the back series also indicate that large revisions can be expected in the future as additional source data become available. Mathematical techniques can be used to more formally study the correlation between annual and quarterly data and to identify and remove any systematic errors (that is, bias) in the quarterly source data's long-term movements. Use of mathematical techniques to identify and adjust for biases is discussed in Chapter VI.

2.38. Specific problems may arise if annual reporting is on a fiscal year basis rather than a calendar year basis. In this respect, the main problem is that in annual statistics, respondents with a nonstandard reporting year (that is, a reporting year that differs from the rest of the industry) are usually included in the statistics for the year that has the largest overlap, which will then create a mismatch with the sum of the quarters. A solution to this problem with the annual data could be found if the annual source statistics would use the information from the quarterly source statistics to allocate the data of an individual respondent to the standard accounting period using the benchmarking technique presented in Chapter VI.

2.39. The reliability of the quarterly source data has important implications for how early sufficiently reliable initial QNA estimates can be prepared. Often the first estimates will have to be based on published or unpublished preliminary versions of source data that are still open to revisions. One important reason for such revisions to the source data is that early response rates are lower, and estimates may change as response increases. These changes may follow a consistent pattern, which implies a "bias," or the changes may be irregular, which implies "noise." A bias in early estimates of an indicator may be caused by selectivity in the response. The reliability of the quarterly source data can be assessed by comparing period-to-period rates of change in the preliminary versions with the corresponding rates of change in the final versions of the series. Obviously, this can only be done if the preliminary versions of the data have been retained in the databases rather then being continually overwritten.

2.40. The timeliness of the quarterly source data also has important implications for how early sufficiently reliable initial QNA estimates can be prepared. Often the first estimates will have to be based on an incomplete set of source data. For some series, data for only two months of the last quarter may be available, while data for other series may be missing altogether. To fill these source data gaps, provisional estimates will have to be made based on simple trend extrapolation or on alternative indicators that are more timely but less accurate. For each individual variable, the impact of these provisional estimates on the reliability of the first estimates can be assessed by constructing provisional estimates for the past years ***as if one were in the past*** and comparing the period-to-period rate change in those estimates with corresponding rates of change in the final quarterly source data for that variable. This and the assessment of the reliability of the quarterly source data described in paragraph 2.39 represent the second of the three tracking exercises listed in paragraph 2.34.

2.41. The assessment of possible source data will determine what source data are suitable for QNA purposes and, from there, which parts of the 1993 SNA

can be implemented. Sometimes the assessment will lead to the conclusion that biases and noise are too substantial for a particular set of data to be used to compile QNA data. This can imply that the QNA compilers have no other choice than to not use these data, but it would be important to discuss with the compilers of the source data whether improvements can be made (see below). While the decision not to use a certain data set might mean that the system cannot be fully implemented, this is likely to be preferable to the use of data that can result in misleading results.

2.42. Sometimes, a choice has to be made among various sources for the same variable. Although in most cases QNA compilers face a lack of source data rather than an abundance, the situation may occur in which several indicators are available for one particular variable. If alternative indicators are available for the same variable, it is important to have some knowledge of their accuracy and reliability to choose between them. Note that the lesser quality data may still be useful as a check on the preferred series.

2.43. Often, QNA compilers need to adjust the source data in the QNA compilation process. If data on supply and use are confronted through SU tables or in a commodity flow equation, it is likely that inconsistencies will emerge. In such cases, knowledge about the accuracy and reliability of the data will provide guidance on how much leeway there is for adjusting the data.

2.44. Assessment of the source data may also help identify areas that need improvement, both for the QNA and the ANA. Necessary improvements may concern coverage, definitions, units, and so on. Obviously, it will be easier for QNA compilers to request improvement of statistics collected by the same agency, but even data from other agencies may be improved. Agencies collecting data for their own use that do not fit well into the QNA compilation might prefer adapting their questionnaires to allow use in the QNA context rather than having their respondents exposed to a new survey.

2.45. In setting priorities for improvements, the relative importance of an indicator should be one of the considerations. For many components, the basic data are so poor that refinement of methods would be of doubtful benefit. There are also likely to be components of little economic significance that have poor data. National accountants need to be careful about expending too much effort on numerous, trivial items at the expense of large, important items. Of course, the fact that an item is small cannot be an excuse for deliberately choosing a poor method when a better one is available, and the methods adopted for even the smallest components need to be defensible to inquisitive users. Also, it should be noted that small items may have a substantial effect on growth estimates (changes in inventories are an example of this).

2.46. In some cases, the development of QNA methods also leads to improvements in the ANA. The process of review often brings to light outdated or unrealistic assumptions in annual estimation, as well as faulty annual compilation practices. In a few cases, the quarterly data may be superior and so may be used to replace the annual data. One instance is annual deflators that are best built up from quarterly data as the ratio between the annual sum of quarterly current and constant price data (see Chapter IX, Section B), instead of constructed as a simple annual average of monthly price data for the year. Similarly, data on inventories and work-in-progress are best built up from short-term data. QNA can also contribute to an improved allocation of fiscal year data to calendar years in cases where the two do not coincide.

b. Assessing the overall compilation system

2.47. Before QNA estimates are published, an aggregate tracking exercise should be undertaken to assess the overall consistency of the quarterly and annual source data and compilation systems with respect to annual rates of change for major aggregates (this is the third of the three tracking exercises listed in paragraph 2.34). Errors in the individual series may go in opposite directions and, thus, may not give a good indication of the degree of future revisions of the main aggregates that can be expected. To undertake an aggregate tracking exercise, the entire compilation process needs to be simulated on historic data to produce time series of unbenchmarked estimates for the major aggregates. That is, the proposed QNA compilation system should be used to produce estimates of QNA aggregates for the past years ***as if one were in the past*** and were producing the first preliminary sum of four quarter estimates for those years without later annual benchmarks. If feasible, it is preferable to perform the aggregate tracking exercise based on the incomplete set of source data that would actually have been available when the first sum of four quarter estimates would have been produced.

2.48. Later, in the operational phase, the aggregate tracking exercise should be repeated by comparing the various releases of annual data from the QNA system with the eventual ANA data. As emphasized in Chapter XI, best practice also involves periodically conducting and publishing studies of long-term trends in the revision patterns. Summaries of these studies may accompany the regular quarterly release of data to remind users that data are subject to revisions.

2.49. It is advisable to also perform test runs in real time before going public with the QNA. Only experience from such test runs can sufficiently ensure the robustness of a QNA system and its ability to cope with unexpected problems. Although user demands and other compelling reasons may provide a push for going public as soon as possible, in the establishment phase, QNA compilers should endeavor to schedule sufficient time to run one or two real-time test runs.

2.50. The tracking exercise on the aggregate level can be used to remove weaknesses in the system overall. For instance, the exercise may indicate that estimates from the production approach are more robust than the estimates from the expenditure approach, which would provide guidance to adjustments in the course of the compilation process.

5. Statistical Processing

2.51. Statistical processing encompasses the assembly of data, benchmarking, deflation, seasonal adjustment, aggregation, and other calculations. In designing a processing system, it is useful to anticipate the differences and links between the preparatory and operational phases of QNA compilation so that different needs can be satisfied using the same processing system. In general, the processes for compiling data in the preparatory and operational phases will be the same. However, the operational phase has some extra complexities that may not be evident in the preparatory phase.

2.52. In the QNA preparatory phase, the objective is to compile data on past years (back series). Compilation of QNA data for a single quarter or year is of little value. The back series of historical data provide greater perspective on economic developments, and for that reason should go as far back as feasible. Long back series also allow compilers setting up a new system to check the data, gain experience in the behavior of the series, and support seasonal adjustment.

2.53. In the operational phase, the objective is to update the time series with data for the current quarters as well as revising the data for past years. The operational phase differs from the preparatory phase in several respects. These differences arise because, in the preparatory phase, compilation was done after the fact with existing ANA totals as benchmarks, which would not be available for the most recent quarters. Other differences are that in the operational phase, the data will be less complete for the most recent quarters, data source revisions will be an issue, and the timing of data supply in a proper sequence becomes much more important. Only running the quarterly compilation system in real time will reveal all the implications. A trial run of a quarter or two before the official release (as recommended above) will allow these problems to be identified and resolved without delays the public may notice.

2.54. For the operational phase, the forward or extrapolation part of the series presents its own difficulties because there will be no annual benchmarks for that part of the series. The challenge is to extend the series beyond the end of the last benchmark, tracking the likely future ANA estimates so that future revisions are minimized while preserving the short-term movements in the quarterly source data (to the extent possible).

2.55. Finally, during the operational phase, there are continuing cycles of revisions to quarterly indicators, revisions to annual benchmarks, and the receipt of annual benchmarks for the most recent years. This new information needs to be incorporated in the QNA estimates as it becomes available.

2.56. The calculations applied to the data are diverse and depend on the characteristics of the series. Some data will be received in a form ready to use without adjustment, but more commonly there will be the straightforward manipulations familiar in annual compilation—addition, subtraction, multiplication (whether called scaling, grossing up, or quantity revaluation), and division (e.g., deflation). However, the mathematical techniques used to produce QNA estimates by combining a quarterly indicator and an annual benchmark series are more complex. Inevitably, the movements in any two nonidentical quarterly and annual series will differ. The challenge is to align the QNA estimate to the ANA estimate while preserving the time-series properties of the data. This process—

called benchmarking—is not an easy matter because simple methods such as pro rata distribution of the annual total introduce a discontinuity in the series between years—the "step problem." Benchmarking improves the quarterly data by taking into account the superior annual information.

2.57. The proportional Denton benchmarking technique with enhancements as presented in this manual, is recommended as an integrated way of dealing with these tasks for both the back and forward parts of the series. It gives results superior to those methods that treat the back data in the preparatory phase, the extrapolation phase, and the arrival of new benchmarks separately. In practice, the Denton technique can be readily automated so that it is not time-consuming. It is worthwhile to set up the system correctly because using alternative methods with step problems can undermine the time-series properties that are the key focus of QNA. The importance of good benchmarking methods increases as quarterly indicators show more divergence in movements from annual data. The Denton method with enhancements is presented in Chapter VI, along with some discussion of its implications and the alternatives.

2.58. It should be emphasized that in the case of incorporation of revised or new benchmarks, the calculations should be based on the original quarterly indicator, not on the preliminary QNA estimates that have already been adjusted. Otherwise, the compilation process risks deteriorating into an unorganized data hashing, in which the compilers lose track of the original data, the effects of benchmarking, and the effects of other adjustments.

2.59. To avoid introducing distortions in the series, incorporation of new annual data for one year will generally require previously published quarterly data for the past several years to be revised. This is a basic feature of all acceptable benchmarking methods. As explained in paragraph 6.30 and as illustrated in Example 6.3, in addition to the QNA estimates for the year for which new annual data are to be incorporated, the quarterly data for one or several preceding and following years may have to be revised. In principle, previously published QNA estimates for all preceding and following years may have to be adjusted to maximally preserve the short-term movements in the indicator if the errors in the indicator are large. However, in practice, with most benchmarking methods, the impact of new annual data will gradually diminish until it no longer has any impact on sufficiently distant past years. With the recommended proportional Denton benchmarking technique, the impact on data for proceeding years will normally become insignificant after three to four years. One of the advantages of the Denton technique is that it allows for revisions to as many preceding years as desired.

6. Relationship between QNA and Source Data Statistics

2.60. As a consequence of benchmarking and calculations in the QNA compilation process, the QNA data may differ from the source statistics. Subjecting data to a balancing process in a commodity flow or SU framework will also generate differences with the source data. Users may find these differences puzzling and awkward, and efforts should be made to work the differences back into the source data. Certain limitations may apply; for instance, the implicit deflator of household consumption in the QNA may differ from the consumer price index (CPI), owing to differences in coverage and differences caused by the use of different index formulas. However, if the variables in the QNA are basically identical to those in the source statistics, consistency should be pursued. Owing to consistency requirements, this consistency should be sought through adjustments in the source statistics. For instance, output and value added data from a production index should tally with the corresponding data from the QNA. At the very minimum, causes for differences should be explored, and they should be documented in a way that facilitates access by users.

2.61. Initially, working the differences resulting from the QNA compilation process back into the source statistics may not be popular with the compilers of these statistics, if only because this would entail a revision process that they may not be accustomed to. However, compilers of source statistics may come to accept that adjusting their statistics to the QNA is beneficial to the consistency of the statistical system and to the quality of their own statistics. One important effect of adjustment may be an increased awareness among the compilers of source statistics of the need to ensure consistency between data from high-frequency statistics (monthly and quarterly data) and annual data; these compilers may also be encouraged to apply benchmarking procedures. Discussions with the compil-

ers of source statistics about the differences will most likely increase their involvement in the way their data are used in the QNA compilation process. For instance, they may develop an interest in participating in the deliberations during the balancing process, for which they could provide valuable input. Obviously, the adjustment process of the QNA source statistics will be easier to establish if a similar process is in place for the ANA. If this is not the case, starting a QNA system is a good opportunity to initiate an adjustment process for the ANA source statistics as well.

C. Dissemination

2.62. Dissemination of QNA has much in common with dissemination of other statistics, and general guidance can be found in the IMF's SDDS and GDDS. These standards center on integrity, and important themes include avoiding nonstatistical interference with the data, simultaneous release to all users, general accessibility of the data, and transparency. These issues are mentioned in Chapter I and elaborated on in Chapter XI.

2.63. This section focuses on some QNA-specific dissemination issues, especially concerning release and presentation. With regard to release, owing to the nature of QNA and their importance for decision making, the predominant condition is that the release should be fast. Rather than spending time on preparing and printing a glossy and comprehensive publication, the emphasis should be on releasing the QNA data as soon as they are available or, if a release calendar is in place, on the scheduled release date.

2.64. Thus, the first release may be a rather limited one, focusing on the most important data. For instance, the focus could be on GDP growth in current and constant prices—both seasonally adjusted and nonadjusted—as well as on trend estimates. As a further extension, it could include breakdowns of expenditure categories and industries. Also, it is important to mention the most important revisions concerning earlier releases (see Chapter XI for more on this subject).

2.65. The quickest ways to release these data are through a press release and the Internet. The press release text should be short (as a rule, not longer than one typed page) and ready for use without rewriting. These conditions promote acceptance by the media and also prevent misrepresentation by hasty or less knowledgeable media staff. Media often mention the source of press releases, which may generate the perception that the published article reflects the view of the statistical agency. Thus, it is important to prepare press releases in a way that prevents tinkering with the text by the media. Try to have a catchy heading; if the press release does not have one, the media will make one up that might be more creative than statisticians would like. Also, because the media shorten articles by simply removing text at the end, the most important news should be first. Furthermore, it is advisable to support the press release with a small table containing the most important data. For easy recognition by the general public, it makes sense to standardize such a table and to consult with media staff about its content. Consulting with the media about press releases is good advice in general. Publication through the Internet should be simultaneous with the press release, and to promote speed it could simply have the same text. Preparation of the releases should start as early as possible and need not wait until all the publishable data are ready; usually an impression of the important news can be developed on the basis of the data that become available in the last phases of the compilation process.

2.66. Many countries also publish a more comprehensive quarterly statistical publication dedicated to the QNA. These publications provide a more thorough analysis of the data, supported by charts depicting the economic developments in various ways. Pie charts depicting contributions to GDP growth from demand categories or from industries are often used; such charts are usually based on seasonally adjusted constant price data. Column diagrams showing the composition of GDP and the changes in this composition are also often published.

2.67. The extent to which statisticians comment on the data differs among countries. In some countries, statistical offices basically provide only the data with technical explanation as needed; in other countries, statistical organizations see it as their task to interpret economic developments. Either way, keep close to the facts to avoid giving the impression that the statistical agency wishes to influence public opinion by taking a position on economic and political issues.

D. Managerial Issues

1. General

2.68. Management of QNA differs from that of ANA because of the greater intensity of work and tightness of deadlines. Also, compilation of QNA is more creative because more assumptions need to be used and more use is made of indirect indicators, with less "bean counting." This implies a need for staff with a solid economic background. As well, because of the more intensive use of mathematical techniques, some staff with a background in mathematical statistics are needed.

2.69. As mentioned before, QNA can only start when sufficient quarterly source data are available. These source data are more efficiently managed in the compilation of QNA when they are available in electronic databases.

2.70. There is no single best way of organizing QNA compilation. Each country develops its system according to its own experience and circumstances. The objective of this chapter is to raise some issues for consideration rather than to give recommendations or answers.

2.71. The pattern of workload peaks is quite different for QNA than for ANA. A statistical office that produces only annual estimates is accustomed to a production cycle spread over a year. The annual estimation may often have some clustering of tasks toward the end of the cycle, and there may be tight deadlines to be met. In a quarterly compilation system, the workload is typically relatively low at the beginning of each quarter because data on the previous quarter are not yet available and compilation of the preceding quarter should be finalized.

2.72. For both ANA and QNA compilation, data from a wide range of sources are brought together. Data are sometimes collected by national accountants themselves; more typically, data come from other parts of the same organization or from other organizations. The sequencing and timing of QNA compilation are complex because it needs to be built around the arrival of the results from numerous collections and suppliers.

2.73. An important organizational issue to be dealt with at an early stage concerns the release cycle—the timing of the first release of the data on a quarter and of subsequent revisions. In a QNA system that is linked closely to the ANA, as promulgated in this manual, the release cycle will also depend on the release cycle of the ANA. As mentioned in Chapter I, it is best practice to publish first results within the next quarter. After the first release, revisions are usually needed, depending on, among other things, the arrival of new or revised source material and, eventually, the arrival of annual data. The release cycle derives directly from the revision policy, which is discussed in Chapter XI.

2. Timing of the Compilation Process

a. Structuring the compilation process

2.74. Sequential and "big bang" processing are alternative ways to structure the compilation process. The sequential approach involves processing in stages (data entry, basic checks, aggregation at lower levels, deflation, seasonal adjustment, overall aggregation). In contrast, with the big bang approach, the data are entered and the whole system is run simultaneously; the results are then viewed in detail in the context of the aggregate trends. This may be done iteratively several times as new data arrive and adjustments are made. In practice, there may be some blending of these two approaches. Some of the considerations to be taken into account in designing the processing system are whether the source data arrive within a short period of time or over several weeks, how much checking of source data is necessary, and the nature of the computer system being used. The big bang approach lends itself to SU methods because it emphasizes interrelationships between different data.

b. Planning workloads

2.75. Because the point of QNA is timeliness, deadlines are necessarily short and tight. This means that QNA compilers are subject to pressure. QNA compilation is also particularly vulnerable to problems like delays in major data inputs or bugs in computing systems.

2.76. To deal with timing problems, a quarterly work schedule should be drawn up. The schedule should take into account the agreed-upon release schedule, the expected time of arrival of each of the required data sources, the period required to carry out each process, and the flow of data from one stage to the next. In this way, it is possible to predict when the results will be ready for publication. It will also help in identifying the sequence of tasks and calculating the effects of delays. The work schedule should identify the following:

- the data inputs and when they are expected to arrive;
- the tasks of the national accounts compilers, including how long each task is expected to take and the order in which they are carried out; and
- the delineation of responsibility for each task.

2.77. The work schedule should account for unforeseen delays. As discussed in Chapter XI and as required by the SDDS, release dates should be preannounced. However, unforeseen problems occur and failure to release the estimates as announced may create suspicion of manipulation for political reasons. When compilers first start compiling QNA, there is a greater potential for unforeseen problems. Therefore, countries might initially provide for a longer compilation period and greater margin for delay and gradually increase timeliness as they gain QNA compilation experience.

c. Methods of speeding compilation

2.78. Because source data are often released only after the end of the quarter and QNA are produced quickly, compilation is necessarily concentrated in a short period. This situation makes accelerating jobs particularly important. Compilation can be speeded up in a number of ways.

2.79. First, it is important to reduce peaks in processing workloads. One way to reduce the burden during the peak processing period is to do as much work as possible in advance. For example, monthly data for the first one or two months of the quarter can be processed early. Similarly, it may be possible to implement revisions made to data for earlier quarters before compilation for the new quarter begins. Some problems in data can be foreseen and dealt with in advance. For example, if a series will be rebased or its coverage changed, it may be possible to set up a program that splices together the old and new series before the data become available.

2.80. Second, QNA often achieve earlier release by improving the arrangements for the supply of source data. Data suppliers may be able to provide preliminary data. Data may be supplied by faster methods, such as by e-mail, on a shared database, on diskettes, or on printouts rather than in a more polished publication that takes longer to produce. Also, data should be supplied in the most efficient format, with the data in the required order and excluding irrelevant data.

2.81. Third, printing of statistical publications can be slow. Timeliness is more important for QNA, so it may be necessary to develop dissemination procedures as discussed in Section C of this chapter.

2.82. The practice runs recommended above will also help to identify general problems that would cause delays and undermine punctuality.

3. Organizing Staff

2.83. The topic of organizing staff needs to be considered according to circumstances in each country. Concerns include the agency involved in compiling QNA, the unit compiling QNA, the number of staff involved, the organization of this staff, and the place of the QNA unit (if there is one) in the compiling agency. The most common situation is for all national accounts data, including QNA, to be compiled in the national statistical office, often by the same part of that institution. In some countries, compilation of quarterly accounts is done in the central bank. In some cases, QNA estimates are done by yet another organization, such as a research institute. Unless there are particular problems with staff and other resources, it is generally undesirable to have different organizations involved because of the potential problems of inconsistent data and methods as well as the loss of synergies between the annual and quarterly systems.

2.84. All too often, the national accounts compilers will have little say in the total number of staff, although they may be able to determine the allocation of staff between quarterly and other activities. Obviously, a small staff means a much more basic quality of estimation and a lower level of detail and timeliness.

2.85. The organization of national accounting divisions varies. In a small organization, there may be no division. In a larger organization, units can be divided in one or more of the following ways:

- detailed sources/integrating data and working on aggregates;
- quarterly data/annual data;
- industries/expenditure components/income components;
- current price data/constant price data;
- orientation on process/orientation on product; and
- development and analyses/operational work.

2.86. Some of the considerations regarding allocation of staff are balancing peaks and troughs in workloads, linking common subject matters and techniques, and

having teams that are easy to manage (too large makes communication harder, too small means fewer skills and more vulnerability to absences and departures). When related issues are dealt with by different teams, there is a risk of duplication or conflicting opinions about methods.

2.87. An important organizational choice to be made is whether there should be a unit focused specifically on QNA or whether QNA or annual national accounts should be compiled within the same unit by the same staff. The pattern of workload peaks is quite different, so peaks in the annual compilation may not crowd out activities in QNA (and vice versa). An advantage of combining both functions is that harmonization between QNA and ANA is more likely if the same staff are working on both.

2.88. When setting up a new QNA system, it is often desirable to identify a separate QNA team. Otherwise, the developmental work may be hampered if staff are continually being called to other, more urgent, tasks. The development of a new system requires a high level of conceptual ability, so the staff should have a good knowledge of the *1993 SNA* and the annual compilation system. Some staff with good background knowledge on monthly and quarterly surveys may complement the knowledge of ANA compilers.

4. Organizing Data Supply

2.89. National accounts are unique in their use of many data sources from different agencies. Because the timing of QNA is typically more crucial than the timing of ANA, coordination with data suppliers is one of the important tasks of the QNA compiler. This issue is discussed in Section D.2.c. of this chapter in the context of speeding compilation.

2.90. National accountants need to be in close contact with their suppliers so that both sides understand the other's needs and problems. The timing, content, and formats of data supply can be arranged. Data sources can have changes in base year, coverage, definitions, procedures, and classifications that need to be identified in advance so that there is no unpleasant surprise during data compilation. Data suppliers can also be good sources of information on what is happening in the economy, shortcomings of the data, and how to deal with problems such as breaks in the series.

2.91. Data suppliers are not always aware of how their data are used. It is the responsibility of national accountants to provide them with this information through meetings or discussions. In some countries, national accountants run seminars or courses for data suppliers.

5. Managing Data Compilation Systems

2.92. For QNA data, the time-series dimension is the dominant feature of the data. Thus, any computer system for compiling QNA estimates must be time-series oriented. Box 2.3 sets out the main elements of a compilation system built on time-series-oriented database software. Most elements are also relevant for spreadsheet-based systems.

2.93. National accounts data processing systems are developed to meet the situations of each country. As noted in paragraph 2.5, some countries have separate QNA and ANA systems while others use the same system. Some countries base their national accounts processing system on spreadsheets such as *Lotus* or *Excel*. For large-scale systems, a processing system based on a general database package is preferable. The structure of a database package is built on data series and algorithms to manipulate them. In contrast, the structure of a spreadsheet is based on individual cells linked by formulas. The large volumes of data involved in national accounts compilation favor the use of databases. Databases are more efficient in handling large volumes of data and are also more suitable for handling data transfer to and from seasonal adjustment and benchmarking packages. In spreadsheets containing massive amounts of numbers, making errors is easy and tracing them difficult. Transfer of data between spreadsheets is clumsy, and it is hard to keep track of different versions of data. Spreadsheets also make it difficult to change compilation methods and to ensure that changes are correctly put through.

2.94. Accordingly, as a general guideline, spreadsheets are useful in small-scale tasks like development work, pre-editing, and summary measures. As the system moves from development to operations, it is desirable to shift to a compilation system built on database software and use it for the large-scale tasks of data storage, calculations, seasonal adjustment, and benchmarking. A database system should allow for receiving and downloading data in spreadsheet format, which will facilitate transition from a spreadsheet-based QNA system and assist in data exchange with suppliers and users. With good interfaces, it is also possible to have mixed systems that use spreadsheets for some functions, such as data

supply or editing charts, while using a database for others, such as large-scale storage and calculation.

2.95. The core of a national accounting processing system built on database software is generally a general-purpose, commercially available database package. A custom-made interface to the database may be needed to ease data exchange between the database and other software packages; smaller tailor-made compilation modules may also be needed. *Access*, *Oracle*, *Sysbase*, and *dBase* are relational database packages specialized for cross-sectional operations. In contrast *Fame*, *Dbank*, and *Aremos* are specialized for time-series operations. None of the database packages currently available is optimal for both types of operations. Time-series databases treat all data objects (data arrays or data vectors) as time series and are particularly suitable when the time dimension is the dominant feature of the data, such as for QNA. Relational databases are more suitable when the time dimension is not the most important feature of the data. Compilation of SU tables and editing and aggregation of microdata are examples of operations best undertaken with relational databases.

2.96. A well-thought-out naming structure for the series is essential for the functionality of a compilation system built on time-series-oriented database software. The naming structure determines how the data are organized and thus how to navigate within the database. The structure should be easy to understand, follow the classification system, show the type of data (frequency, value/price index), and show the stage of processing. Other aspects of a well-designed system include well-documented programs and easy operation of the system. The programs should be documented by descriptive files and by comments and notes within the programs themselves. Finally, the system should be able to be run by national accounts compilers, rather than by computer specialists without any national accounts expertise.

2.97. In a spreadsheet-based system, or in spreadsheet components of a system otherwise built on database software, some good practices to be followed include these:

- Separate sheets should be used for data entry and subsequent stages of processing. Each figure should be entered only once and subsequently always referenced by links so that all consequential changes are made in the event of revisions.
- Documentation of sources, processes, assumptions, and adjustments to assist later compilers should be included in spreadsheets as text or notes. Data should have headings that describe the series and its units.
- Standardized formats should be used for all parts of the system (e.g., basic sheets for input, deflation, checking, aggregation; time series as either rows or columns, not both; several years of data should be visible on the screen; choose millions or billions, not both). The formats should be designed for compatibility with input formats required by seasonal adjustment and benchmark tasks that need to be done outside the spreadsheet.
- Multiple layers of worksheets should be used to show stages separately while allowing links to related stages.
- Color and font options should be used to separate inputs, outputs, data that have a different reference base (to facilitate later changing of the base), and edit checks.
- Spreadsheets should be dated (e.g., printed copies can be dated by using the Excel function "=today()"). Backups of previous versions should be stored. One option would be to store

Box 2.3. Elements of a QNA Processing System Built on Database Software

The core of a well-designed computer system for compiling QNA estimates should contain the following main elements:

- Databases for data input
  - A set of databases for storage of monthly quarterly and annual source data
  - A database for storage of ANA estimates
  - A set of databases for storage of annual source data
- Compilation routines
  - Benchmarking of time series of indicators to time series of annual data—quarterization and extrapolation
  - Deflation/reflation
  - Source data assessment procedures—tracking on a detailed level, editing
  - Compilation system assessment procedures—simulations on historical data/tracking on an aggregated level
  - Reconciliation/comparison of GDP estimates from the production, expenditure, and income sides
  - Seasonal adjustment (link to X-11-Arima and/or X-12-Arima)
- Databases for storage of compiled QNA data
  - Database(s) for official published data
  - Archived copies of previous quarters—published data, to facilitate studies of revisions
  - Working databases for unpublished estimates
  - Storage of alternative versions of data (i.e., both before and after adjustments/revisions) to facilitate verifiability and checking
- Routines for tabulation of the data to construct publication tables and for transferring data to diskettes and external databases

all the spreadsheets from a quarter in a single folder to separate them from other quarters without having to rename each file. As well, the practice of automatic overwriting of previous versions means that a mistake may be hard to undo. Within each quarterly run, it may be safer to rename files each time they are changed (e.g., "Manufacturing Aug22-B" for the second time it was saved on August 22; after completion, the last version could be archived and the others deleted).

- Files and worksheets should have meaningful names (e.g., not "Sheet1" and "Sheet 2" but "CPI Data Entry" and "CPI Rereferencing").
- Formulas should be double-checked to see that they do what was intended and have not been unintentionally affected by other changes.
- The chart facility of the spreadsheet package should be used frequently.
- Row and column headings should always be visible (in Excel, applying the "split" command followed by the "freeze panes" option achieves this result).