UPDATE OF "QUARTERLY NATIONAL ACCOUNTS MANUAL: CONCEPTS, DATA SOURCES AND COMPILATION"[1]

CHAPTER 5. SPECIFIC QNA COMPILATION ISSUES[2]

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Examples

[1] The QNA manual is being updated by the IMF Statistics Department. For more information on the update, please visit the website http://www.imf.org/external/pubs/ft/qna/index.htm.

[2] Draft posted for comments in May 2016.

CHAPTER 5. SPECIFIC QNA COMPILATION ISSUES

The compilation of quarterly accounts generates specific compilation issues that are caused by the quarterly frequency of the source data. This chapter tackles some of these issues and provides guidance on how they should be resolved in order to provide accurate measurement of short-term macroeconomic developments.

1. INTRODUCTION

1. The compilation of quarterly accounts requires specific techniques and estimation methods to process, transform, and integrate quarterly source data within the SNA framework. Typically, sub-annual data are derived from a small sample of the population; they are influenced by seasonal effects; and they are subject to short-term volatility or atypical events. Quarterly data may require specific treatment to be usable for national accounts purposes. Specific compilation issues may arise at all compilation levels of the QNA and should be resolved by the compiling agency. Users should receive QNA data that are as ready for economic analysis as possible. Compilers should not expect users to make their own adjustments, because this would generate confusion between alternative estimates and reduce the serviceability of the official QNA data. Compilers usually have considerable information to perform adjustment to quarterly data. However, some treatment may require skills and competence beyond the pure knowledge of national accounts methodology.

2. In the next chapters, the Manual will cover three specific methods of the QNA: benchmarking, seasonal adjustment, and chain-linking techniques for quarterly series. Benchmarking is needed to incorporate the usually more accurate annual information into the quarterly estimates, ensuring that quarterly and annual data are temporally consistent. The aim of seasonal adjustment in the QNA is to allow a short-term analysis of trends and turning points in the economy. Finally, specific quarterly techniques should be used to chain-link quarterly series with a shifting base year.

3. This chapter provides guidance on other specific issues that typically arise when compiling the quarterly accounts. First, a few considerations are provided on when to implement, or possibly deviate from, a full-accrual principle in the QNA. Next, it is emphasized the role of good-quality measures of seasonal effects in the QNA to provide an accurate measurement of seasonal macroeconomic fluctuations. Finally, the chapter gives advice on how to conduct backcasting exercises to produce long and continuous QNA series when major revisions in the national accounts methodology are implemented.

2. TIME OF RECORDING ISSUES

4. The general time of recording principle in the SNA is the accrual basis. This principle applies to both annual and quarterly accounts. Under the accrual principle, flows are recorded

at the time economic value is created, transformed, exchanged, transferred or extinguished. Accrual accounting is in full agreement with the way economic activities and other flows are defined in the SNA. For example, the accrual principle implies that intermediate consumption of a good or service is recorded at the time when the good or service is used in the production process, and not at the time it is acquired by the producer. It also implies that output is recorded at the time the production process takes place, and not at the time the final product is sold or withdrawn from inventories.

5. The application of accrual principles may present specific practical and conceptual problems for quarterly flows. These situations typically arise when monthly or quarterly statistics record flows referring to economic events that accrue to periods longer (or shorter) than a calendar month or quarter. For example, wage arrears may be recorded in a particular month although they accrue to a number of past payroll periods. The accrual recording is even more complicated when there is a significant delay between the reporting period and the full-accrual event, which may give rise to long and hard-to-justify revision processes of quarterly estimates.

6. In order to deal with timing issues, it is useful to identify two categories of payments based on their relationship to previous periods:

- Payments that have a purely ad hoc character should be recorded in the period in which they are actually declared payable. Dividends, for example, are usually determined only after the books are closed on a fiscal year and may not even relate to the company's profits over that year. Another case is a discretionary bonus payment that cannot be linked to a particular period.

- Payments that have a fixed relation to a particular period (e.g., accrued in a previous period or accrued over a number of accounting periods) should be allocated to the periods in which they accrued. Examples are taxes on incomes and products that may be collected in a subsequent period and vacation bonuses that build up over the period of a year and on which employees have a claim if they leave the employment before payment is due. To obtain accrual-based data, the options may include surveys of enterprises—if businesses use accrual principles—allocating data on payments back to the relevant periods, or estimating the accrual of income from data on the underlying flow (e.g., income taxes from wages and profits, possibly subject to a lag). Another option is to use indicators of seasonal activity or other appropriate indicators to allocate annual totals. Once these issues are considered on a quarterly basis, the compiler may also realize that the annual data need to be adjusted to meet accrual principles.

7. Compilers should be aware that a pure accrual recording in the QNA can generate inconsistencies between transactions of the accounts that are linked by economic

relationships. A typical example is the payment of an extra salary at the end of the year (usually called the 13th salary). Employees who worked all the 12 months are entitled to receive the full payment. The accrued part of the 13th salary should be recorded as compensation of employees throughout the year (in equal parts, or in proportion of the monthly paychecks received), whereas the accrual adjustment should be recorded in the other accounts receivable or payable. However, this recording may create a timing difference between income and consumption patterns, and consequently, a measurement error in the saving rate. A peak in household consumption generally occurs in the month when the 13th salary is disbursed (for example, for purchases of gifts during the Christmas period). This consumption should be accrued to the month when it occurs, and not allocated to previous periods – in contrast with the extra salary that generated it. An inconsistency may also appear when the accrual principle is not applied symmetrically to both parties of a transaction, or when it is not applied uniformly in the quarterly and annual accounts.

8. Uncertainty in the amount to be allocated is another element that may complicate the compilation of quarterly data on an accrual basis. For example, the amount of a tax that is paid at the end of the year may not be known at the beginning of the year. If the government introduces a tax reform during the year, there could be a significant difference between the estimated amount and the true amount. This problem does not arise usually in the annual accounts, who record the true amount of tax once annually. An exception is when the tax is paid in the subsequent year (e.g., income tax), which requires an accrual distribution to the previous year in the annual accounts. Similar uncertainty exists in the allocation of expected crops output based on the work-in-progress principle (see Chapter 12 for details).

9. The lack of accrual data should never be an obstacle to the compilation of QNA. Some flexibility in the application of accrual principles is permitted, especially in the initial steps of a new QNA system. Its implementation in the QNA is likely to be more complex than in the ANA and may require additional estimates. Compilers may decide to use the recording basis of the data sources received, without making complex and dubious transformations to satisfy the accrual principle. Alternative recording principles identified in the *2008 SNA* are: (i) cash basis, with flows recorded when cash is received or disbursed; (ii) commitment basis, with flows recorded when an institutional unit commits itself to a transaction; (iii) due-for-payment basis, with flows recorded at the time cash payments can be paid without incurring additional charges or penalties. If QNA compilers choose to deviate from the accrual principle, they should clearly state the reasons of this deviation and how the adopted principle influences the evolution of QNA estimates. This information should be given in the national accounts metadata.

10. Another issue related to time of recording arises when reported data do not coincide with calendar periods. For example, enterprise data may be reported for four or five-week intervals or government data may be available for the fiscal year. In these cases, the QNA can play an important role in moving estimates in a fiscal year to their calendar year of reference (and vice versa).

3. SEASONAL EFFECTS

11. QNA series should display seasonal variations when they measure economic flows that are influenced by weather conditions, administrative reasons, or other recurrent within-a-year patterns. Annual accounts variables, in contrast, largely do not contain seasonal patterns because the seasonal movements disappear when the quarterly data are aggregated into annual data. The presence of seasonal effects brings additional conceptual and compilation issues that are specific to the QNA. Some of these issues are briefly discussed in this section.

12. As noted in the introduction to this manual, seasonal effects in the QNA disturb the identification of turning points in the business cycle. For this reason, it is common practice for QNA compilers to produce seasonally adjusted data based on well-established seasonal adjustment procedures (which are discussed in Chapter 7). Seasonally adjusted data combine the long-term trend, the business cycle movements, and the irregular effects in the series, excluding seasonal and calendar effects.

13. However, there is also an interest from users in analyzing seasonal effects of the QNA variables. Seasonality of macroeconomic variables can offer an illustrative view on how economic activity is distributed across the quarters. Unadjusted data can also be useful in econometric models, which can exploit the information contained in the seasonal component of the series in modeling the dynamic relationship among the variables. In the context of QNA compilation, unadjusted series may be better suited for balancing purposes when the seasonal component is significant. Clearly, to be relevant for users the unadjusted QNA data should reflect true underlying seasonal patterns in the economy. Sometimes compilers tend to forget about the quality of seasonal effects, as their main focus in the dissemination of QNA is on year-on-year rates or quarter-to-quarter rates from seasonally adjusted data.

14. Seasonal effects should be estimated accurately for two reasons. First, unadjusted data observe the true behavior of macroeconomic variables. Indicators of economic activity are normally received in unadjusted form, being a measurement of what is happening in the economy. It would be a waste of information if the seasonal patterns from these indicators were not used in the QNA. Many users prefer to work with unadjusted data, and possibly apply seasonal adjustment procedures by themselves. Second, seasonal adjustment procedures require that seasonal effects are stable and consistent for the entire length of the unadjusted series. Seasonal adjustment procedures do not produce accurate results when the seasonal component has an unstable and fast-evolving pattern or when it shows breaks in the seasonal pattern. Clearly, the unadjusted data should contain such effects if they reflect the reality. Structural changes in the seasonal patterns can be handled by seasonal adjustment procedures. However, compilers should avoid that implausible or artificial seasonal effects are treated as true signal and passed on as such to the seasonal adjustment phase.

15. The seasonal pattern of QNA series should be checked and validated. Before applying seasonal adjustment, one quick way to look at the seasonal effects is to look at the quarter-to-quarter rates of change of unadjusted QNA series (or their corresponding indicators). These changes can be tabulated or plotted in a chart to appreciate the regularity and magnitude of the seasonal component. Another convenient way to look at the stability of seasonal effects is to plot the level (or the rate of change) of each quarter over time in four separate graphs (see chart 7.3 for an example). The four lines, which should not present seasonal movements, should highlight how stable each quarter is throughout the years. It may also be useful to compare the seasonal effects of indicators with the seasonal effects of QNA series, so that compilers can verify that the observed seasonal pattern is fully transmitted to the QNA variables. After seasonal adjustment, a common method to validate the seasonal component is to calculate and plot the ratio between the unadjusted series and the seasonally adjusted series (the so-called seasonal factors).

16. In the assessment of seasonality, compilers should pay particular attention to possible breaks in the seasonal pattern. Sudden breaks in the seasonal pattern can arise due to administrative and economic reasons. Possible examples are when the government introduces changes in the national calendar of public holidays, or when corporations decide to change their production plans in response to booms and recessions phases. When these breaks are noted, it is necessary to investigate the causes behind these breaks and understand whether these events are temporary or permanent (which may influence their treatment in the seasonal adjustment procedure). The news in the media may offer an explanation for important events, otherwise it may be necessary to request clarifications from the data providers. When breaks in the data are visible in the main QNA aggregates (such as the GDP), an explanation of the break should be given in the press release notes and included in the metadata of QNA.

17. A further element to consider in the compilation of unadjusted QNA data is to verify that the seasonality in the indicator is representative of the seasonality in the QNA series. Quarterly indicators may fail to reproduce the true seasonal effects of QNA series (which are unknown), even when they are good at reproducing their short-term and long-term changes. Typically, this happens when the indicator covers just a subset of a much broader concept measured in the national accounts, which may be influenced by different seasonal effects. An example of this type is when an indicator of tourist arrivals in hotels, which usually presents strong seasonal variation, is used to estimate the output of accommodation services as a whole, whose fluctuations are more evenly spread out across the year. When the seasonal pattern in the indicator is not considered adequate, compilers should make adjustments to the seasonal pattern of the QNA variable. Seasonal effects from other related indicators or ad-hoc assumptions on the quarterly pattern of the QNA underlying concept should be used to make these adjustments.

18. Seasonal movements of related variables of the accounts should be coherent. It is expected that seasonal peaks and troughs are consistent in the supply and use components of the same product. These checks are promptly available when supply-use tables are available

on a quarterly basis: discrepancies between supply components (output and imports) and use components (consumption, capital formation, exports) can be calculated for each quarter in an automated manner (see the supply-use model presented in Chapter 9). A seasonal pattern in this discrepancy may signal the need for a better integration of QNA indicators. When quarterly supply-use tables are not available, a validation should be done by cross-checking the seasonal effects of related QNA variables (e.g., by using a simple commodity flow model). In some situations, deviations between seasonal effects of related variables may be caused by different patterns in the decisions of economic agents. For example, production and consumption of motor vehicles may peak at different quarters. In such case, a deviation between production and consumption seasonal patterns may be justified by a concurrent change in the seasonal pattern of inventories.

19. Finally, consistency in seasonality should also be preserved between price, volume, and value components of the same QNA variable. Price changes are often non-seasonal, but they can show seasonal movements for products with specific price changes that occur repeatedly at the same time of the year (e.g., tuition fees, rents, fruits, tourism activities). Normally, seasonal changes in the QNA are observed in value and volume indicators. When the price index is implicit, the value and volume indicator should show a consistent seasonal pattern. At a minimum, they should show peaks and troughs in the same quarters of the year. However, there are cases when the value component is strongly seasonal while the volume component is not (or vice versa). For example, the output at current prices of non market services (e.g., health or education) may show a pronounced seasonality while the output in volume shows a fairly flat level during the year.[3] This situation may occur if the output at current prices is estimated using an indicator of wages and other current expenses (which contain seasonal effects), while the output at constant prices is based on employment indicators or measures of outcome (which are generally less influenced by seasonal fluctuations).

4. BACKCASTING

20. A major strength of the national accounts is to offer long and continuous time series for economic analysis. Long and continuous QNA series are necessary for short-term economic modeling and forecasting. QNA data should be comparable over time so that they can provide accurate measurements of short-term and long-term economic changes between any chosen quarters. In theory, new concepts and methodologies of national accounts should be carried as far backward as possible to avoid breaks in the QNA series. In practice, this task is complex because the data to compile backward periods under new principles may not be available or new classifications may simply not be applicable to previous periods.

[3] However, the volume estimate of non market output may show strong seasonal effects when the volume measure is done using hours worked.

Consequently, it may not be possible to recalculate back series following the same methodology used for current periods.

21. The term "backcasting" (or "back-calculation") indicates all the steps undertaken to reconstruct backward data using current measurement standards. The objective is to provide the user with long and continuous time series. In the national accounts, a backcasting exercise is typically required at the time of a major revision for introducing methodological changes, new accounting standards, new classifications, new benchmark years or base years, or new data sources. These revisions may lead to breaks in the time series when they cannot be applied for the entire length of the national accounts. These breaks can hamper the comparability between observations in the pre- and post- revision periods. Backcasting can also refer to specific items of the accounts, when there is a need to revise the specific methodology for those components.

22. A backcasting exercise should be conducted in a coordinated manner for both annual and quarterly accounts. The same principles of backcasting should apply for both annual and quarterly accounts. However, in some situations it may not be possible to use the same approach for the quarterly data. For example, data sources for back periods may only be available at the annual level. In addition, the QNA are often compiled using a different, simplified framework than the one used for the ANA. Whatever approach is used, QNA and ANA should be consistent in any backward period. The benchmarking methods presented in Chapter 6 can be used to realign quarterly data to annual benchmarks that are back-calculated independently.

23. There are two approaches to backcasting in QNA compilation: (i) the micro approach, and (ii) the macro approach. The micro approach aims at recompiling the QNA variables starting from the source data at the most elementary level of detail. The micro approach guarantees the most accurate results as the micro data are processed and aggregated using the new concepts, principles, and definitions. However, it may not be feasible to re-run the entire compilation process with available resources and time constraints. The micro approach should certainly be considered the best approach in the annual accounts, as these usually determine the levels of national accounts variables. In the QNA, instead, an exact reconstruction of the levels may not be essential when the same calculations are done in the ANA. The main purpose of the QNA is to provide a measurement of short-term changes in the economy, which may be reconstructed without recurring to complex and tedious calculations at the micro-level.

24. Opposite to the micro approach, the macro approach works at more aggregate levels. The macro approach comprises statistical techniques and estimation methods that make a greater use of assumptions about how new concepts and principles apply to the past. These methods can make use of previously published QNA series, indicator series, or intermediate series calculated in the various steps of the QNA compilation process. Results may differ according to the aggregation level of the data; compilers should choose the preferred detail

level taking into account the complexity of the backcasting exercise and the quality of the recalculations. Ideally, backcasting methods should be applied at the most detailed level of the GDP compilation. It is also preferable to start from the original quarterly indicator series instead of previously published QNA data. In practice, countries should adopt a mix of methods that best suit the specific circumstances and needs of their particular backcasting exercise.

25. Splicing (or linking) is the simplest and most common backcasting method. Splicing can be used to link the new series with the old published national accounts series. The only requirement is to have an overlap between the old and new series for at least a period. Clearly, the old and new series should measure as much as possible the same concept. Backward data are obtained by multiplying the values of the old series by the ratio between new and old levels in the overlap period. In the case of quarterly series, the overlap period can be either the first quarter or the first year in the new series. In the former case, the new series will show the same quarter-to-quarter rates of change of the old series in the backward period. The underlying assumption is that the impact of the changes in the overlap period remains the same in the backcasting period. With an annual splicing, the adjustment ratio is taken from the whole year; in this case, the spliced series will preserve the old year-on-year rates for the overlap year (i.e., each quarter compared with the same quarter of the previous year). The two splicing techniques are shown in Example 5.1.

26. The quarterly splicing is the preferred approach as it provides the smoothest transition between the old and new series. The annual splicing may introduce a step in the overlap year. However, compilers should be aware that the quarterly splicing may introduce a break in the seasonal pattern if the new series presents seasonal effects that are different from those in the old series. The annual splicing could be preferable when there is a need to preserve the new seasonality in the backward series.

27. Another splicing possibility is to link gradually the old series to the new series. This approach aims at interpolating the new level of the series with a particular point in time of the backcasting period (one year or one quarter). The rates of change in the in-between periods will change accordingly. This method can be appropriate when a particular level in the old series should be preserved. This situation could arise when it is required to maintain levels of national accounts variables that had been estimated from previous benchmark revisions. A possible method to obtain a graduated splicing is explained in Example 5.2.

28. More sophisticated estimation methods may be required when the assumptions underlying basic splicing techniques do not hold. For example, a more elaborated backcasting solution should be devised when there is an update of classifications. In such cases, assuming that the new series present the same movements of the old series may lead to incorrect results. New classifications bring items that did not exist before, or may change the way previous items were aggregated in top-level groups. Furthermore, an additional constraint for pure classification changes is that the total should not change. Bridge tables

between old and new classifications should be created to help reconstruct old indicators according to a new classification. One way to reconstruct short-term dynamics of new items in past periods is to estimate regression models between QNA series and proxy indicators for those items. For example, the output of a newly-classified economic activity can be related to employment or wage data from affine activities. The regression model can include lags of the variables and other auxiliary information. This approach should be used with caution as these methods rely on behavioral relationships between national accounts variables and related information that may not hold for the entire time period.

29. In the backcasting exercise, compilers of QNA should be mindful of preserving consistency with the annual accounts and within the quarterly accounts. Benchmarking methods should be used to realign backcast QNA series with the counterpart series of the annual accounts. To maintain consistency across the accounts, it may be chosen to derive one item of the accounts as a residual component. Alternatively, back-calculated QNA series can be made consistent across time and space using reconciliation methods that align the series with both temporal and cross-sectional constraints. Benchmarking and reconciliation methods are presented in Chapter 6.

30. One problem of consistency that may arise from the application of backcasting techniques at all levels of compilation is the lack of additivity between components and aggregates. This approach has the advantage of preserving the original information for each series. However, it will show discrepancies between components and aggregates. This problem can be solved if these techniques are applied at the component level only, while the aggregate is derived as the sum of the reconstructed components. A disadvantage of this approach is that the aggregate rates of change will differ from the original ones, which may lead to confusion and criticisms from the user. The choice will also depend on the types of revision introduced. If there is a reshuffle in classifications, components that are not affected by the classification change should be preserved. When new methods are introduced, the aggregate changes should not be preserved. Generally speaking, compilers should implement a backcasting solution that preserves as much as possible the consistency property of national accounts and, at the same time, minimizes the changes on the economic history of a country.

31. QNA series should always be recalculated as far back as the annual accounts. However, it may not be possible to reconstruct the entire QNA series at the time of a major revision of national accounts when all the resources are focused on developing the new benchmark estimates. In such cases, the reconstruction of QNA series should take place as soon as possible after the completion of the revision. Short QNA series can be accepted by users for a limited time if there is a clear plan on when the backward series will be communicated. Users may question the capability of a compiling agency if it takes a long time to release long QNA series. In case of delays, other institutions or individuals may decide to compile their own “unofficial” recalculations of QNA series. This would add further confusion in the user and pressure on the compiling agency. The best approach is that

sufficiently long QNA series are reconstructed and published by the compiling agency when a benchmark revision on national accounts is released.

32. Clearly, backcasting exercises have resource implications that need to be considered at a very preliminary stage. A great deal of work is required to recalculate the QNA series and to validate the consistency and coherence of the results. When national accounts managers consider pros and cons of alternative backcasting techniques, they should have in mind how much time will be required to achieve the expected results. Simplified approaches should be preferred over more sophisticated methods when the gain in quality is not expected to overcome the additional costs involved. When the cost is too high, it may be decided that old QNA series are not reconstructed, or are reconstructed starting from a later period. When the old QNA database is left in the public domain, the metadata should clearly describe the differences with the new database and warn users of potential breaks in comparing the two sets of series.

33. Backcasting of the QNA should be planned as an integral part of major revisions of national accounts. All the steps of a backcasting exercise should be decided well in advance, and not left for future implementation after the release of the revision. Decisions should be taken on the coverage of backcasting, namely how far back the series should be recalculated and at what level of detail. Furthermore, the different kinds of revisions should be identified and properly accounted for in the backcasting methods used. Sufficient time should be allocated to analyze and validate the results of backcasting before the new series are released to the public. Compilers should detect all the changes in the pattern of main QNA aggregates, and connect them to one or more specific sources of revisions due to changes in data sources, statistics methods, or compilation practices. Compilers should also ensure that all these changes are economically plausible. Finally, the publication date of back-calculated QNA series should be scheduled in the advance release calendar. Users should be informed in advance if the length of QNA series will be shorter than in the previous estimates.

34. The results of a backcasting exercise should be validated and carefully assessed before publication. A comparison between old and new QNA series is essential for assessing the impact of the revision to historical data (see Chapter 12 for details on revisions analysis). Large deviations from previous quarterly movements should be explained and accounted for, especially for large macroeconomic aggregates. In particular, compilers should check that the timing of turning points in the quarterly GDP is broadly maintained. In general, the QNA team should be able to address any possible queries from users about the revised short-term developments of the main QNA aggregates.

35. Consultations with stakeholders and other major users of the QNA should be held during the various steps of the backcasting exercise. At an early stage, it is advisable to reach out to key users such as the Central Bank and the Ministry of Finance when the most important decisions of backcasting are taken. These preliminary meetings can be useful to get informal views from users on how to conduct the backcasting exercise and how to

communicate the results. Before the official release, the compiling agency can organize internal seminars for broad groups of users to present the backcasting methodology and show some key results. Finally, the publication of revised QNA series should be accompanied with detailed metadata describing the different approaches used in the recalculation. Revisions studies should also be published at the time of release (using the methodology presented in Chapter 12). Particular attention should be given to the changes in the quarterly and annual movements of the GDP and the main production and expenditure components.

SUMMARY OF KEY RECOMMENDATIONS

- *Although the general time of recording principle in the SNA is the accrual basis, the application of accrual principles may present specific practical and conceptual problems for quarterly flows. Some flexibility in the application of accrual principles in the QNA may be necessary when this may generate incoherent patterns in related QNA variables and increase uncertainty in the preliminary estimates.*
- *Seasonal effects in the QNA should be estimated accurately. Seasonality of macroeconomic variables can offer an illustrative view on how economic activity is distributed across the quarters. Stability in the seasonal pattern is also a requirement for seasonal adjustment procedures.*
- *Backcasting techniques should be used to produce long and continuous QNA series when a benchmark revision on national accounts is conducted. QNA should preferably be recalculated as far back as the annual accounts. All the steps of a backcasting exercise should be decided well in advance as an integral part of major revisions of national accounts.*

Example 5.1. Basic Splicing Techniques

	QNA series		Spliced QNA series	
	New	Old	Quarterly Splicing	Annual Splicing
	(1)	(2)	(3)	(4)
q1 2010		885.7	1080.9	1129.7
q2 2010		862.7	1052.8	1100.4
q3 2010		696.6	850.1	888.5
q4 2010		845.3	1031.6	1078.2
q1 2011		907.0	1106.9	1156.9
q2 2011		963.6	1176.0	1229.1
q3 2011		798.8	974.9	1018.9
q4 2011		900.8	1099.3	1149.0
q1 2012	1189.4	974.6	1189.4	1189.4
q2 2012	1242.5	1037.3	1242.5	1242.5
q3 2012	1178.3	876.1	1178.3	1178.3
q4 2012	1318.4	976.0	1318.4	1318.4
q1 2013	1370.1	1155.4	1370.1	1370.1
q2 2013	1388.9	1171.7	1388.9	1388.9
q3 2013	1279.5	989.0	1279.5	1279.5
q4 2013	1402.9	1090.5	1402.9	1402.9

Basic Splicing Techniques

Example 5.1 presents two alternative splicing techniques for quarterly series. The quarterly splicing is the preferred method in most cases. The annual splicing can be used when there is a need to combine the long-term trend in the old series with the seasonality in the new series.

- **Quarterly splicing** (column 3). The splice point is the first overlapping quarter for the two series, which is the first quarter of 2012 in this example. The splice factor is the ratio between the new value and the old value for $\text{q1 2012} \Rightarrow 1189.4 \big/ 974.6 = 1.2204$

  The backward series is obtained by multiplying the values of the old indicators and the splice factor:

  $\text{q4 2011} \Rightarrow 900.8 \cdot 1.2204 = 1099.3$ and so forth.

- **Annual splicing** (column 4). The splice point is the first overlapping year. The splice factor is calculated for 2012 as the ratio between the new annual value and the old annual value for 2012:

  $$2012 \Rightarrow (1189.4 + 1242.5 + 1178.3 + 1318.4) \big/ (974.6 + 1037.3 + 876.1 + 976) = 1.2755$$

  The backward series is obtained by multiplying the values of the old indicators and the annual splice factor:

  $\text{q4 2011} \Rightarrow 900.8 \cdot 1.2755 = 1149.0$ and so forth.

Example 5.2. Graduated Splicing

	QNA series		Graduated Spliced QNA series	
	New Indicator	Old Indicator	Step 1	Step 2
	(1)	(2)	(3)	(4)
2010		3290.3	3290.3	
2011		3570.2	3891.0	
2012		3864.0	4601.3	
2013	5441.3	4406.6	5441.3	
2014	5753.3	4668.5	5753.3	
q1 2010		885.7		867.8
q2 2010		862.7		852.6
q3 2010		696.6		700.2
q4 2010		845.3		869.7
q1 2011		907.0		962.0
q2 2011		963.6		1045.8
q3 2011		798.8		880.5
q4 2011		900.8		1002.7
q1 2012		974.6		1088.4
q2 2012		1037.3		1147.3
q3 2012		876.1		1104.5
q4 2012		976.0		1261.1
q1 2013	1370.1	1155.4		1345.0
q2 2013	1388.9	1171.7		1387.7
q3 2013	1279.5	989.0		1290.5
q4 2013	1402.9	1090.5		1418.1
q1 2014	1409.2	1242.3		1416.4
q2 2014	1447.8	1236.8		1448.9
q3 2014	1383.8	1046.9		1380.8
q4 2014	1512.6	1142.5		1507.1

Graduated Splicing Technique

The graduated splicing technique can offer a convenient approach for linking a new benchmark level to an old one.

Example 5.2 shows a possible way to recalculate a QNA series for the period 2010-2012 maintaining the level of the 2010 benchmark year. In the first step (column 3), the annual data for 2011 and 2012 are reconstructed using the following equations:

$$2011 \Rightarrow \left(\frac{5441.3}{3290.3}\right)^{1/3} \cdot 3290 = 3891.0$$

$$2012 \Rightarrow \left(\frac{5441.3}{3290.3}\right)^{2/3} \cdot 3290 = 4601.3$$

The 2011 and 2012 data are reconstructed by extrapolating the 2010 benchmark level using a variable adjustment factor: the ratio between the 2013 benchmark level (5441.3) and the 2010 benchmark level (3290.3) raised to the power of $\frac{t}{3}$, where t is the number of years from 2010.

It should be noted that this interpolation method reconstructs the annual levels between two benchmark years assuming a constant annual rate of change in the backcast period. In fact, the rate of change for 2011, 2012 and 2013 remains constant in this example:

$$2011 / 2010 \Rightarrow \left(\frac{3891.0}{3290.3} - 1 \right) = 18.3\%$$

$$2012 / 2011 \Rightarrow \left(\frac{4601.3}{3891.0} - 1 \right) = 18.3\%$$

$$2013 / 2012 \Rightarrow \left(\frac{5441.3}{4601.3} - 1 \right) = 18.3\%$$

In the second step, the quarterly spliced series obtained in Example 5.1 is benchmarked to the annual series (3) using the Denton proportional benchmarking method illustrated in Chapter 6. The new QNA series in (4) maintains the two benchmark levels of 2010 and 2013 and preserves at the best the quarterly movements of the original quarterly spliced series.

This approach produces a much faster growth in the period 2010-2012 than the old series. When this method is used, compilers should verify that revisions in the trend between benchmark periods accurately describe the true developments in the economy and are not generated by a pure statistical construct.