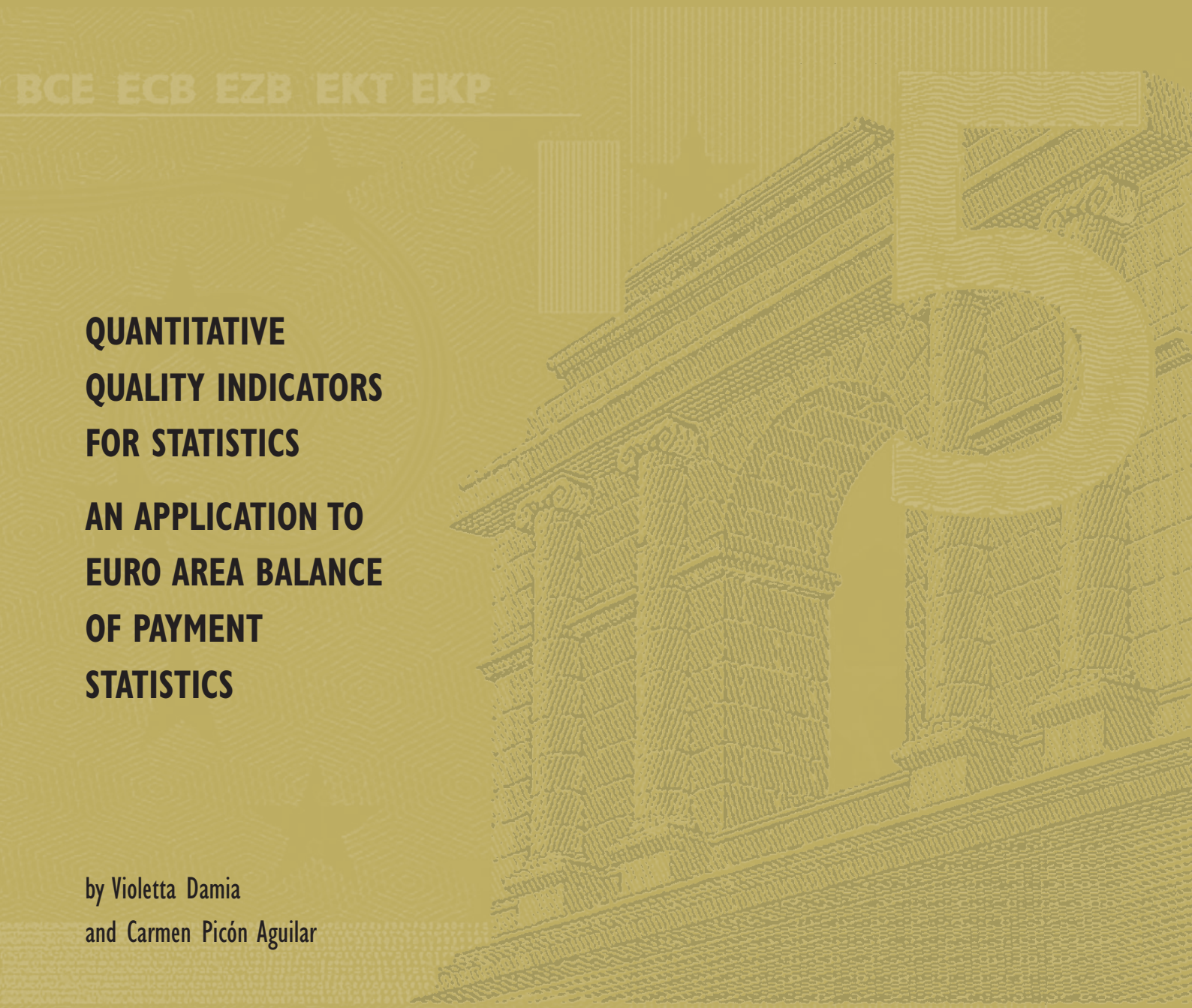
EUROPEAN CENTRAL BANK
EUROSYSTEM

OCCASIONAL PAPER SERIES
NO 54 / NOVEMBER 2006



QUANTITATIVE QUALITY INDICATORS FOR STATISTICS

AN APPLICATION TO EURO AREA BALANCE OF PAYMENT STATISTICS

by Violetta Damia
and Carmen Picón Aguilar

EUROPEAN CENTRAL BANK

EUROSYSTEM

OCCASIONAL PAPER SERIES

NO 54 / NOVEMBER 2006

QUANTITATIVE QUALITY INDICATORS FOR STATISTICS

AN APPLICATION TO EURO AREA BALANCE OF PAYMENT STATISTICS

by Violetta Damia

and Carmen Picón Aguilar

In 2006 all ECB publications feature a motif taken from the €5 banknote.

Address
Kaiserstrasse 29
60311 Frankfurt am Main
Germany

Postal address
Postfach 16 03 19
60066 Frankfurt am Main
Germany

Telephone
+49 69 1344 0

Website
http://www.ecb.int

Fax
+49 69 1344 6000

Telex
411 144 ecb d

ISSN 1607-1484 (print)
ISSN 1725-6534 (online)

CONTENTS

ABSTRACT

Quality is a subjective notion and encompasses all aspects of how well a product meets users' needs. It is inherently a multi-faceted concept that cannot be easily defined; any chosen definition is likely to change over time as new aspects gain importance following the evolving users' needs.

The purpose of this paper is threefold; (1) to present a number of quantitative quality indicators, (2) to apply them to measure the quality of balance of payments (b.o.p.) data at the euro area level, and (3) to identify various aspects of data quality that may be enhanced, together with their interrelations with other quality dimensions.

The indicators used are compatible with the IMF Data Quality Assessment Framework (DQAF), as defined for b.o.p. statistics, focusing mainly on revisions and consistency.

The results obtained from such quantitative indicators may help compilers to set priorities in order to improve the quality of the euro area data still further in dimensions such as accuracy, reliability and serviceability. Additionally, this assessment may help users to understand better the quality of the data, to anticipate the possible size and direction of the forthcoming revisions, and to evaluate the impact of using different datasets in their analysis.

EXECUTIVE SUMMARY

Quality is a subjective concept and encompasses all aspects of how well goods or services meet users' needs. When applied to statistics, quality is linked to users' expectations about the information content of the disseminated data.

The IMF Data Quality Assessment Framework (DQAF), as defined for balance of payments (b.o.p.) statistics, covers all possible aspects of users' needs. This framework assists in considering all the quality features of the data and in measuring them, as well as in assessing the trade-offs among the various dimensions and/or elements of quality.

The purpose of this paper is to describe some quantitative quality indicators and to apply them to measure the quality of b.o.p. data at the European level. It focuses on revisions and consistency. The intention is not to present a unique measure for the assessment of the quality of b.o.p. data, but to identify various aspects of data quality that may be enhanced, together with their interrelations with other quality dimensions.

The results obtained from applying the revision indicators to the monthly euro area b.o.p. data indicate that in the last five years, the relative magnitude of revisions has decreased for the majority of the examined series. However, some series seem to display a significant revision bias, which points to the need for further analysis and for better coverage or improved estimation methods for the initial data releases at the level of country contributions. Finally, based on the results of the revision indicators, users may be able to anticipate when the data will become sufficiently stable.

The results of the internal consistency indicators show that errors and omissions in the euro area b.o.p. statistics have recently increased. In particular for 2004, they followed a persistent negative pattern, although this bias is still not statistically significant. At the same time, these indicators have considerably improved since the data revisions in April 2004, October 2004 and April 2005.

The external consistency indicators between exports and imports of goods in the b.o.p. statistics and the external trade statistics show that the divergence between the two datasets for imports has been quite stable for the last four years, after recording a major improvement in 1999. By contrast, for exports this divergence worsened during 2003 and 2004. An important reason for the discrepancy between the two datasets is the difference in timeliness, in terms of both the time of recording and the time of reporting. The effect of the latter is smoothened after the incorporation of the revisions. On the other hand, the consistency indicators between b.o.p. financial flows and monetary financial institution (MFI) balance sheet statistics show that both series tend to follow the same pattern and that no significant bias exists. The consistency between the series significantly improved between 1999 and 2000, and has since remained stable. Moreover, revisions appear to have had no substantial effect on the consistency between b.o.p. and monetary data.

The results obtained from these quantitative indicators may help compilers to set priorities in order to improve further the quality of the euro area data in dimensions such as accuracy, reliability and serviceability. Additionally, this assessment may help users to understand better the quality of the data, to anticipate the possible size and direction of the forthcoming revisions, and to evaluate the impact of using different datasets in their analysis.

Finally, all the indicators in this paper may also be applied to other macroeconomic datasets, such as national accounts or monetary statistics.

I INTRODUCTION

A key factor in the future success of an organisation is its reputation with regard to the quality of its products. Organisations must be dedicated to achieving ongoing improvements in order to meet customer needs as they evolve. Following this requirement, quality is defined as the totality of the features and characteristics of a product or service that affect its ability to satisfy stated or implied needs.[1]

As applied to statistics within the ECB, quality encompasses all aspects of how well statistics meet users' needs and their expectations about the information content of the disseminated data. Users of statistics expect reliable data upon which they can base their decisions. In addition, these data need to be available on a timely basis. At the same time, users understand that statistical data are often revised, notably when further basic information becomes available, so as to increase their accuracy and to contribute effectively to econometric modelling and in the preparation of monetary and other economic policies.

The measurement of quality is not straightforward. For example, in terms of reliability it is typically assumed – but not guaranteed – that the most recently published data for a certain reference period are also the most reliable. Therefore, these data serve as a reference for measuring the deviation from previous assessments of the same phenomenon. However, there may be interrelations and trade-offs between the various aspects of quality, or different priorities which may result in different benchmarks of quality.

Against this background, the fourth progress report on the Economic and Monetary Union (EMU) action plan, endorsed by the ECOFIN Council[2] in November 2001, invited the SPC[3], in close cooperation with the CMFB[4], to make some proposals on the operational assessment of the various quality dimensions. Following this request, the CMFB approved the mandate for a joint ECB/European Commission (Eurostat) task force on (output) quality (TF-QA) at its January 2002 meeting, dealing with balance of payments (b.o.p.) and with quarterly national accounts statistics.

The TF-QA took stock of the quality concepts and definitions as presented in the IMF's Data Quality Assessment Framework (DQAF)[5], with the aim of identifying and evaluating a set of operational indicators on output quality to be applied to the euro area/EU aggregates and to the contributing b.o.p./i.i.p. (international investment position) data from Member States. Indicators were set up to assess the size, recurrence, bias, etc. of the revisions. For some indicators, e.g. on errors and omissions, it was also considered important to define a standard so that comparisons could be made across countries/economic unions.

This paper, which complements the "Euro Area b.o.p. and i.i.p. Statistics Annual Quality Report"[6], is a continuation of the work conducted by the TF-QA, and focuses on revision and consistency indicators. It presents quantitative indicators for the assessment of quality in these two areas, and applies these indicators to the euro area b.o.p. data, with the aim of generalising and extending this approach to other datasets.

This paper is structured as follows. Section 2 defines the users of statistics and their needs, and outlines the DQAF, which forms the main reference framework. Section 3 describes the methodology followed for the consistency and revision indicators. Section 4 presents the euro area b.o.p. data used in the quality study. Section 5 provides the main results. Finally, Section 6 provides a summary and concludes with a proposal to improve quality by taking

1 Source: ISO 8402 (1986).
2 Short for the EU Council of Ministers of Economic Affairs and Finance.
3 The European Commission's Statistical Programme Committee, created in 1990.
4 The Committee for Monetary, Financial and Balance of Payments Statistics, created in 1991.
5 http://dsbb.imf.org/vgn/images/pdfs/dqrs_bop.pdf IMF, July 2003: http://dsbb.imf.org/Applications/web/dqrs/dqrsdqaf/
6 The 2005 report: http://www.ecb.int/pub/pdf/other/bop_intinvpos-2006en.pdf

into account the various trade-offs as well as the necessity of updating users' needs.

2 IDENTIFICATION OF USERS' NEEDS AND OF MAIN QUALITY DIMENSIONS

2.1 USERS OF STATISTICS

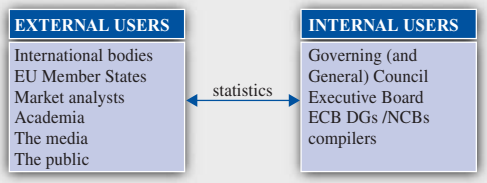
The definition of quality as the ongoing satisfaction of users' stated or implied needs means that quality depends on the use to which the statistics in question are put.

External and internal users of statistics – such as policymakers in central banks, governments and international organisations, investment fund managers, financial market rating agencies and academics – all expect reliable data for taking decisions. At the same time, these data are hardly useful if they are not delivered in a timely manner. There is therefore a clear trade-off when assessing data quality between accuracy and reliability on the one hand, and timeliness on the other.

Users also expect that the statistical data will be revised so as to increase their accuracy. Researchers and analysts are particularly interested in finding out the probability, direction and magnitude of any subsequent revisions and the speed of convergence to the final data in order to enhance their analyses and forecasting exercises.

In parallel, statisticians need feedback on the quality of their data in order to define priorities for the evaluation and improvement of their statistical collection methods and compilation processes, and to be able to produce the highest quality data despite constraints such as scarce resources.

Chart 1 Users of statistics



2.2 THE IMF DATA QUALITY ASSESSMENT FRAMEWORK

The IMF DQAF[7] serves as the reference framework for the work presented in this paper. This framework is primarily based on two factors: (a) a common understanding of the quality dimensions and elements, and a shared approach to assessing and measuring quality which allows data and metadata to be internationally comparable; and (b) a common vision with regard to the priorities to be given to quality standards, especially taking into account the possible trade-offs.

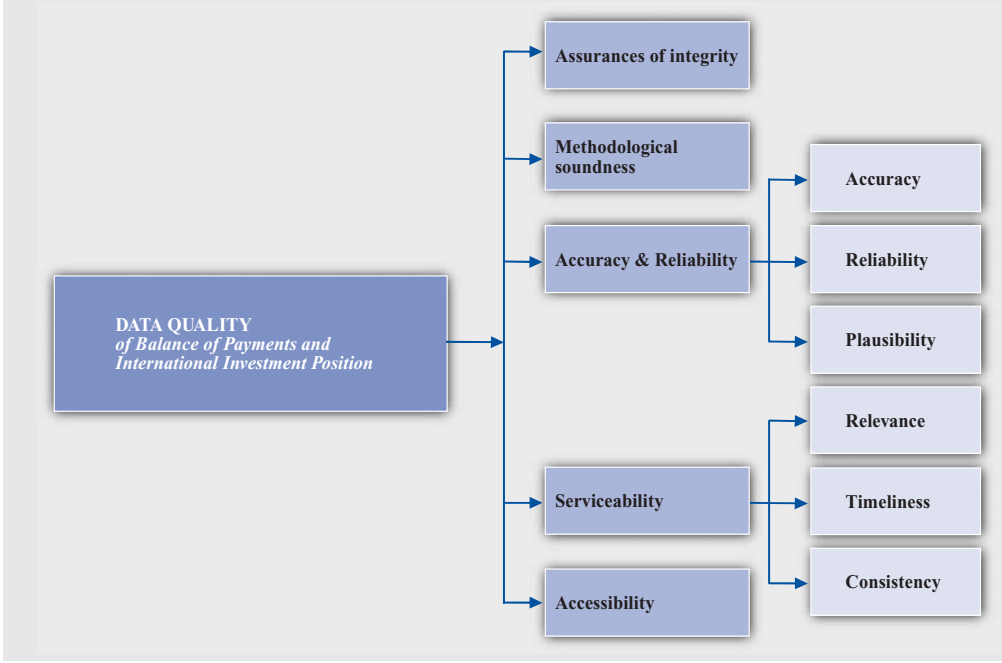
As per Chart 2, the quality components in the DQAF follow a cascade structure that proceeds from the abstract/general to the more concrete/specific with various dimensions, whereby each dimension comprises a number of elements that are in turn associated with a group of potential indicators.

A first step in the data quality assessment may cover the dimensions of methodological soundness, accessibility and integrity. These dimensions can only be assessed in a qualitative manner; integrity may be more difficult to assess in practice, and depends on the transparency of the data-providing institution. A second step in assessing quality is then to consider the other two dimensions: accuracy and reliability, and serviceability.

Given that this paper concentrates on revision indicators within the dimension of accuracy and reliability, and on consistency indicators within the dimension of serviceability, it is worthwhile defining them in the field of b.o.p. statistics. According to the DQAF, with regard to b.o.p. statistics[8], the accuracy and reliability

7 http://dsbb.imf.org/Applications/web/dqrs/dqrsdqaf/
8 http://dsbb.imf.org/vgn/images/pdfs/dqrs_bop.pdf

Chart 2 Data quality framework



dimension "*covers the idea that source data and statistical techniques are sound and statistical outputs sufficiently portray the reality of the economy*" and thus "*the revisions, as a gauge of reliability, are tracked and mined for the information they may provide*".

Following these definitions, the DQAF suggests that revisions to b.o.p. statistics should be assessed in terms of their frequency and number, their direction and magnitude, and their pattern. The analysis of these revisions provides the basis for recognising any persistent or predictable bias in data initially released that could be removed through a better first estimation. The findings should then be fed back into the data compilation process.

Regarding the serviceability dimension, the DQAF states that "*statistics, with adequate periodicity and timeliness, are consistent and follow a predictable revisions practice*", whereas in terms of consistency, statistics should be "*consistent within a dataset, over time, and with major other datasets*".

Apart from the application of consistent concepts and compilation approaches in the different sub-accounts of the b.o.p., the definition mentioned above implies for the internal consistency of b.o.p. data, the existence of small and stable net errors and omissions.[9] External consistency refers to the comparison with international merchandise trade data, with national accounts, with monetary and financial statistics, with external debt statistics, and/or with i.i.p. statistics.

2.3 TRADE-OFF BETWEEN QUALITY DIMENSIONS/ELEMENTS

Although the DQAF makes a clear distinction between the various dimensions and their

9 For monetary statistics, an internal consistency indicator could be applied to the consolidated balance sheet of the euro area monetary financial institution (MFI) sector (ECB Monthly Bulletin, Section 2.2); the latter is obtained by netting the aggregated balance sheet positions between MFIs in the euro area. The sum of the inter-MFI positions should ideally be zero or very small and, as a consequence, could be used as an internal consistency indicator (this balance is shown in column 10 on the liabilities side of the same Monthly Bulletin section).

elements, it also takes into account their interrelations and trade-offs.

For example, there may be a trade-off between *reliability/stability* (expressed as the difference between the first and "final" estimates of a phenomenon) and *accuracy* (i.e. the difference between an estimate and the true value of the variable being measured). Although users appreciate stable data, stability can also imply that additional (more comprehensive) information was not used to enhance the information provided in the first assessment. Even worse, it may suggest that deficiencies in the first estimation of the variable are not revealed at all. As a consequence, stable data might not accurately reflect reality. The same applies when a methodological change is made but the historical data are not revised. By contrast, a high degree of instability is an indication of a suboptimal data collection and compilation procedure.

A second possible trade-off is between *timeliness* and *accuracy/reliability*. The common understanding is that the shorter the deadline, the more challenging it is to be accurate. Up to a certain point, timeliness may be improved without (substantially) reducing accuracy. After this point, however, this is no longer possible, and more reduced timeliness purely results in very incomplete source data, whereby a significant part of the source information only becomes available after the first release of the statistics concerned. This in turn is likely to lead to substantial revisions, which damages the reliability of the data. An optimal balance between these two objectives thus needs to be achieved.

Another possible trade-off can exist between *reliability/stability* and *integrity*. All statistical agencies need to provide an accurate picture of recent as well as previous periods, according to a predetermined release calendar. If significant errors or revisions of the data are not revealed as soon as they are known, data users could assume a lack of integrity on the part of the agency concerned.

Against that background, this paper does not advocate a unique measure for the quality of b.o.p. data. It recognises that different aspects of data quality should be considered, while specifically focusing on revisions as a key element of reliability, and on consistency as a key element of serviceability.

3 METHODOLOGY

This section describes the methodology followed in the assessment of the stability and the consistency of the data. The quality indicators have been designed for b.o.p. data, but most can also be applied to other kinds of macroeconomic statistics.

3.1 REVISION INDICATORS

The size and direction of revisions can be assessed by simple statistics and/or by using a variety of more sophisticated indicators. The choice may depend on the characteristics of the data (e.g. b.o.p. or national accounts, national data or supranational aggregates) and/or the phenomenon the compiler wishes (or is able) to measure. The latter can for example take the form of a simple assessment of the size of revisions; a comparison of revisions across items and/or countries and lifecycles, and an analysis of these revisions (and their changes) over time; or the identification of systematic distortions and correlations with other variables.

Two types of indicators will be presented in this section: (i) descriptive measures of revisions, which aim at assessing the size or the direction of revisions, and (ii) relative measures of revisions, in order to make the indicators comparable across items and/or countries, and to detect any persistent patterns in the revisions.

3.1.1 DESCRIPTIVE MEASURES OF REVISIONS

Size indicators

Simple indicators of revisions $R = (X^j - X^i)$ express the changes in relation to the size of the variable X, where i and j identify two specific time-lags, with j >i.

An average of these revisions, R_r, provides an indication of how far on average the first assessment was from the latest assessment. However, if large positive and negative revisions almost cancel each other out, this may provide a spuriously positive impression of data quality. Therefore, the average of the absolute revisions R_l is generally seen as a better indicator of stability.

Directional indicators

Two additional indicators are considered concerning the sign and trend of the revisions.

In principle, both positive and negative revisions could occur in a series. If the revisions are systematically positive or negative, this points to the necessity of analysing and correcting the underlying reasons for this, e.g. a lack of coverage in early estimates. This simple indicator is the ratio between the number of upward revisions and the number of observations considered (N).

$$\text{upward revisions} = {}^{\#\text{ upward revisions}}/_{N} \qquad (1)$$

To assess whether the sign of the changes over time as revealed by the earlier estimates has not been systematically altered by the revisions, a 2 × 2 contingency table can be set up. In this contingency table, the columns consist of positive and negative first differences of the early estimates, $\Delta x_t^i = x_t^i - x_{t-1}^i$ while the rows consist of positive and negative changes of the latest values $\Delta x_t^j = x_t^j - x_{t-1}^j$.

Table 1 Contingency table for directional reliability

	$\Delta x_t^i > 0$	$\Delta x_t^i \leq 0$	Subtotal
$\Delta x_t^j > 0$	n_{11}	n_{12}	$n_{11}+n_{12}$
$\Delta x_t^j \leq 0$	n_{21}	n_{22}	$n_{21}+n_{22}$
Subtotal	$n_{11}+n_{21}$	$n_{12}+n_{22}$	N

The directional reliability indicator (Q) is built as follows:

$$Q = \frac{n_{11} + n_{22}}{N} \qquad (2)$$

The coefficient (Q) is equal to 1 when the changes of the early and latest estimates always follow the same pattern ($n_{11}+n_{22}=N$), and equal to 0 when this is never the case ($n_{11}+n_{22}=0$).

The directional reliability indicator (Q) expresses the percentage of cases in which earlier and later assessments move in the same direction. High values are optimal in terms of increasing the reliability of the data.

3.1.2 RELATIVE MEASURES OF REVISIONS

The simple calculation of revisions, using the differences between first and later estimates, expresses the revisions in original units of a variable 'X', and depends on the magnitude of these estimates. This hampers comparability across time, across different variables and across the same variables of different countries, and therefore makes it preferable to provide a relative measure that links the revision to the size of the variable. Two main types of indicators have been developed: one for observations of a time series that have only positive values (series on gross transactions), and another for series that can have either positive or negative values (series on net transactions).

Gross transactions

In the case of gross data series (data which are always positive), a relative measure of revisions is the percentage error, which measures the percentage change from the initial assessment according to the formula $[X^j - X^i] / X^i$ [10]. In the

usual case that X is a time series, an average over time can be taken. Hence, a mean percentage error can be calculated with the formula $\frac{1}{N}\sum_{t=1}^{N}\frac{x_t^j - x_t^i}{x_t^i}$, where i and j identify two specific time-lags, with j >i, and where t is a time indicator identifying the reference periods of the series X.

As revisions can be positive or negative, it is more appropriate to assess their absolute value. The expression becomes a mean absolute percentage error (MAPE), which is the appropriate indicator for gross data.

$$MAPE = \frac{1}{N}\sum_{t=1}^{N}\left|\frac{x_t^j - x_t^i}{x_t^i}\right| \qquad (3)$$

Net transactions

In the case of net data, revisions cannot be properly related to the series value itself because the observations may have different signs and, even more importantly, the values of the series may often be close to zero. For example, the b.o.p. series in the financial account are expressed in net terms that are the result of the acquisition minus the disposition of certain assets or liabilities during the period concerned. As the revision of these net data cannot meaningfully be related to the size of the variable itself, alternative dimensional measures of the variable X must be used. A measure of the variability of the variable (series) X can for instance serve as a reference point for assessing the relative size of the revision. This measure reflects the fact that in practice it is more difficult to estimate correctly the values of a volatile series. The result has no economic meaning as such, and thus only becomes meaningful when compared over time or across variables.

The relative error (relative revision) then becomes $[X^j - X^i] / vrb(X^j)$, on which an average can also be taken across time to produce an expression that we call here (given its similarities with the MAPE shown before) the mean absolute relative error (MARE):

$$MARE = \frac{1}{N}\sum_{t=1}^{N}\left|\frac{x_t^j - x_t^i}{vrb(x_t^j)}\right| \qquad (4)$$

where $vrb(X^j)$ is the variability of the latest assessment of the series X.

There are several ways of calculating the variability of X, using either the standard deviation, the average distance from the mean, or the median of the distances from the median. In principle, the volatility should be calculated for the latest assessment (X^j), because these values should be the most accurate. One advantage of using the average distance from the mean is that with a small transformation the resulting indicator can be decomposed into a bias and a variance component as explained below.

Following the literature on measures of forecast quality, the earlier assessments (X^i) are considered to be the best forecast of the series X, estimated with the information available at that moment. The latest assessment (X^j) is assumed to be the most accurate estimate. Subsequently, the revision is considered a forecasting error, and the indicator measures the quality of the forecast.

This indicator is a ratio between two different mean square errors (MSEs), making it a relative measure.

The numerator uses the MSE applied to the difference between both assessments (the revision measure):

$$MSE = \frac{1}{N}\sum_{t=1}^{N}(x_t^j - x_t^i)^2$$

By contrast, the denominator uses the MSE applied to the difference between variable X and a reference value for X:

$$MSE = \frac{1}{N}\sum_{t=1}^{N}(\Theta - x_t^j)^2$$

10 Where X is a generic variable or series, and (i,j) the predefined time-lags. The time-lag indicates the time elapsed between the reference period and the publication period (i.e. in case of publication in June of data referring to January, the time-lag is five months). Hence k different sets $\{X^1, X^2, \ldots, X^k\}$ of the same variable will be available.

This indicator is a relative measure of the revisions expressed as a forecasting error in relation to a naive estimate of the same variable. In order to use the original units and to build an indicator comparable with previous ones, the square root is applied to the ratio. The *root mean square relative error (RMSRE*) is expressed as:

$$RMSRE = \sqrt{\frac{\sum_{t=1}^{N}(x_t^j - x_t^i)^2}{\sum_{t=1}^{N}(\Theta - x_t^j)^2}} \qquad (5)$$

where Θ is the reference value for X_t. The proposed reference value for X is its average.[11]

In principle, the RMSRE's value can vary from 0 to infinity. It is 0 when the forecast is perfect ($x_t^i = x_t^j$), 1 if the forecast is only as accurate as the reference value for X ($x_t^i = \Theta$), and greater than 1 when the forecast is less accurate than the reference value for X.

Both the size of the revisions (the numerator) and the volatility of the series (the denominator) have an effect on the result of this indicator. In general, in series with an important stochastic component, the more volatile they are, the more difficult they are to forecast, and therefore larger revisions can be expected. By construction, the resulting RMSRE does not penalise such volatile series, and a similar size of revisions will result in a larger RMSRE for a less volatile series.

This yields the variance of X in the denominator. Using the average has one significant advantage in that the calculated indicator can be decomposed into three components which have very interesting applications for the study of the revisions:

MSE = (1) Bias component + (2) Regression component + (3) Disturbance component

Applying this decomposition, the square of the RMSRE can be expressed as:

$$RMSRE^2 = MSRE = \left[\frac{\overline{X^j} - \overline{X^i}}{S_{X^j}}\right]^2 + \left[r_{X^iX^j} - \frac{S_{X^i}}{S_{X^j}}\right]^2 + \left[1 - (r_{X^iX^j})^2\right]$$

where $r_{x^ix^j}$ is the correlation between the two series, S_{x^i} and S_{x^j} are the standard deviations and $\overline{X}^i$ and $\overline{X}^j$ the means of x_t^i and x_t^j respectively.

These three components can also be presented as proportions of the RMSRE, in which case they will add to 1.

$$1 = \frac{RMSRE^2}{RMSRE^2} = \frac{\left[\frac{\overline{X^j} - \overline{X^i}}{S_{X^j}}\right]^2}{RMSRE^2} + \frac{\left[r_{X^iX^j} - \frac{S_{X^i}}{S_{X^j}}\right]^2}{RMSRE^2} + \frac{\left[1 - (r_{X^iX^j})^2\right]}{RMSRE^2}$$

The three components can be interpreted as follows:

- the *unconditional or bias component* is an indication of the systematic error (revision), since it measures the extent to which the average values of the early and later series deviate from each other;
- the *conditional or regression component* is another systematic component that reflects the extent to which the overall patterns of both series deviate; and
- the *unsystematic or disturbance component* is the variance of the residuals obtained by regressing the data of the early estimates on the later ones. This can be seen as the random component of the revisions.

11 Assuming that b.o.p. financial net flows are stationary, the average was chosen owing to its simplicity, ease of interpretation, and because it enables the decomposition of the indicator. If the series are not stationary, the indicator can still be applied by using the previous value of the series as the reference value, or by using the first difference of the series itself.

From an analytical point of view, the interpretation of the results of these three components is more important than the isolated RMSRE results. For example, a smaller RMSRE value with a significant bias component is more worrying in terms of data quality than a larger RMSRE with a much greater unsystematic component.

This indicator has two main limitations: (i) in the case of non-stationary series[12], its value and decomposition become meaningless; and (ii) its interpretation is less straightforward than that of the previous indicators.

Table 2 summarises which revision indicators may be considered for each b.o.p. series, taking on board their limitations and advantages.

Only the results for the same indicator are comparable across items, countries and time. In the overall assessment these indicators may be complemented by simple measures of revisions as well as by an explanation of major methodological and/or data source revisions when they take place together with advance release calendars and a clear description of the revision practice adopted (e.g. the number and timing of revisions).

3.2 CONSISTENCY INDICATORS

Indicators measuring overall consistency across statistical series are broken down into the following two sub-categories:

– internal consistency, e.g. within integrated statistics (b.o.p./i.i.p. or national accounts);
– external consistency (between different sources of data and/or different statistical frameworks, including mirror statistics). Conceptual consistency, as highlighted by the International Monetary Fund (IMF), fosters the international comparability of statistics, even when compiled by different institutions.[13] In addition, different measurements of the same phenomenon should not result in very different data.[14]

3.2.1 INTERNAL CONSISTENCY INDICATORS

All the b.o.p. indicators presented under this heading are based on the net errors and omissions (EO) series, which is a *natural* indicator for internal consistency in b.o.p. statistics. The principle of double-entry bookkeeping used in b.o.p. implies that the sum of all international transactions should be equal to zero. Nevertheless, "*... data for balance of payments estimates often are derived independently from different sources; as a result, there may be a summary net credit or net debit (i.e. net errors and omissions in the accounts). A separate entry, equal to that amount with the sign reversed, is then made to balance the accounts.*" (IMF, BPM5, 1993, p.17).

12 Gross data series are generally non-stationary on average, and therefore it is inappropriate to use the RMSRE to assess revisions of gross series.
13 Discrepancies may still arise from different practices, for instance the publication calendar of revisions. Different institutions aiming at *integrity* and *accuracy* should aim at minimising these differences.
14 For example, different international organisations should aim at achieving consistency between the aggregated b.o.p. statistics that they compile (i.e. ensuring that there are no asymmetries).

Table 2 Revision indicators

Current account items[1]:	Credits	Debits	Net
Indicator:	MAPE	MAPE	RMSRE
Financial account items[2]:	**Assets (net)**	**Liabilities (net)**	**Balance (net)**
Indicator:	RMSRE	RMSRE	RMSRE

1) Goods, services, income and current transfers, credit, debit and net.
2) Direct, portfolio and other investment assets, liabilities and balances.

The errors and omissions may be attributed either to sampling errors or non-sampling errors.

While a small net residual does not guarantee the consistency of the b.o.p. data, a large and persistent residual is a clear indicator of inconsistency, impedes analysis and interpretation of the estimates, and diminishes their credibility. A large net residual may also spill over into the interpretation of the i.i.p. statement.

A measure of b.o.p. inconsistency is thus the *average absolute error* of the EO series:

$$AAE(EO) = \frac{\sum_{i=t-a}^{t} |EO_i|}{a+1} \qquad (6)$$

where t is the reference period of the last observation and $a+1$ equals the number of periods considered.

An alternative measure of volume is provided by *the mean square error of net errors and omissions (MSE(EO)*[15]:

$$MSE(EO) = \sum_{i=t-a}^{t} (EO_i)^2 / a+1$$

The advantage of this measure is that it can be decomposed into a bias and a variance component[16]:

MSE(EO) = (1) *bias component* + (2) *variance component*

$$MSE(EO) = \left[\frac{\sum_{i=t-a}^{t} (EO_i)}{a+1}\right]^2 + \frac{\sum_{i=t-a}^{t} (EO_i - \overline{EO})^2}{a+1}$$

where $\overline{EO}$ is the average of the EO between *t-a* and *t*.

In order to use the original units and to ensure comparable and harmonised indicators across all elements, the square root is applied to the ratio. This results in the *root mean square error of the net errors and omissions (RMSE(EO))*, which can be expressed as:

$$RMSE(EO) = \sqrt{\sum_{i=t-a}^{t} (EO_i)^2 / (a+1)} \qquad (7)$$

The components of the MSE(EO) can also be presented as proportions of the RMSE(EO).

To make these absolute indicators comparable across countries, the series used in the calculations should be scaled. The variables considered for producing a relative measure are, for example, total gross flows (average of debits and credits) in the current account, country GDP + imports, or i.i.p. assets.

As an alternative to the previous, more advanced indicator, a simple sign indicator, namely the number of positive EOs during the period under study divided by the number of observations, can be used to indicate whether the EOs are typically in one direction:

$$CP(EO) = \frac{Count(EO_t > 0)}{N} \qquad (8)$$

where N is the number of periods considered.

3.2.2 EXTERNAL CONSISTENCY INDICATORS

Although minor discrepancies can arise from remaining methodological differences in two estimates of the same variable on the basis of different sources and/or different statistical frameworks, a comparison of their values over time should form part of the overall quality checking.

Size indicators

– Comparing series with positive and negative values

For example, it is deemed important to reconcile b.o.p. statistics with monetary financial institution (MFI) balance sheet statistics. The quality indicator should compare "other investment" in the financial account of the b.o.p. and the deposits/loans of MFIs. These

15 The internal consistency indicators have been built with the assumption that the true value of errors and omissions is nil.

16 Following the simplest MSE decomposition; see F. X. Diebold (2001), *Elements of Forecasting*.

series are rather volatile, and the consistency indicator should consequently take into account both the magnitude of the differences and the volatility of the original series.

The RMSRE indicator, which is used as a stability measure for the b.o.p. financial account items, has also been selected to assess the external consistency of net flows and to observe whether a persistent bias exists between both sources. (For more explanation concerning the properties of this indicator, see sub-section 3.1.) It is expressed as follows:

$$\text{RMSRE} = \sqrt{\frac{\sum_{t=1}^{N}(X_t - Y_t)^2}{\sum_{t=1}^{N}(\Theta - X_t)^2}} \qquad (9)$$

where Y_t is the external dataset to compare with, X_t the b.o.p item, N the time frame, and Θ the average for X.

This indicator is only relevant for countries that do not obtain their b.o.p. financial account directly from MFI balance sheet data. It should however be noted that increasing external consistency sometimes requires countervailing corrections to be made elsewhere in the b.o.p. data.

– Comparing series with only positive values

A second example of external consistency for b.o.p statistics concerns the consistency between goods credits and debits in b.o.p. statistics, and exports and imports in international trade statistics. In this case, both series show gross flows, with only positive values, and are non-stationary. In addition, the methodological and valuation differences are more or less constant during the period under consideration.

A simple indicator based on the difference between both series will thus show a constant bias, in view of the different coverage, definition and valuation of the differences of both datasets. In order to detect any additional discrepancies, the first difference of the series or their growth rates is analysed instead of the raw data. Consistency is related to the magnitude of the discrepancies and positive and negative deviations should not cancel each other out in the quality assessment. Therefore, absolute values of the differences are used. This indicator has the advantage that it is not influenced by the previously mentioned methodological differences; it simply focuses on the differences in the monthly growth rates of each series that should be in general rather similar. This indicator is constructed as follows:

$$C_t = \frac{\sum_{t=2}^{N}\left|\Delta x_t / x_{t-1} - \Delta y_t / y_{t-1}\right|}{N-1} \qquad (10)$$

where *y* reflects the b.o.p. data series, *x* the series under comparison, Δ the first differences, *t* the observation period and *N* the time frame. The values for C_t range from zero (perfect match) to plus infinity (no match possible).

Although the methodologies of these series are not fully consistent with the b.o.p. data, they broadly reflect the same economic phenomenon. Therefore, these comparisons are useful for checking whether differences remain stable over time. In this context, after transforming both series into growth rates, they become stationary, and the RMSRE can be applied to analyse the significance of the bias and the rest of the components.

Directional indicators

In addition to the indicators presented above, a further indicator can be used to assess the consistency of the information provided by the two sources, the *directional consistency* indicator. This is related to the signs of the first differences of both series, and has the same properties as the directional reliability indicator already explained in sub-section 3.1.1.

In Table 3, the columns show the number of positive and negative changes for b.o.p. series ($\Delta x_t = x_t - x_{t-1}$), and the rows show the number of positive and negative changes for the mirror series ($\Delta y_t = y_t - y_{t-1}$).

Table 3 Contingency table for directional consistency

	$\Delta x_t > 0$	$\Delta x_t \leq 0$	Subtotal
$\Delta y_t > 0$	n_{11}	n_{12}	$n_{11}+n_{12}$
$\Delta y_t \leq 0$	n_{21}	n_{22}	$n_{21}+n_{22}$
Subtotal	$n_{11}+n_{21}$	$n_{12}+n_{22}$	N

In Table 3, n_{11} is the number of cases when both Δx_t and Δy_t are positive, and n_{22} when they are negative.

Maximum directional consistency would require a high sum for the main diagonal ($n_{11}+ n_{22}$). As before, the directional consistency indicator (Q_C) is constructed as follows:

$$Q_C = \frac{n_{11} + n_{22}}{N}$$

4 DATA: THE EURO AREA BALANCE OF PAYMENTS

The empirical quality assessment in this paper focuses on the monthly euro area b.o.p. series. The b.o.p. transactions are recorded in three sub-balances: the current, capital and financial accounts. The transactions considered are those involving goods, services, income and transfers (such as debt cancellation), and those involving financial claims on, and liabilities to, the rest of the world. In the b.o.p. current account, gross outflows from and inflows to the economy are recorded as credits and debits respectively. Entries in the financial account are recorded on a net basis, i.e. increases in assets or liabilities less decreases. Therefore, b.o.p. statistics are characterised by two types of series: (i) gross series, which are always positive, for example the export of goods; and (ii) net series, which can assume either positive or negative values, for example portfolio investment in equity assets.

The euro area b.o.p. data are based on an aggregation of statistics provided by euro area Member States, reflecting the transactions[17] between euro area residents and non-euro area residents. Taking into account the variety of methods and sources at the national level, no simple measure can fully reflect the quality of the euro area statistics. Nonetheless, to help users analyse the data, the indicators described above have been applied and are commented upon below.

Another characteristic of the euro area time series is their relatively short length, as most of the series start in January 1999. Obviously, this feature reduces the possibility of analysing the development of quality indicators over time.

4.1 REVISION INDICATORS

The study on revisions was performed for the following b.o.p. items:

– Gross flows: export and import of goods, export and import of services, credit and debit of income, and credit and debit of current transfers.

– Net flows: assets and liabilities of direct investment, portfolio investment and other investment.

The indicators were computed for three overlapping periods of 36 monthly observations (Jan. 1999 to Dec. 2001, Jan. 2000 to Dec. 2002 and Jan. 2001 to Dec. 2003). These periods were chosen in order to produce statistically meaningful results. The most recent observations were excluded to avoid underestimating the revision indicators, as there may still be revisions in the pipeline.

For the purpose of this analysis, euro area revisions were split into subsequent waves of revisions (so called “vintages”), as shown in Box 1.

17 A transaction is defined as an economic flow that reflects the creation, transformation, exchange, transfer or extinction of economic value, and involves changes in the ownership of goods and/or financial assets or liabilities, the provision of services or the provision of labour and capital.

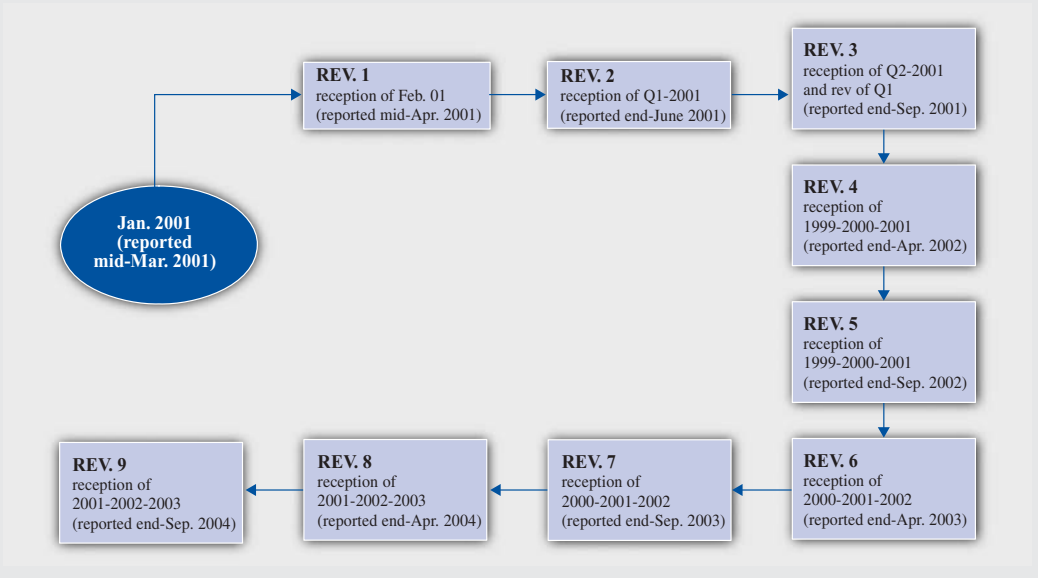
Box 1

B.O.P. REVISION SCHEDULE

The euro area b.o.p. data are revised according to the following schedule. Quarterly data are revised with the publication of the following quarter and thereafter twice a year, at end-April and at end-October for three consecutive years. Monthly data are revised after the publication of the following month's data, as well as after the corresponding quarter's revisions.

For example, taking January 2001 data, nine revisions have in the meantime been made according to the above-mentioned schedule, as per the following chart:

Revisions cycle



The revision practice followed by the ECB has changed several times in the last few years in order to align, to the extent possible, the diverse national revision policies. For example, the original revision practice consisted of only two stages, namely revisions one month after the respective quarterly and yearly reporting (see stages 2 and 5 in Box 1). However, owing to the ongoing need for further timely and accurate information, the reporting schedule progressed and the consequent revision schemes became more complicated. For this reason, and in order to create long time series without breaks, the current vintages do not reflect all stages of the revision practice, but are built as follows:

- series X^0 represents the first assessment;
- series X^1 contains the data after the first quarterly assessment (including rev. 1 and rev. 2 in Box 1);
- series X^2 comprises the data after the first quarterly revision, the first annual assessment and its subsequent revision (may include revs. 3 to 5 in Box 1); whereas
- series X^3 represents the final published assessment for a specific item (may include revs. 6 to 9 in Box 1).

Table 4 Intertemporal structure of the assessments of a statistical item

Time period[1)*]	First assessment reported for a given time t t+6 weeks	Second assessment Revision on t reported in time t+10 to 22 weeks	Third assessment Revision on t reported in time t+26 to 87 weeks	Final value for time t
	X^0	X^1	X^2	X^3
1	x_1^0	x_1^1	x_1^2	x_1^3
2	x_2^0	x_2^1	x_2^2	x_2^3
....	.....	.....	.....	.....
t-1	x_{t-1}^0	x_{t-1}^1	x_{t-1}^2	x_{t-1}^3
t	x_t^0	x_t^1	x_t^2	x_t^3

1) For example, when building the data vintages for the period January 1999 to December 2001 (36 months), the subscript t of the variable X receives values from t=1 to t=36, whereas its superscript varies from 0 to 3, representing the three different assessments of the variable X over time. As a consequence, for the January 1999 and February 1999 data, the first assessment is x_1^1 and x_2^1, and the second assessment is x_1^0 and x_2^0 respectively, resulting finally in the construction of four time series per item that correspondingly incorporate the first, second, third and final published assessments.

In general, the evolution of a statistical time series has a two-dimensional dynamic structure covering the following two aspects: the development of a given item over time, and the revisions of the assessments of the period-specific value of an item over time.

Table 4 shows these two dimensions for the series used in the analysis. For any period t, there is an initial assessment x_t^0 which is then updated by subsequent revisions. The published values (the last actual value of period t in the current period) therefore change over time, depending on the number of revisions that have been reported.

A significant caveat when interpreting the revision indicators concerns revisions originating in methodological changes introduced in order to prevent breaks in the reported series. For example, in April 2004 a change in the compilation methodology followed by one Member State led to the reporting of revisions for more than three years backwards. These revisions are mainly reflected in the X^3 series, and slightly distort the information obtained by the calculations.

4.2 DATA ON CONSISTENCY INDICATORS

The study examining consistency was performed for the following b.o.p. items:

– Internal consistency: analysis of the net errors and omissions item.

– External consistency: for the gross flows, the b.o.p. goods and Eurostat's foreign trade statistics for both exports and imports were compared. For the net flows, the b.o.p. net other investment of the MFI sector was compared with the money and banking balance sheet statistics.

The calculations were performed for four overlapping periods of 36 monthly observations (Jan. 1999 to Dec. 2001, Jan. 2000 to Dec. 2002, Jan. 2001 to Dec. 2003 and Jan. 2002 to Dec. 2004). These periods were chosen in order to assess the evolution of discrepancies over time.

Additionally, the evolution of internal and external consistency after incorporating revisions was analysed. The study examining consistency was initially conducted using the most recent data available in February 2004, then repeated with data available in November 2004, after two more rounds of revisions had

taken place (April and October), and finally performed a third time with data available in April 2005. The results were compared in order to analyse how the data revisions affect consistency.

5 QUALITY INDICATORS: RESULTS

This section describes the most relevant findings. Further tables and graphs containing all the calculations are included in Annex 2.

5.1 REVISION STUDIES

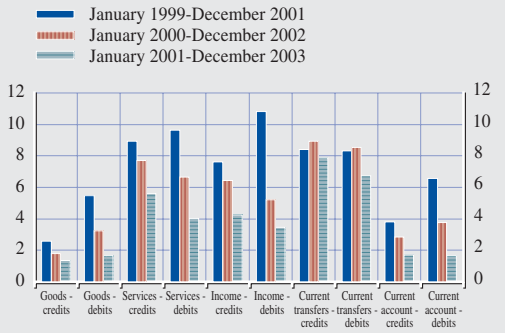
5.1.1 B.O.P. CURRENT ACCOUNT

For the euro area current account gross series, the total MAPE indicator (based on the first and the last assessment of the series) is presented in Chart 3 for the three periods under study (Jan. 1999 to Dec. 2001, Jan. 2000 to Dec. 2002 and Jan. 2001 to Dec. 2003). The MAPE indicator reflects the magnitude of the revisions, but not their direction (positive or negative trend).

The relative size of the revisions appears to have generally declined over time. The highest relative size in terms of revisions can be found in current transfers, credits and debits, together with services credits, while the smallest revisions have occurred for goods.

Interestingly, Table 5 shows that for all three periods and for all items, upward revisions prevailed. For items such as services, current transfers and the total current account, the percentage of upward revisions was around 90%. Although this bias has declined in most items, these figures clearly demonstrate the need to obtain a more complete coverage of the early estimates, or to apply statistical methods to correct the expected under-coverage of these estimates, in particular for services and current transfer debits.

Chart 3 Revisions of the euro area current account as a % of the respective flows (MAPE)



Finally, Table 6 displays the results of the directional reliability indicators, which assess whether the direction of the change implied by the earlier estimates has been altered by the revisions. Two main observations can be made: (1) data revisions typically do not alter the sign of the original change of the series, and (2) this indicator has in most cases improved over time.

5.1.2 GOODS CREDITS

Goods credits offer an indicative example for the analysis of current account revisions. In this category the revisions are smaller than for the other items; the revision bias decreases over the

Table 5 Percentage of upward revisions of the euro area current account

	Goods-credits	Goods-debits	Services-credits	Services-debits	Income-credits	Income-debits	Current transfers-credits	Current transfers-debits	Current account-credits	Current account-debits
Jan.99-Dec.01	75.0	83.3	**100.0**	**100.0**	66.7	72.2	75.0	97.2	91.7	91.7
Jan.00-Dec.02	66.7	75.0	94.4	97.2	61.1	61.1	83.3	97.2	91.7	88.9
Jan.01-Dec.03	52.8	69.4	94.4	88.9	44.4	44.4	72.2	94.4	80.6	86.1

Table 6 Directional reliability indicator Q for the euro area current account

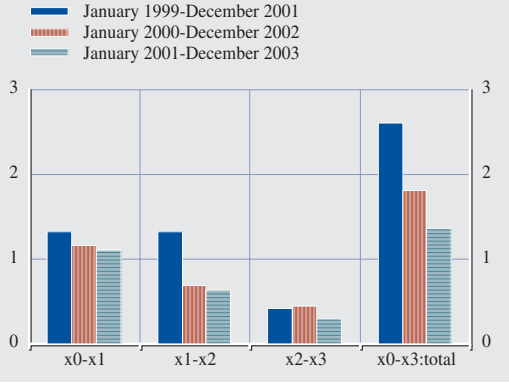
(percentages)

$Q(x_0-x_3)$	Goods-credits	Goods-debits	Services-credits	Services-debits	Income-credits	Income-debits	Current transfers-credits	Current transfers-debits	Current account-credits	Current account-debits
Jan.99-Dec.01	97.1	94.3	91.4	82.9	85.7	85.7	91.4	74.3	88.6	94.3
Jan.00-Dec.02	97.1	94.3	94.3	88.6	85.7	88.6	97.1	74.3	94.3	97.1
Jan.01-Dec.03	100.0	94.3	88.6	91.4	82.9	94.3	97.1	82.9	94.3	97.1

three periods under study (see Table 5); and the directional reliability indicator stands at 100% (see Table 6). Additionally, the time structure of the revisions can be identified through more detailed analysis of the MAPE results, broken down into the subsequent waves of revisions (see Chart 4).

Chart 4 illustrates that the speed of convergence to the final value of the goods credits has changed between the first and last periods studied. In the first period, the revisions included in the second vintage were as high as in the first one, while in the last periods, revisions had the highest impact in the first vintage. This change indicates that the goods credits data approximated their final value at a faster pace. The largest part of the revision takes place between 6 and 22 weeks after the end of the reference period. This is partly to be expected owing to the lack of synchronisation between the reporting time of the first assessment of b.o.p. data and the availability of its main source, namely statistics on external trade in goods.

Chart 4 Revisions of euro area goods credits as a % of the respective flows (MAPE)



5.1.3 INCOME

The development of the revisions for income (for both credits and debits) is of particular interest with regard to the current account, where the revisions in the third period under study are mainly negative, as shown in table 5. This can be attributed to the fact that the main contributor to the income item is investment income, which is estimated based on the i.i.p. and on the financial flows. As a consequence, income revisions are closely linked to the revisions of the financial account, and therefore follow a similar speed of convergence to the final value. Furthermore, an important part of these revisions relates to methodological changes which alter the meaning of the vintages. In recent years, for example, some countries have changed from the cash to the accrual principle at the time of recording, which means that the whole series have been revised to avoid breaks in the series.

To illustrate the time structure of the revisions, Chart 5 shows the MAPE results for the successive vintages of income debit revisions. The first period (Jan. 1999 to Dec. 2001) reveals significantly higher total revisions than the two subsequent periods. The time structure of the revisions has changed considerably. In the first period (Jan. 1999 to Dec. 2001) the trend was positive for the three rounds of successive revisions, whereas in the most recent period (Jan. 2001 to Dec. 2003), the indicators are almost the same for each successive vintage of revisions. Regardless of the period, more time

Chart 5 Revisions of the euro area income debits as a % of the flows (MAPE)

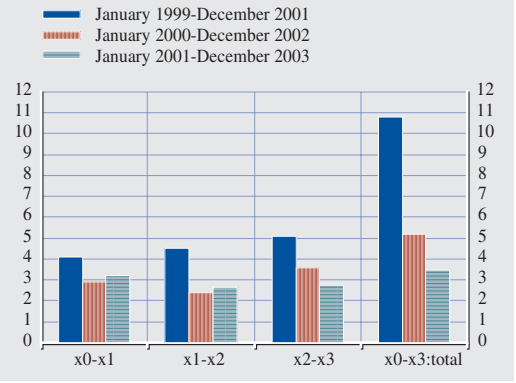
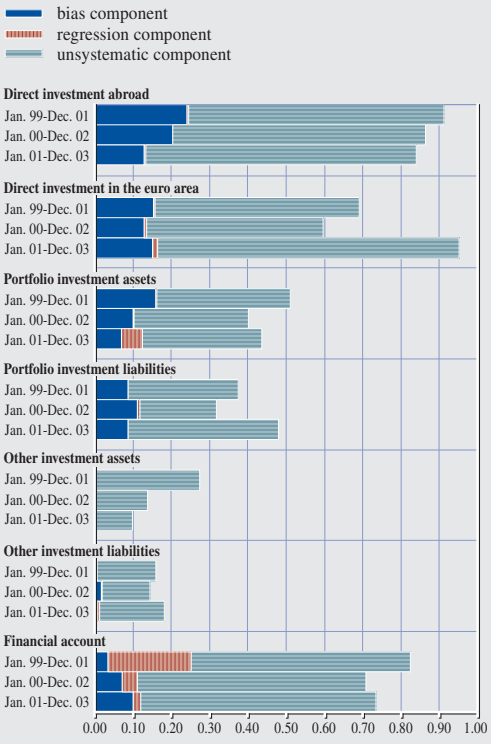


Chart 6 Total revisions of the euro area financial account as related to their volatility (RMSRE)

(percentages)



elapses before these data become stable than for the rest of the current account items.

5.1.4 B.O.P. FINANCIAL ACCOUNT

To assess the quality of the euro area financial account, the RMSRE indicator is calculated for each financial account item as well as for the total financial account. As explained in Section 3, this indicator is equal to the square root of the average of the square values of the revisions relative to the volatility of the series. Chart 6 presents its three components (bias, regression and disturbance) as a proportion of the total RMSRE.

The chart clearly shows that the significance of the overall revisions ($X^3 - X^0$) in relation to the volatility of the series (RMSRE) was lower in the second period considered for all items, but higher in the third period than in the second for most items.

The highest RMSRE values are for direct investment (DI), in both directions, whereas the most significant increase in the last period was in inward DI. Regarding the evolution of the three RMSRE components, the bias component is persistently significant for DI (both abroad and in the euro area), for portfolio investment (PI) (assets and liabilities), and in the last period for the total financial account as well.

The regression component for the total financial account, on the other hand, is only sizeable for the first three years. This phenomenon seems to have been corrected afterwards.

Chart 7 shows an alternative measure for assessing the bias of the revisions in the financial account items. The bias in the DI, both abroad and in the euro area, has been reduced in recent years, but in absolute terms upward revisions still far exceed 50%; for DI abroad, 28% of the revisions are still positive (i.e. reflecting more net outflows), whereas for DI in the euro area, 72% are positive (i.e. reflecting more net inflows). In practice, most of these revisions are owing to late reporting by special purpose entities (SPEs). This generates a revision of DI in the euro area that is often compensated by a similar revision of DI abroad. In this case, the net figures are thus not affected. The picture is similar for PI owing to late

Chart 7 Upward total revisions in the euro area financial account

(percentages)

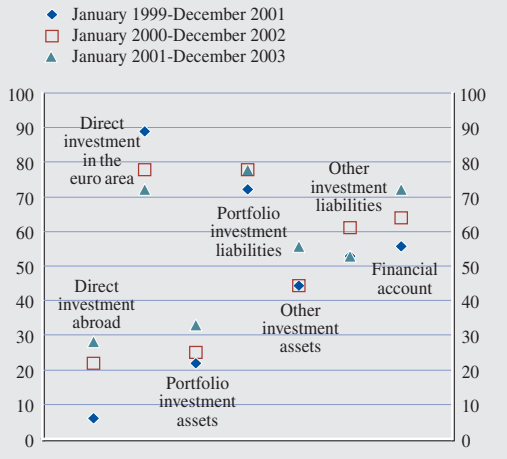
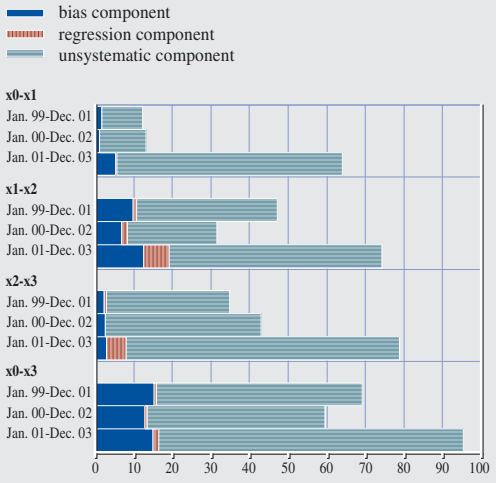


Chart 8 Direct investment in the euro area: revision vintages in relation to volatility

(percentages)



reporting (reallocation between assets and liabilities); for PI assets, 33% of the revisions are positive, while for PI liabilities, 78% of the revisions are positive.

For DI in the euro area, the total revision in relation to its volatility increased significantly in the third period; this is due not only to the increase in revisions, mainly in the first vintage, but also to the reduction in volatility of the DI flows. The main reason for this increase in revisions has been the fact that coverage of SPE transactions by the euro area Member States has gradually improved. Looking at the distribution of the revisions across the different vintages in Chart 8, it is interesting to note that unlike the current account items, the revisions in the second and third vintages for DI are much higher than the revisions in the first vintage. Additionally, the significant bias component of the total revisions, which is already apparent in the second vintage for all periods, suggests that better first estimates may be feasible.

To complete the analysis of the financial account, Table 7 illustrates the directional reliability indicator. Although the results are not as good as for the current account, especially for DI in the euro area, the total financial account shows a significant improvement in the value of this indicator between the first and the third period considered.

Table 7 Directional reliability indicator Q for the euro area financial account

(percentages)

Q (x_0-x_3)	Direct investment abroad	Direct investment in the euro area	Portfolio investment assets	Portfolio investment liabilities	Other investment assets	Other investment liabilities	Financial account
Jan.99-Dec.01	77.1	62.9	74.3	94.3	85.7	91.4	68.6
Jan.00-Dec.02	80.0	65.7	88.6	94.3	91.4	91.4	74.3
Jan.01-Dec.03	88.6	57.1	91.4	82.9	94.3	91.4	82.9

Chart 9 Root Mean Square Error (RMSE) on EO as a % of the gross flows in the current account

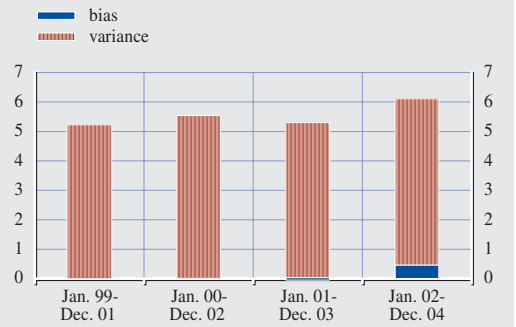
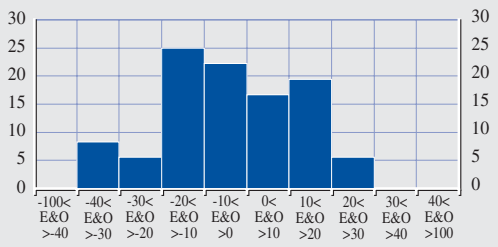


Chart 10 Errors and omissions histogram for the period Jan. 2002-Dec. 2004

(x-axis: billion of EUR; y-axis: percentages)



5.2 CONSISTENCY

5.2.1 INTERNAL CONSISTENCY

To assess the internal consistency of the b.o.p. data, the RMSE of the net EO series is calculated for four overlapping periods (Jan. 1999 to Dec. 2001, Jan. 2000 to Dec. 2002, Jan. 2001 to Dec. 2003, and Jan. 2002 to Dec. 2004). This indicator is used to measure the size of the internal inconsistency, as well as to identify any potential bias. Chart 9 presents the RMSE decomposed into its two components: the bias and the variance. The results show that the internal consistency of the euro area b.o.p. data remained more or less stable up to December 2003, but deteriorated considerably in the last period. Although the EO bias has constantly increased, it is not significantly different from zero, according to a standard statistical test. The RMSE of the EO in the last period was €16.6 billion (see Table 8), which amounted to 6.1% of the gross flows in the current account during that period.

Chart 10 illustrates the distribution of monthly EOs between January 2002 and December 2004. The median is €4 billion, and 58% of the data are negative. Especially in 2004, 67% of the EO was negative.

Table 8 shows the results of the indicators calculated with data available in February 2004, November 2004 and April 2005. These subsequent dates incorporate all revisions made in the meantime. As the table clearly shows, the internal consistency has improved over time. In particular, the April 2005 revisions[18], which included mainly methodological revisions from 1999 to 2001, have largely improved the internal consistency for the first two periods under study. Two main conclusions can be drawn from these results: (1) the subsequent revisions also improve the internal consistency; and (2) such

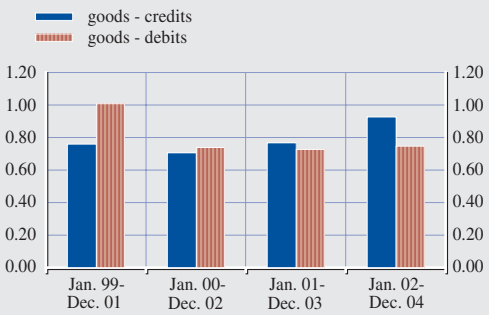
18 Following the ECB revision practice, only regular revisions from 2002 to 2004 were incorporated to the data in April 2005. Furthermore, due to some methodological revisions and in order to avoid breaks, data from 1999 onwards were also revised.

Table 8 Root Mean Square Error (RMSE) on the EO

	Data available at:					
Period	Feb. 04	Nov. 04	Apr. 05	Feb. 04	Nov. 04	Apr. 05
Jan.99-Dec.01	13.60	13.44	13.05	5.3	5.3	5.2
Jan.00-Dec.02	16.29	15.59	14.89	5.8	5.6	5.5
Jan.01-Dec.03	16.18	15.12	14.50	5.7	5.4	5.3
Jan.02-Dec.04	-	-	16.60	-	-	6.1
	Units: EUR billion			% of the gross flows in the CA		

Chart 11 External consistency indicator C_t[1] for b.o.p. goods

(percentage point)



1) A higher value for this indicator indicates less consistency.

improvements can still occur four to six years after the reference period.

5.2.2 EXTERNAL CONSISTENCY

Gross flows of goods in b.o.p. and external trade

To analyse the external consistency of the b.o.p. data, the b.o.p. goods series (credits and debits) are compared with the analogous foreign trade statistics (exports and imports) published by Eurostat. Although both series differ slightly in terms of their methodology, they both describe the same economic phenomena.

Chart 11 depicts the calculated indicators C_t for four overlapping periods (Jan. 1999 to Dec. 2001, Jan. 2000 to Dec. 2002, Jan. 2001 to Dec. 2003, and Jan. 2002 to Dec. 2004). C_t measures the average absolute discrepancy of the growth rates of the series under consideration.

The results reveal that the average absolute differences between the growth rates of b.o.p. goods and external trade series for imports have been very stable over the last four years. In the case of exports, by contrast, consistency worsened in 2003 and 2004. However, the levels of directional reliability (see Table 9) depict a less problematic picture for all periods, indicating that in general the direction of the month-on-month changes to the external transactions in goods was the same in more than 90% of cases.

The above-mentioned results were obtained using data from January 1999 to December 2004, which became available in April 2005. In order to examine whether the consistency varies with the revisions, Table 10 contains in addition the results of the C_t indicator for the data published in February 2004 and in November 2004. The results of the indicators after the revisions received in April and October 2004 for 2001, 2002 and 2003 b.o.p. data and for 2003 foreign trade data revealed considerable improvement in terms of consistency for both exports and imports, while the recalculation of the indicators with the data that became available in April 2005 points to a slight deterioration in external consistency.

The temporal inconsistency between these two datasets can be attributed not only to the different timeliness of their recording and reporting, but also to the different revision policies followed for these datasets by the ECB and Eurostat.

Table 9 Goods in b.o.p. and external trade

(percentages)

	Period	Exports	Imports
Directional reliability	99-01	100	94
	00-02	97	100
	01-03	97	97
	02-04	91	94

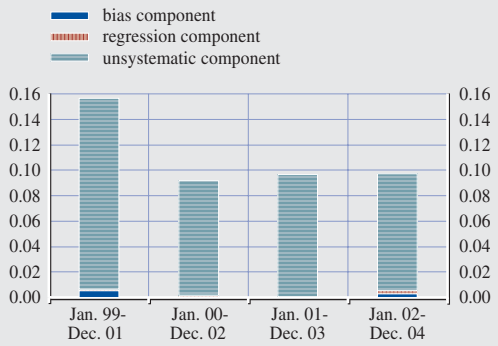
Table 10 External consistency indicator C_t for goods in b.o.p. and external trade

(percentage point)

	Data available at:			
	Period	Feb. 04	Nov. 04	Apr. 05
Exports	01-03	0.91	0.73	0.75
Imports	01-03	0.81	0.65	0.72

Chart 12 External consistency indicator (RMSRE) for b.o.p. and MFI balance sheet transactions

(percentages)



Net flows of deposits and loans of MFIs in b.o.p. and money and banking data

As mentioned before, the main consistency indicator for net flows is the RMSRE, which captures the magnitude of the discrepancies in terms of the volatility of the b.o.p. series. Chart 12 displays the differences and thus the consistency between the comparable b.o.p. and money and banking statistics: other investment + direct investment/other capital series of the MFI sector in the financial account and the external deposits/loans of MFIs derived from the MFI balance sheets.

The calculation of the RMSRE indicates that the consistency between the series significantly improved between 1999 and 2000, and has since remained stable. The bias and regression components are almost negligible, indicating that both series have similar averages and are highly correlated. From 2002 onwards, the bias component has slightly increased without becoming significantly different from zero. This was due to the introduction – purely in the b.o.p. data – of an adjustment to cover the circulation of euro banknotes outside the euro area. 95% of the inconsistency is unsystematic. The high value of this component illustrates the difficulty of further increasing the consistency between these datasets.

Table 11 shows how the consistency between these datasets has varied with the revisions of the series.

The results show that although the systematic component diminishes further after the revisions, the total inconsistency between both series hardly changes after the subsequent revisions.

6 CONCLUSIONS

In general, the indicators suggest that b.o.p. data quality has improved over time, although further improvements are needed. These results should take into account the fact that euro area b.o.p series have only been compiled from 1999 onwards.

The results of the *revision indicators* reveal that after a short period of adaptation to the intra/extra-geographical breakdown and to additional ECB requirements regarding methodology, the accuracy of the preliminary estimate has improved at the euro area level, and therefore in general at the national level as well.

Table 11 Deposits and loans of MFIs – comparison with money and banking data

(percentages)

	Data available at:							
Period	Feb. 04				Apr. 05			
	RMSRE	Bias component	Regression component	Unsystematic component	RMSRE	Bias component	Regression component	Unsystematic component
Jan.99-Dec.01	15.6	3.6	1.0	95.5	15.7	3.6	0.5	95.9
Jan.00-Dec.02	9.4	0.4	3.7	95.9	9.2	1.0	1.3	97.8
Jan.01-Dec.03	9.7	0.4	2.9	96.6	9.6	0.4	0.3	99.3
Jan.02-Dec.04	-	-	-	-	9.7	3.2	2.1	94.7

However, some series still display a significant revision bias, which points to the need for further analysis and better coverage or improved estimation methods at the level of country contributions. Finally, some series continue to be revised long after the reference period, which is rather cumbersome for users.

More specifically, a detailed country contribution study needs to be conducted for the current account, and in particular for services, which are characterised by persistent positive revisions. Although these revisions seem to have become somewhat smaller over time, their existence reveals that early estimates provide insufficient coverage. The same applies to direct investment series within the financial account, which are characterised by a significant bias (a negative bias for direct investment abroad, and a simultaneously positive bias for direct investment in the euro area).

Fortunately, the indicators reveal that for most current account items (except income), the highest revisions occur in the first vintages. Goods and services credits approximate the final value faster, and 22 weeks after the reference period the data seem to become quite stable. The debits series currently needs one more vintage to become stable. Concerning the income item, the results confirm that the revisions are linked to i.i.p. data collection, which is based on less frequent surveys, and causes the data to take more than two years to stabilise. The opposite phenomenon is generally observed for the financial account, on the other hand. The indicators show that the highest revisions for direct investment and other investment (liabilities) happen in the latest vintage, which means that the data take at least two years to stabilise. Conversely, the results for portfolio investment assets seem to stabilise faster.[19]

Regarding the *internal consistency* of b.o.p. data, the results reveal that errors and omissions have recently increased. In particular for 2004, they follow a persistent negative pattern, although this bias is not significantly different from zero.

The recalculation of the internal consistency indicators after the reception of two rounds of revisions, firstly in April and October 2004 (which revised data from January 2001 to December 2003), and again after the April 2005 revisions (which revised data from January 2002 to December 2004), led to a significant improvement in the EO.

The *external consistency* indicators concerning b.o.p. goods series and external trade statistics show that the inconsistency for imports has been very stable over the last four years after significantly improving in 1999, while for exports the situation worsened during 2003 and 2004. These indicators also tend to improve with revisions to the underlying series, a phenomenon that is mostly noticeable for exports. This shows the desirability of harmonising revision policies for those sets of data that describe similar phenomena.

The external consistency between financial flows in b.o.p and MFI balance sheet statistics improved at the beginning of the period investigated and stabilised thereafter. The bias and regression components are almost negligible, indicating that both series have similar averages and are highly correlated.

A comparison of the RMSRE results before and after the b.o.p. data revisions reveals that these revisions have not decreased the total inconsistency between these series, although the systematic component has further diminished.

Identifying room for quality improvements

An appropriate interpretation of the results obtained from these quantitative indicators will help compilers to identify whether there is room for quality improvements in the euro area data. At the same time, this assessment will help users to make more accurate use of the data, to

19 The time required for data to approximate their final value depends on the reporting system. DI reporting, for example, relies on annual surveys that can take up to two years, whereas PI reporting relies on a security-by-security system that is somewhat faster.

anticipate future revisions and to evaluate the impact of using different datasets in their analysis.

Trade-offs complicate the quality assessment

The existence of trade-offs between timeliness and accuracy, the level of detail and reliability, etc. implies that these quantitative quality indicators should not be looked at in isolation, but should instead form part of a comprehensive regular quality assessment of statistics. The way forward to enhance quality is to strike the right balance between the various quality elements. For instance, the absence of revisions (perfect stability) does not necessarily mean that the data are accurate.

In addition, the results included in this paper confirm the existence of a trade-off between stability and consistency. The methodological or other types of data revisions can improve internal consistency as well as external consistency with other datasets.

Update of users' needs

As this paper has demonstrated, quality is a multifaceted phenomenon, and trade-offs between various aspects of quality often exist, which makes it important for compilers to understand how the statistics are used and which elements of quality are more significant to the users.

As defined in Section 2, b.o.p. compilers may also use the proposed indicators to carry out a quality control of the statistics produced. For their part, users may also be requested to assess the usefulness, relevance and clarity of these quality indicators for their own purposes.

The results presented in this paper will hopefully serve to facilitate such a dialogue between the compilers and users of statistics.

ANNEXES

I GLOSSARY

Accessibility: one of the five DQAF quality dimensions, which refers to the data, metadata and assistance to users. Statistics should be presented in a clear and understandable manner, forms of dissemination should be adequate, and statistics should be made available on an impartial basis. Up-to-date and pertinent metadata will be made available, accompanied by prompt and knowledgeable service support.

Accuracy: a DQAF quality dimension linked to the dimension of *Reliability*, which considers whether source data and statistical techniques are sound and whether statistical outputs sufficiently portray reality. The accuracy dimension is generally evaluated at the level of the materially significant b.o.p. data items.

Balance of payments (b.o.p.): the statistical statement that systematically summarises, for a specific time period (usually monthly, quarterly and/or annually), the economic transactions of an economy with the rest of the world. Transactions between residents and non-residents consist of those involving goods, services and income; those involving financial claims on and liabilities to the rest of the world; and those classified as transfers (such as gifts) which involve offsetting entries in order to balance – in an accounting sense – one-sided transactions.

Committee for Monetary, Financial and Balance of Payments Statistics (CMFB): this committee was established by a Council Decision in 1991 to assist the European Commission in drawing up and implementing work programmes concerning monetary, financial and balance of payments statistics. The CMFB is the forum for coordination of statisticians from the national statistical institutes and Eurostat on the one hand, and the national central banks and the ECB on the other.

Consistency: a quality element of *Serviceability*, which covers different aspects such as whether statistics are consistent within a dataset, over time, or with major datasets.

Data Quality Assessment Framework (DQAF): this framework defined by the IMF, in cooperation with a number of statistical agencies and international organisations, covers all aspects of the statistical environment or infrastructure in which data are collected, processed and disseminated, by integrating aspects of the quality of the institution and of its products. Five dimensions – *Integrity*, *Methodological Soundness*, *Accuracy and Reliability*, *Serviceability* and *Accessibility* of data quality – and a set of prerequisites for the assessment of data quality form the basis of the DQAF.

Direct investment: cross-border investment for the purpose of obtaining a lasting interest in an enterprise resident in another economy (assumed, in practice, for ownership of at least 10% of the ordinary shares or voting power). This includes equity capital, reinvested earnings and other capital associated with inter-company operations. The direct investment account records net transactions/positions in assets abroad by euro area residents (as "direct investment abroad") and net transactions/positions in euro area assets by non-residents (as "direct investment in the euro area").

European Union b.o.p./i.i.p. statistical methods ("the B.o.p. Book"): a manual produced by the ECB which aims to provide parties interested in b.o.p. and i.i.p. statistics (i.e. as users or compilers) with information relating to all EU countries on (I) the content and structure of statistical data

and (ii) the collection methods used. It also gives an overview of the compilation of the euro area aggregate figures by explaining the compilation procedures and the underlying methodological concepts agreed by the EU Member States. The "B.o.p. Book" was first issued in January 1998, and has been successively updated every year. The latest version is November 2005.

External trade in goods: exports and imports of goods with countries outside the euro area, measured in terms of value and as indices of volume and unit value. External trade statistics are not comparable with the exports and imports recorded in the national accounts, as the latter include both intra-euro area and extra-euro area transactions, and also combine goods and services. Nor are they fully comparable with the goods item in b.o.p. statistics. Besides methodological adjustments, the main difference is to be found in the fact that imports in external trade statistics are recorded including insurance and freight services, whereas they are recorded free on board in the goods item in the b.o.p. statistics.

Integrity: one of the five DQAF quality dimensions, which considers whether the principle of objectivity in the collection, processing and dissemination of statistics is firmly adhered to in terms of professionalism, transparency and ethical standards.

International investment position (i.i.p.): the value and composition of an economy's outstanding net financial claims on (or financial liabilities to) the rest of the world.

Methodological soundness: one of the five DQAF quality dimensions, which considers whether the methodological basis for the statistics follows internationally accepted standards, guidelines or good practices. This dimension is assessed against the balance of payments guidelines outlined in the fifth edition of the Balance of Payments Manual (BPM5). The application of these guidelines is generally evaluated at the level of materially significant balance of payments data items (e.g. goods, services, income, direct investment and portfolio investment).

MFI net external assets: the external assets of the euro area MFI sector (such as gold, foreign currency banknotes and coins, securities issued by non-euro area residents and loans granted to non-euro area residents) minus the external liabilities of the euro area MFI sector (such as non-euro area residents' deposits and repurchase agreements, as well as their holdings of money market fund shares/units and debt securities issued by MFIs with a maturity of up to and including two years).

MFIs (monetary financial institutions): financial institutions which together form the money-issuing sector of the euro area. These include the Eurosystem, resident credit institutions (as defined in Community law) and all other resident financial institutions whose business is to receive deposits and/or close substitutes for deposits from entities other than MFIs and, for their own account (at least in economic terms), to grant credit and/or invest in securities. The latter group consists predominantly of money market funds.

Plausibility: a quality element which describes the likelihood of the data. Plausibility may be assessed over time (trend) or in comparison with related series. Although not included in the DQAF, *Plausibility* is considered to be a significant element of the dimension of *Accuracy*.

Portfolio investment: euro area residents' net transactions and/or positions in securities issued by non-residents of the euro area ("assets") and non-residents' net transactions and/or positions in securities issued by euro area residents ("liabilities"). This includes equity securities and debt

securities (bonds and notes, and money market instruments). Transactions are recorded at the effective price paid or received, less commissions and expenses. To be regarded as a portfolio asset, ownership in an enterprise must be equivalent to less than 10% of the ordinary shares or voting power.

Relevance: a quality element of *Serviceability*, which reflects whether statistics cover relevant information on the subject field. The relevance and practical utility of existing statistics in meeting users' needs are monitored. (In the July 2003 version of the DQAF, *Relevance* has been reclassified as a "prerequisite" of quality.)

Reliability: a DQAF quality dimension linked to the dimension of *Accuracy*, which refers to the closeness of the initial estimated value to the subsequent estimated value. Assessing reliability involves comparing estimates over time and considering whether revisions have been tracked and analysed for the information they may provide.

Serviceability: one of the five DQAF quality dimensions, which considers whether statistics are relevant, timely, consistent, and whether they follow a predictable revision policy.

Stability: a quality element of *Reliability*, which refers to the likelihood or intensity of revisions of a data item until its final value is calculated.

Statistical Programme Committee (SPC): this committee is composed of the heads of the national statistical institutes of EU Member States, and is empowered to amend EU regulations in the field of statistics in some specific circumstances (the 'Comitology' procedure).

Timeliness: a quality element of *Serviceability*, which displays the time-lag between the reference period and the data publication. *Timeliness* should follow internationally accepted dissemination standards.

2 TABLES AND GRAPHS

STUDIES ON REVISIONS: B.O.P. CURRENT ACCOUNT

Table 12 Exports of goods

Item	Period	No. of Obs	MAPE				% Upward revisions	Q (%)
				3rd quartile	90th percentile	Max.		
100:2 - Goods credits (exports)	x0-x1:Jan.99-Dec.01	36	0.013	0.021	0.030	0.050	69.4	94.3
	x1-x2:Jan.99-Dec.01	36	0.013	0.020	0.025	0.037	77.8	94.3
	x2-x3:Jan.99-Dec.01	36	0.004	0.005	0.008	0.015	80.6	97.1
	x0-x3:Jan.99-Dec.01	36	0.026	0.034	0.062	0.076	75.0	97.1
100:2 - Goods credits (exports)	x0-x1:Jan.00-Dec.02	36	0.012	0.018	0.025	0.037	69.4	94.3
	x1-x2:Jan.00-Dec.02	36	0.007	0.010	0.012	0.021	61.1	94.3
	x2-x3:Jan.00-Dec.02	36	0.004	0.005	0.009	0.018	80.6	97.1
	x0-x3:Jan.00-Dec.02	36	0.018	0.030	0.035	0.053	66.7	97.1
100:2 - Goods credits (exports)	x0-x1:Jan.01-Dec.03	36	0.011	0.016	0.025	0.037	52.8	97.1
	x1-x2:Jan.01-Dec.03	36	0.006	0.009	0.011	0.014	61.1	97.1
	x2-x3:Jan.01-Dec.03	36	0.003	0.004	0.008	0.018	63.9	100.0
	x0-x3:Jan.01-Dec.03	36	0.014	0.019	0.033	0.053	52.8	100.0

Chart 13 Revisions of the exports of goods (MAPE and upward revisions)

(percentages; MAPE = left-hand scale; upward revisions = right-hand scale)

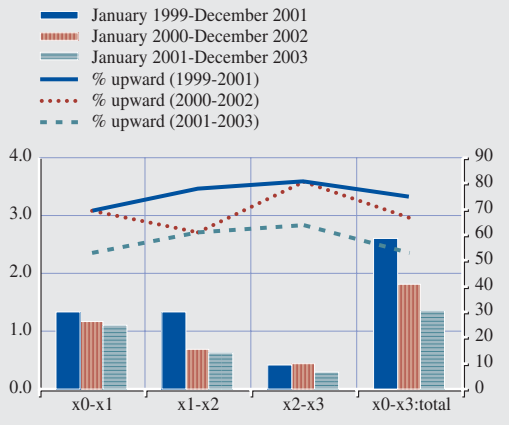


Table 13 Imports of goods

Item	Period	No. of Obs	MAPE				% Upward revisions	Q (%)
				3rd quartile	90th percentile	Max.		
100:3 - Goods debits (imports)	x0-x1:Jan.99-Dec.01	36	0.022	0.032	0.040	0.064	66.7	91.4
	x1-x2:Jan.99-Dec.01	36	0.030	0.045	0.053	0.073	86.1	91.4
	x2-x3:Jan.99-Dec.01	36	0.009	0.015	0.019	0.026	94.4	94.3
	x0-x3:Jan.99-Dec.01	36	0.055	0.081	0.101	0.125	83.3	94.3
100:3 - Goods debits (imports)	x0-x1:Jan.00-Dec.02	36	0.019	0.029	0.037	0.064	58.3	91.4
	x1-x2:Jan.00-Dec.02	36	0.017	0.029	0.035	0.049	80.6	97.1
	x2-x3:Jan.00-Dec.02	36	0.006	0.008	0.011	0.018	94.4	100.0
	x0-x3:Jan.00-Dec.02	36	0.032	0.046	0.074	0.102	75.0	94.3
100:3 - Goods debits (imports)	x0-x1:Jan.01-Dec.03	36	0.012	0.016	0.025	0.037	47.2	94.3
	x1-x2:Jan.01-Dec.03	36	0.010	0.016	0.019	0.028	83.3	100.0
	x2-x3:Jan.01-Dec.03	36	0.004	0.006	0.010	0.012	69.4	100.0
	x0-x3:Jan.01-Dec.03	36	0.016	0.023	0.039	0.053	69.4	94.3

Chart 14 Revisions of the imports of goods (MAPE and upward revisions)

(percentages; MAPE = left-hand scale; upward revisions = right-hand scale)

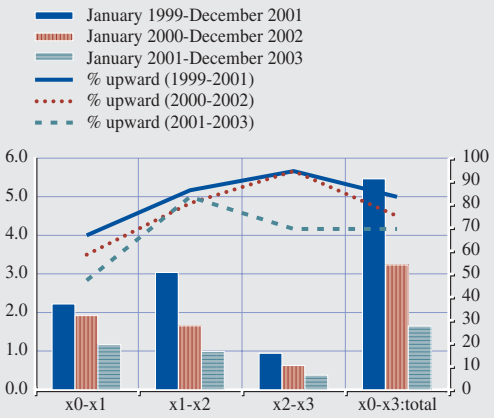


Table 14 Exports of services

Item	Period	No. of Obs	MAPE				% Upward revisions	Q (%)
				3rd quartile	90th percentile	Max.		
200:2 - Services (credits)	x0-x1:Jan.99-Dec.01	36	0.053	0.071	0.086	0.098	94.4	88.6
	x1-x2:Jan.99-Dec.01	36	0.029	0.037	0.052	0.113	83.3	85.7
	x2-x3:Jan.99-Dec.01	36	0.019	0.024	0.036	0.064	72.2	94.3
	x0-x3:Jan.99-Dec.01	36	0.089	0.102	0.133	0.193	100.0	91.4
200:2 - Services (credits)	x0-x1:Jan.00-Dec.02	36	0.047	0.068	0.086	0.098	94.4	94.3
	x1-x2:Jan.00-Dec.02	36	0.021	0.027	0.046	0.108	91.7	94.3
	x2-x3:Jan.00-Dec.02	36	0.016	0.022	0.029	0.064	72.2	94.3
	x0-x3:Jan.00-Dec.02	36	0.077	0.098	0.127	0.193	94.4	94.3
200:2 - Services (credits)	x0-x1:Jan.01-Dec.03	36	0.043	0.068	0.084	0.098	86.1	88.6
	x1-x2:Jan.01-Dec.03	36	0.015	0.018	0.032	0.049	77.8	97.1
	x2-x3:Jan.01-Dec.03	36	0.009	0.010	0.024	0.061	50.0	97.1
	x0-x3:Jan.01-Dec.03	36	0.056	0.081	0.104	0.193	94.4	88.6

Chart 15 Revisions of the exports of services (MAPE and upward revisions)

(percentages; MAPE = left-hand scale; upward revisions = right-hand scale)

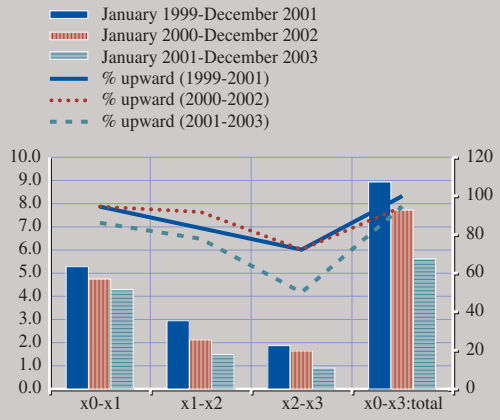


Table 15 Imports of services

Item	Period	No. of Obs	MAPE				% Upward revisions	Q (%)
				3rd quartile	90th percentile	Max.		
200:3 - Services (debits)	x0-x1:Jan.99-Dec.01	36	0.044	0.054	0.083	0.124	97.2	88.6
	x1-x2:Jan.99-Dec.01	36	0.035	0.048	0.070	0.095	97.2	97.1
	x2-x3:Jan.99-Dec.01	36	0.024	0.030	0.044	0.068	80.6	91.4
	x0-x3:Jan.99-Dec.01	36	0.096	0.106	0.131	0.192	100.0	82.9
200:3 - Services (debits)	x0-x1:Jan.00-Dec.02	36	0.035	0.047	0.061	0.099	94.4	91.4
	x1-x2:Jan.00-Dec.02	36	0.027	0.039	0.054	0.072	86.1	94.3
	x2-x3:Jan.00-Dec.02	36	0.017	0.022	0.031	0.044	55.6	91.4
	x0-x3:Jan.00-Dec.02	36	0.067	0.094	0.117	0.181	97.2	88.6
200:3 - Services (debits)	x0-x1:Jan.01-Dec.03	36	0.026	0.042	0.048	0.065	80.6	94.3
	x1-x2:Jan.01-Dec.03	36	0.020	0.028	0.044	0.055	72.2	94.3
	x2-x3:Jan.01-Dec.03	36	0.011	0.017	0.025	0.044	36.1	97.1
	x0-x3:Jan.01-Dec.03	36	0.040	0.067	0.084	0.104	88.9	91.4

Chart 16 Revisions of the import of services (MAPE and upward revisions)

(percentages; MAPE = left-hand scale; upward revisions = right-hand scale)

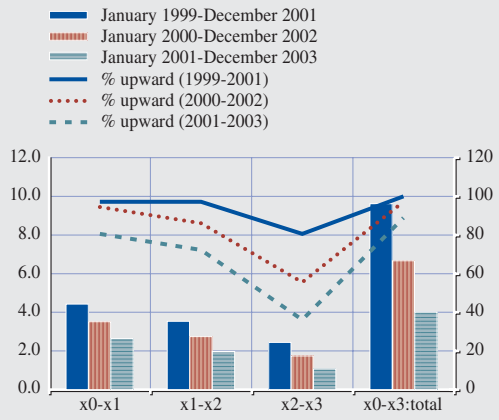


Table 16 Income credits

Item	Period	No. of Obs	MAPE				% Upward revisions	Q (%)
				3rd quartile	90th percentile	Max.		
300:2 - Income (credits)	x0-x1:Jan.99-Dec.01	36	0.047	0.066	0.100	0.146	72.2	74.3
	x1-x2:Jan.99-Dec.01	36	0.040	0.055	0.074	0.133	55.6	88.6
	x2-x3:Jan.99-Dec.01	36	0.037	0.057	0.068	0.088	33.3	94.3
	x0-x3:Jan.99-Dec.01	36	0.076	0.100	0.142	0.226	66.7	85.7
300:2 - Income (credits)	x0-x1:Jan.00-Dec.02	36	0.041	0.054	0.100	0.146	75.0	85.7
	x1-x2:Jan.00-Dec.02	36	0.026	0.035	0.056	0.100	44.4	97.1
	x2-x3:Jan.00-Dec.02	36	0.032	0.054	0.069	0.110	38.9	97.1
	x0-x3:Jan.00-Dec.02	36	0.064	0.085	0.125	0.226	61.1	85.7
300:2 - Income (credits)	x0-x1:Jan.01-Dec.03	36	0.025	0.034	0.047	0.066	52.8	82.9
	x1-x2:Jan.01-Dec.03	36	0.022	0.034	0.042	0.072	44.4	97.1
	x2-x3:Jan.01-Dec.03	36	0.026	0.052	0.069	0.110	22.2	97.1
	x0-x3:Jan.01-Dec.03	36	0.042	0.058	0.082	0.160	44.4	82.9

Chart 17 Revisions of the income credits (MAPE and upward revisions)

(percentages; MAPE = left-hand scale; upward revisions = right-hand scale)

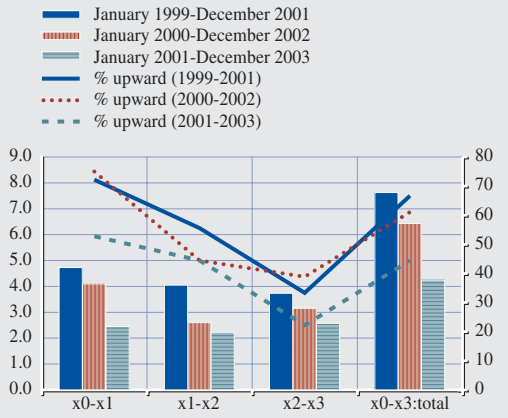


Table 17 Income debits

Item	Period	No. of Obs	MAPE				% Upward revisions	Q (%)
				3rd quartile	90th percentile	Max.		
300:3.- Income (debits)	x0-x1:Jan.99-Dec.01	36	0.041	0.061	0.083	0.106	86.1	82.9
	x1-x2:Jan.99-Dec.01	36	0.045	0.054	0.087	0.237	75.0	94.3
	x2-x3:Jan.99-Dec.01	36	0.051	0.070	0.091	0.144	55.6	97.1
	x0-x3:Jan.99-Dec.01	36	0.108	0.152	0.250	0.272	72.2	85.7
300:3.- Income (debits)	x0-x1:Jan.00-Dec.02	36	0.029	0.042	0.061	0.083	72.2	85.7
	x1-x2:Jan.00-Dec.02	36	0.024	0.028	0.060	0.103	63.9	94.3
	x2-x3:Jan.00-Dec.02	36	0.036	0.060	0.074	0.087	47.2	97.1
	x0-x3:Jan.00-Dec.02	36	0.052	0.076	0.113	0.230	61.1	88.6
300:3.- Income (debits)	x0-x1:Jan.01-Dec.03	36	0.032	0.046	0.061	0.086	50.0	91.4
	x1-x2:Jan.01-Dec.03	36	0.027	0.032	0.056	0.115	61.1	91.4
	x2-x3:Jan.01-Dec.03	36	0.027	0.058	0.067	0.082	36.1	100.0
	x0-x3:Jan.01-Dec.03	36	0.035	0.053	0.074	0.113	44.4	94.3

Chart 18 Revisions of the income debits (MAPE and upward revisions)

(percentages; MAPE = left-hand scale; upward revisions = right-hand scale)

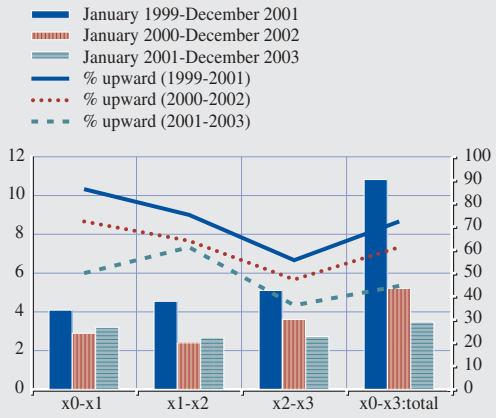


Table 18 Current transfer credits

Item	Period	No. of Obs	MAPE				% Upward revisions	Q (%)
				3rd quartile	90th percentile	Max.		
379:2- Cur.transfers (credits)	x0-x1:Jan.99-Dec.01	36	0.058	0.081	0.142	0.174	75.0	91.4
	x1-x2:Jan.99-Dec.01	36	0.026	0.036	0.064	0.091	58.3	100.0
	x2-x3:Jan.99-Dec.01	36	0.029	0.037	0.050	0.089	38.9	100.0
	x0-x3:Jan.99-Dec.01	36	0.084	0.131	0.172	0.209	75.0	91.4
379:2- Cur.transfers (credits)	x0-x1:Jan.00-Dec.02	36	0.053	0.082	0.112	0.163	69.4	97.1
	x1-x2:Jan.00-Dec.02	36	0.026	0.042	0.064	0.091	63.9	97.1
	x2-x3:Jan.00-Dec.02	36	0.030	0.039	0.061	0.089	63.9	97.1
	x0-x3:Jan.00-Dec.02	36	0.089	0.119	0.179	0.209	83.3	97.1
379:2- Cur.transfers (credits)	x0-x1:Jan.01-Dec.03	36	0.047	0.082	0.104	0.140	72.2	97.1
	x1-x2:Jan.01-Dec.03	36	0.029	0.051	0.062	0.091	44.4	97.1
	x2-x3:Jan.01-Dec.03	36	0.024	0.039	0.061	0.089	69.4	97.1
	x0-x3:Jan.01-Dec.03	36	0.079	0.112	0.141	0.209	72.2	97.1

Chart 19 Revisions of the current transfer credits (MAPE and upward revisions)

(percentages; MAPE = left-hand scale; upward revisions = right-hand scale)

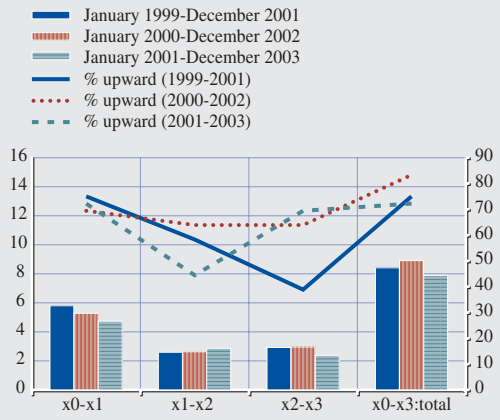


Table 19 Current transfer debits

Item	Period	No. of Obs	MAPE				% Upward revisions	Q (%)
				3rd quartile	90th percentile	Max.		
379:3- Cur.transfers (debits)	x0-x1:Jan.99-Dec.01	36	0.051	0.071	0.124	0.156	88.9	80.0
	x1-x2:Jan.99-Dec.01	36	0.024	0.028	0.043	0.090	88.9	97.1
	x2-x3:Jan.99-Dec.01	36	0.016	0.027	0.037	0.063	66.7	97.1
	x0-x3:Jan.99-Dec.01	36	0.083	0.107	0.157	0.215	97.2	74.3
379:3- Cur.transfers (debits)	x0-x1:Jan.00-Dec.02	36	0.047	0.067	0.106	0.156	86.1	80.0
	x1-x2:Jan.00-Dec.02	36	0.020	0.026	0.043	0.090	77.8	97.1
	x2-x3:Jan.00-Dec.02	36	0.024	0.033	0.040	0.070	94.4	97.1
	x0-x3:Jan.00-Dec.02	36	0.085	0.114	0.144	0.215	97.2	74.3
379:3- Cur.transfers (debits)	x0-x1:Jan.01-Dec.03	36	0.037	0.051	0.076	0.135	77.8	85.7
	x1-x2:Jan.01-Dec.03	36	0.017	0.024	0.041	0.090	80.6	100.0
	x2-x3:Jan.01-Dec.03	36	0.021	0.031	0.040	0.070	69.4	97.1
	x0-x3:Jan.01-Dec.03	36	0.067	0.099	0.121	0.175	94.4	82.9

Chart 20 Revisions of the current transfer debits (MAPE and upward revisions)

(percentages; MAPE = left-hand scale; upward revisions = right-hand scale)

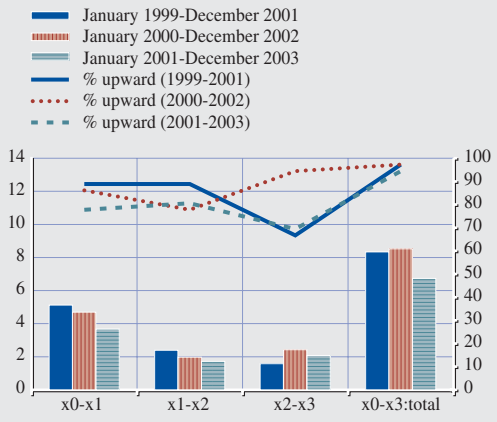


Table 20 Current account credits

Item	Period	No. of Obs	MAPE				% Upward revisions	Q (%)
				3rd quartile	90th percentile	Max.		
993:2- Current account (credits)	x0-x1:Jan.99-Dec.01	36	0.022	0.030	0.043	0.051	94.4	91.4
	x1-x2:Jan.99-Dec.01	36	0.015	0.024	0.032	0.039	83.3	97.1
	x2-x3:Jan.99-Dec.01	36	0.007	0.009	0.015	0.030	50.0	94.3
	x0-x3:Jan.99-Dec.01	36	0.038	0.052	0.059	0.093	91.7	88.6
993:2- Current account (credits)	x0-x1:Jan.00-Dec.02	36	0.019	0.026	0.032	0.047	94.4	88.6
	x1-x2:Jan.00-Dec.02	36	0.008	0.010	0.018	0.031	72.2	94.3
	x2-x3:Jan.00-Dec.02	36	0.008	0.009	0.015	0.030	55.6	94.3
	x0-x3:Jan.00-Dec.02	36	0.029	0.043	0.049	0.078	91.7	94.3
993:2- Current account (credits)	x0-x1:Jan.01-Dec.03	36	0.014	0.023	0.027	0.037	75.0	88.6
	x1-x2:Jan.01-Dec.03	36	0.006	0.009	0.012	0.022	72.2	91.4
	x2-x3:Jan.01-Dec.03	36	0.005	0.007	0.012	0.030	47.2	91.4
	x0-x3:Jan.01-Dec.03	36	0.017	0.025	0.038	0.055	80.6	94.3

Chart 21 Revisions of the current account credits (MAPE and upward revisions)

(percentages; MAPE = left-hand scale; upward revisions = right-hand scale)

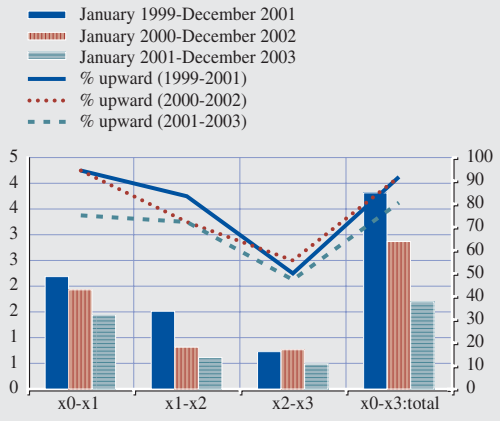
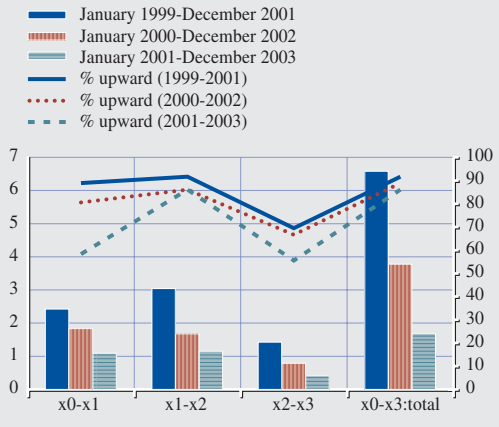


Table 21 Current account debits

Item	Period	No. of Obs	MAPE				% Upward revisions	Q (%)
				3rd quartile	90th percentile	Max.		
993:3- Current account (debits)	x0-x1:Jan.99-Dec.01	36	0.024	0.031	0.044	0.074	88.9	91.4
	x1-x2:Jan.99-Dec.01	36	0.030	0.043	0.053	0.095	91.7	88.6
	x2-x3:Jan.99-Dec.01	36	0.014	0.022	0.028	0.036	69.4	91.4
	x0-x3:Jan.99-Dec.01	36	0.066	0.096	0.113	0.127	91.7	94.3
993:3- Current account (debits)	x0-x1:Jan.00-Dec.02	36	0.018	0.026	0.036	0.074	80.6	91.4
	x1-x2:Jan.00-Dec.02	36	0.017	0.026	0.039	0.052	86.1	91.4
	x2-x3:Jan.00-Dec.02	36	0.008	0.011	0.013	0.025	66.7	91.4
	x0-x3:Jan.00-Dec.02	36	0.038	0.066	0.078	0.103	88.9	97.1
993:3- Current account (debits)	x0-x1:Jan.01-Dec.03	36	0.011	0.016	0.026	0.029	58.3	97.1
	x1-x2:Jan.01-Dec.03	36	0.011	0.016	0.019	0.033	86.1	97.1
	x2-x3:Jan.01-Dec.03	36	0.004	0.007	0.010	0.019	55.6	97.1
	x0-x3:Jan.01-Dec.03	36	0.017	0.021	0.033	0.044	86.1	97.1

Chart 22 Revisions of the current account debits (MAPE and upward revisions)

(percentages; MAPE = left-hand scale; upward revisions = right-hand scale)



STUDIES ON REVISIONS: B.O.P. FINANCIAL ACCOUNT

Table 22 Direct investment abroad

Item	Period	No. of Obs	RMSRE	Bias comp. (%)	Regress. comp. (%)	Unsyst. comp. (%)	% Upward revisions	Q (%)	Complementary tests: Stationarity test	Normality test	Mean Bias T-Test
505:4-Direct investment abroad	x0-x1;Jan.99-Dec.01	36	0.354	13.5	2.6	83.9	27.8	85.7	167.05	89.12	2.5
	x1-x2;Jan.99-Dec.01	36	0.652	16.3	1.8	81.9	19.4	82.9	184.26	0.00	1.3
	x2-x3;Jan.99-Dec.01	36	0.596	10.1	0.4	89.5	38.9	80.0	187.00	0.00	5.6
	x0-x3;Jan.99-Dec.01	36	0.913	26.5	0.4	73.2	5.6	77.1	187.00	0.0	0.1
505:4-Direct investment abroad	x0-x1;Jan.00-Dec.02	36	0.370	16.4	2.9	80.6	25.0	85.7	156.23	71.89	1.3
	x1-x2;Jan.00-Dec.02	36	0.447	27.9	0.1	72.1	22.2	82.9	143.88	0.02	0.1
	x2-x3;Jan.00-Dec.02	36	0.768	4.5	0.1	95.4	50.0	88.6	206.83	0.00	20.9
	x0-x3;Jan.00-Dec.02	36	0.865	23.5	0.0	76.5	22.2	80.0	206.83	0.00	0.2
505:4-Direct investment abroad	x0-x1;Jan.01-Dec.03	36	0.450	20.3	1.4	78.3	25.0	88.6	215.94	1.44	0.5
	x1-x2;Jan.01-Dec.03	36	0.529	8.6	0.8	90.6	33.3	85.7	176.75	0.02	7.8
	x2-x3;Jan.01-Dec.03	36	0.765	2.0	0.0	98.0	61.1	91.4	236.14	0.00	40.4
	x0-x3;Jan.01-Dec.03	36	0.840	15.3	0.6	84.1	27.8	88.6	236.14	0.00	1.7

Chart 23 Revisions of direct investment abroad (RMSRE and upward revisions)

(percentage; left-hand scale = RMSRE; right-hand scale = upward revisions)

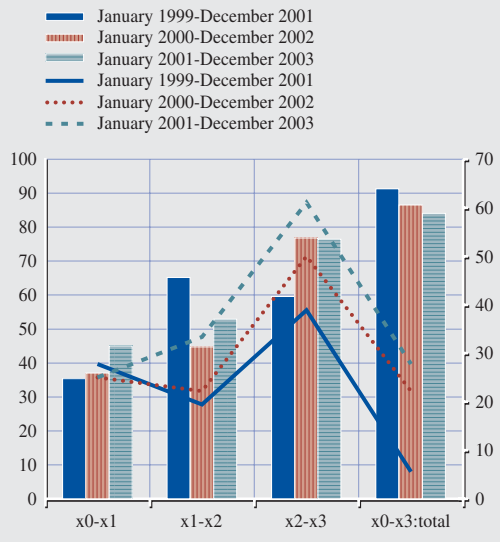


Chart 24 RMSRE decomposition

(percentage)

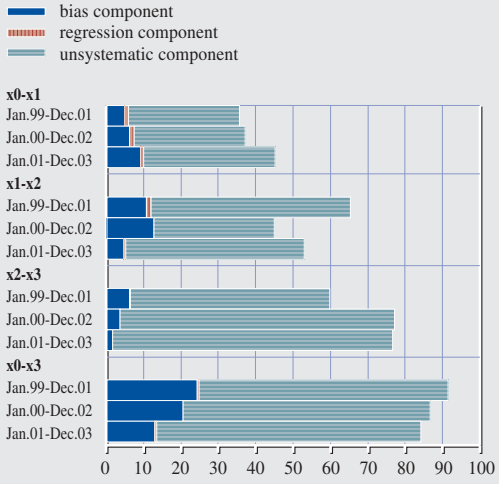


Table 23 Direct investment in the euro area

Item	Period	No. of Obs	RMSRE				% Upward revisions	Q (%)	Complementary tests		
				Bias comp. (%)	Regress. comp. (%)	Unsyst. comp. (%)			Stationarity test	Normality test	Mean Bias T-Test
555:4-Direct investment in the euro area	x0-x1;Jan.99-Dec.01	36	0.123	14.4	0.5	85.1	72.2	77.1	169.04	0.00	2.0
	x1-x2;Jan.99-Dec.01	36	0.471	21.0	1.8	77.2	77.8	68.6	181.41	0.00	0.4
	x2-x3;Jan.99-Dec.01	36	0.347	6.7	1.7	91.6	52.8	88.6	172.12	0.00	12.2
	x0-x3;Jan.99-Dec.01	36	0.691	22.1	0.9	77.1	88.9	62.9	172.12	0.00	0.3
555:4-Direct investment in the euro area	x0-x1;Jan.00-Dec.02	36	0.133	8.3	0.8	91.0	69.4	85.7	174.05	0.96	8.4
	x1-x2;Jan.00-Dec.02	36	0.315	22.4	4.4	73.2	72.2	74.3	174.78	0.00	0.3
	x2-x3;Jan.00-Dec.02	36	0.431	6.4	0.1	93.5	52.8	88.6	185.54	0.00	13.0
	x0-x3;Jan.00-Dec.02	36	0.596	21.9	0.8	77.3	77.8	65.7	185.54	0.00	0.4
555:4-Direct investment in the euro area	x0-x1;Jan.01-Dec.03	36	0.640	8.2	0.6	91.1	66.7	74.3	217.91	0.31	8.5
	x1-x2;Jan.01-Dec.03	36	0.741	16.9	9.0	74.1	63.9	68.6	196.55	0.72	1.2
	x2-x3;Jan.01-Dec.03	36	0.787	3.8	6.5	89.8	33.3	91.4	210.80	0.00	24.9
	x0-x3;Jan.01-Dec.03	36	0.951	15.9	1.4	82.7	72.2	57.1	210.80	0.00	1.4

Chart 25 Revisions of direct investment in the euro area (RMSRE and upward revisions)

(percentage; left-hand scale = RMSRE; right-hand scale = upward revisions)

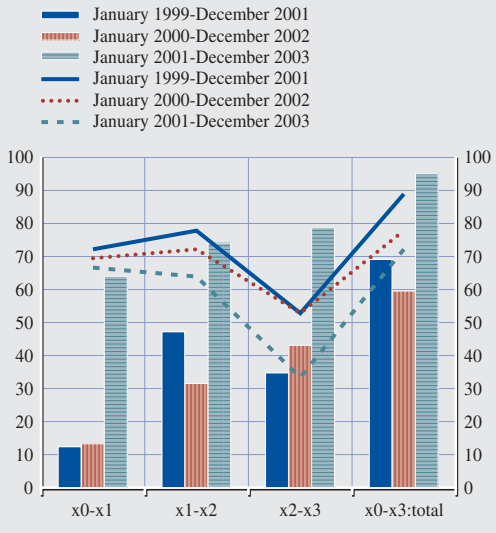


Chart 26 RMSRE decomposition

(percentage)

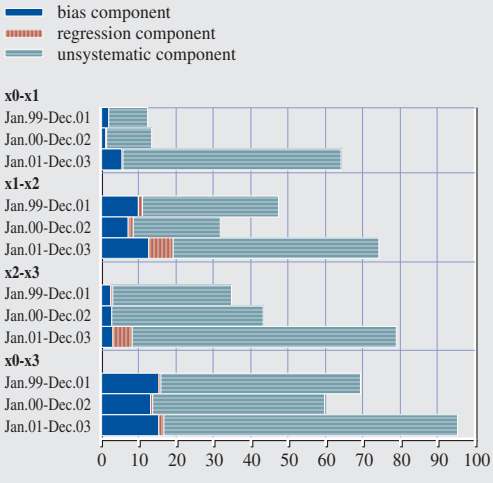


Table 24 Portfolio investment assets

Item	Period	No. of Obs	RMSRE	Bias comp. (%)	Regress. comp. (%)	Unsyst. comp. (%)	% Upward revisions	Q (%)	Complementary tests: Stationarity test	Normality test	Mean Bias T-Test
602:4-Portfolio investment - assets	x0-x1;Jan.99-Dec.01	36	0.438	20.7	1.0	78.2	30.6	77.1	178.38	0.00	0.5
	x1-x2;Jan.99-Dec.01	36	0.279	8.8	18.6	72.6	36.1	91.4	182.62	8.61	7.5
	x2-x3;Jan.99-Dec.01	36	0.110	0.4	2.1	97.5	55.6	100.0	181.47	20.01	71.1
	x0-x3;Jan.99-Dec.01	36	0.511	31.5	0.4	68.1	22.2	74.3	181.47	90.12	0.0
602:4-Portfolio investment - assets	x0-x1;Jan.00-Dec.02	36	0.288	11.2	6.9	81.8	38.9	91.4	154.81	0.00	4.2
	x1-x2;Jan.00-Dec.02	36	0.221	24.1	13.3	62.6	27.8	91.4	149.80	0.00	0.2
	x2-x3;Jan.00-Dec.02	36	0.118	0.6	0.2	99.2	52.8	100.0	150.58	96.89	65.3
	x0-x3;Jan.00-Dec.02	36	0.402	25.4	0.0	74.6	25.0	88.6	150.58	68.61	0.1
602:4-Portfolio investment - assets	x0-x1;Jan.01-Dec.03	36	0.273	4.3	1.9	93.8	41.7	94.3	179.39	11.08	43.3
	x1-x2;Jan.01-Dec.03	36	0.280	19.0	11.0	70.0	27.8	91.4	161.02	0.00	0.7
	x2-x3;Jan.01-Dec.03	36	0.113	0.8	3.9	95.2	44.4	100.0	165.85	17.34	58.9
	x0-x3;Jan.01-Dec.03	36	0.437	16.0	12.6	71.3	33.3	91.4	165.85	81.84	1.4

Chart 27 Revisions of portfolio investment assets (RMSRE and upward revisions)

(percentage; left-hand scale = RMSRE; right-hand scale = upward revisions)

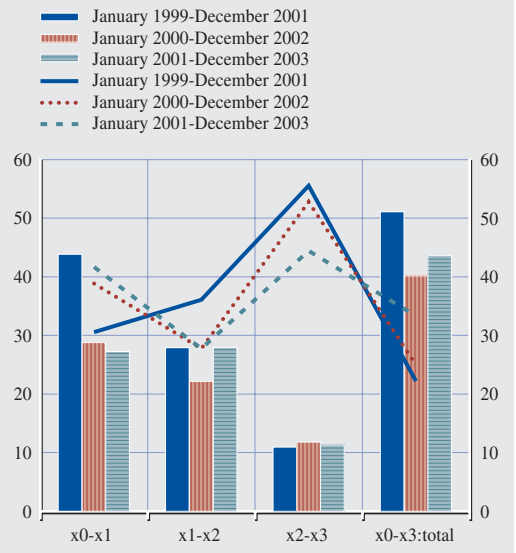


Chart 28 RMSRE decomposition

(percentage)

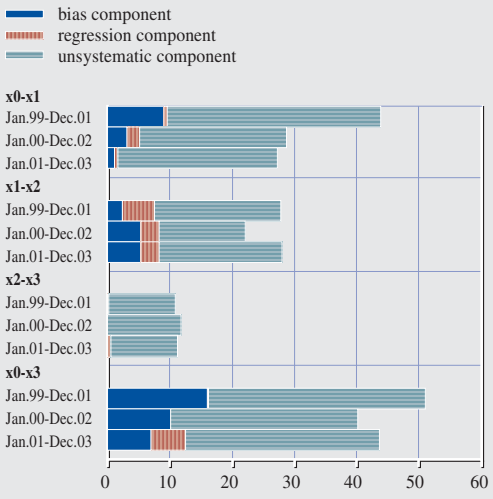


Table 25 Portfolio investment liabilities

Item	Period	No. of Obs	RMSRE				% Upward revisions	Q (%)	Complementary tests		
				Bias comp. (%)	Regress. comp. (%)	Unsyst. comp. (%)			Stationarity test	Normality test	Mean Bias T-Test
652:4-Portfolio investment - liabilities	x0-x1;Jan.99-Dec.01	36	0.336	10.7	2.9	86.4	63.9	94.3	179.99	92.42	4.8
	x1-x2;Jan.99-Dec.01	36	0.275	3.6	1.3	95.1	58.3	94.3	176.59	99.30	25.8
	x2-x3;Jan.99-Dec.01	36	0.133	4.7	0.7	94.6	61.1	100.0	174.06	63.81	40.5
	x0-x3;Jan.99-Dec.01	36	0.375	23.2	0.4	76.4	72.2	94.3	174.06	44.48	0.3
652:4-Portfolio investment - liabilities	x0-x1;Jan.00-Dec.02	36	0.235	5.3	5.6	89.1	66.7	91.4	166.82	61.96	17.0
	x1-x2;Jan.00-Dec.02	36	0.212	32.0	5.0	63.0	75.0	91.4	163.22	14.41	0.0
	x2-x3;Jan.00-Dec.02	36	0.177	2.1	3.8	94.1	61.1	100.0	159.16	0.12	39.6
	x0-x3;Jan.00-Dec.02	36	0.318	34.8	2.3	62.8	77.8	94.3	159.16	50.33	0.0
652:4-Portfolio investment - liabilities	x0-x1;Jan.01-Dec.03	36	0.384	1.1	0.8	98.1	66.7	80.0	163.37	0.02	53.0
	x1-x2;Jan.01-Dec.03	36	0.286	26.9	0.6	72.5	72.2	91.4	163.89	16.51	0.1
	x2-x3;Jan.01-Dec.03	36	0.161	2.4	3.7	93.9	50.0	100.0	159.04	0.00	35.7
	x0-x3;Jan.01-Dec.03	36	0.480	18.1	0.4	81.5	77.8	82.9	159.04	0.11	0.9

Chart 29 Revisions of portfolio investment liabilities (RMSRE and upward revisions)

(percentage; left-hand scale = RMSRE; right-hand scale = upward revisions)

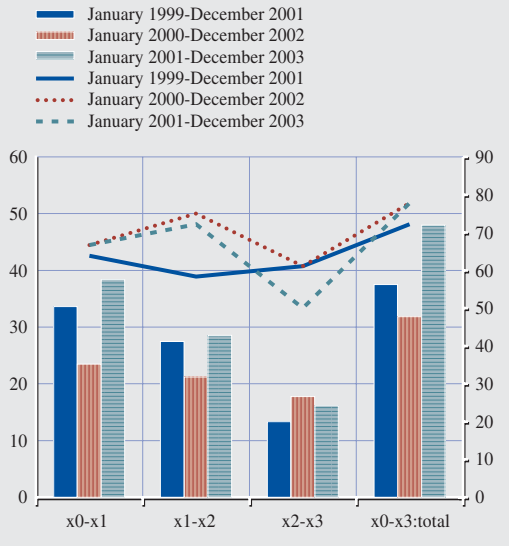


Chart 30 RMSRE decomposition

(percentage)

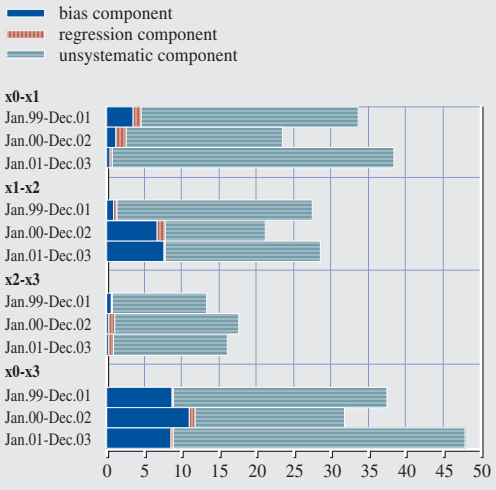


Table 26 Other investment assets

Item	Period	No. of Obs	RMSRE	Bias comp. (%)	Regress. comp. (%)	Unsyst. comp. (%)	% Upward revisions	Q (%)	Complementary tests: Stationarity test	Normality test	Mean Bias T-Test
703:4-Other investment - assets	x0-x1;Jan.99-Dec.01	36	0.187	1.3	0.5	98.2	50.0	91.4	247.48	79.31	50.1
	x1-x2;Jan.99-Dec.01	36	0.174	8.8	1.3	90.0	44.4	88.6	231.44	0.00	7.5
	x2-x3;Jan.99-Dec.01	36	0.070	11.3	5.4	83.3	38.9	94.3	227.48	66.45	16.2
	x0-x3;Jan.99-Dec.01	36	0.273	0.0	0.0	99.9	44.4	85.7	227.48	0.00	90.0
703:4-Other investment - assets	x0-x1;Jan.00-Dec.02	36	0.144	2.2	2.0	95.7	50.0	88.6	184.94	6.67	37.7
	x1-x2;Jan.00-Dec.02	36	0.100	6.2	8.0	85.8	44.4	91.4	186.28	0.52	13.6
	x2-x3;Jan.00-Dec.02	36	0.106	4.2	3.5	92.3	41.7	94.3	179.63	45.76	22.3
	x0-x3;Jan.00-Dec.02	36	0.139	1.8	1.7	96.4	44.4	91.4	179.63	81.00	42.4
703:4-Other investment - assets	x0-x1;Jan.01-Dec.03	36	0.098	0.1	0.0	99.9	55.6	94.3	177.17	86.42	85.2
	x1-x2;Jan.01-Dec.03	36	0.096	0.0	0.2	99.8	47.2	94.3	171.73	0.07	94.5
	x2-x3;Jan.01-Dec.03	36	0.082	7.2	3.6	89.2	22.2	100.0	167.55	28.60	27.5
	x0-x3;Jan.01-Dec.03	36	0.098	0.1	0.0	99.9	55.6	94.3	177.17	86.42	85.2

Chart 31 Revisions of other investment assets (RMSRE and upward revisions)

(percentage; left-hand scale = RMSRE; right-hand scale = upward revisions)

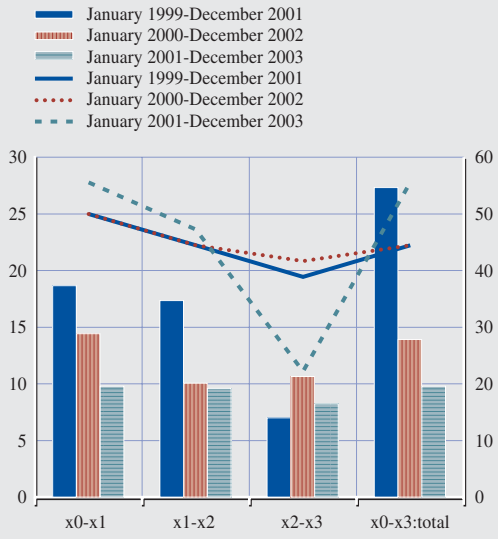


Chart 32 RMSRE decomposition

(percentage)

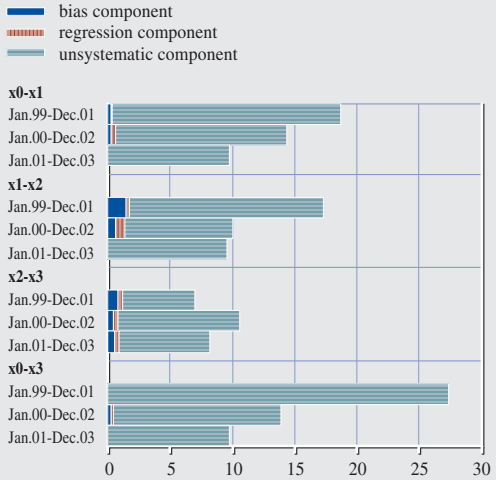


Table 27 Other investment liabilities

Item	Period	No. of Obs	RMSRE				% Upward revisions	Q (%)	Complementary tests		
				Bias comp. (%)	Regress. comp. (%)	Unsyst. comp. (%)			Stationarity test	Normality test	Mean Bias T-Test
753:4-Other investment - liabilities	x0-x1;Jan.99-Dec.01	36	0.175	3.9	1.4	94.7	50.0	91.4	220.31	0.45	24.2
	x1-x2;Jan.99-Dec.01	36	0.149	8.6	1.5	89.9	66.7	88.6	221.50	5.82	7.9
	x2-x3;Jan.99-Dec.01	36	0.095	4.4	3.1	92.4	58.3	94.3	211.26	0.00	21.1
	x0-x3;Jan.99-Dec.01	36	0.161	3.6	0.0	96.4	52.8	91.4	211.26	16.49	26.3
753:4-Other investment - liabilities	x0-x1;Jan.00-Dec.02	36	0.090	0.7	5.3	94.0	52.8	94.3	182.16	2.30	61.8
	x1-x2;Jan.00-Dec.02	36	0.083	6.4	14.8	78.8	63.9	94.3	182.40	72.94	13.0
	x2-x3;Jan.00-Dec.02	36	0.131	7.9	0.0	92.0	58.3	91.4	172.40	0.72	9.1
	x0-x3;Jan.00-Dec.02	36	0.145	12.2	1.1	86.7	61.1	91.4	172.40	85.82	3.4
753:4-Other investment - liabilities	x0-x1;Jan.01-Dec.03	36	0.087	4.8	9.2	86.0	52.8	94.3	208.61	3.89	19.4
	x1-x2;Jan.01-Dec.03	36	0.121	2.9	9.1	88.0	55.6	91.4	210.23	68.40	31.7
	x2-x3;Jan.01-Dec.03	36	0.141	7.2	0.7	92.1	44.4	94.3	193.85	0.14	10.8
	x0-x3;Jan.01-Dec.03	36	0.182	4.9	2.0	93.2	52.8	91.4	193.85	62.19	19.0

Chart 33 Revisions of other investment liabilities (RMSRE and upward revisions)

(percentage; left-hand scale = RMSRE; right-hand scale = upward revisions)

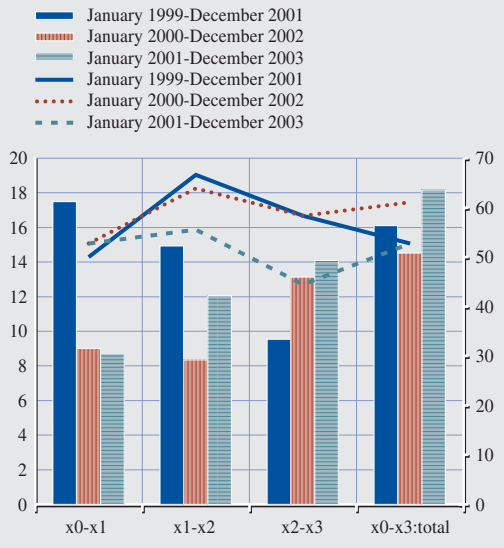
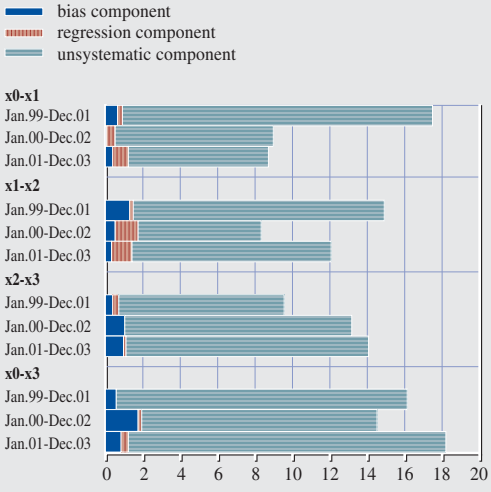


Chart 34 RMSRE decomposition

(percentage)



REFERENCES

ABS (1996), "Quality of Australian balance of payments statistics". W. McLennan, February, report presented at the BOPCOM meeting, Canberra, 21-25 October 1996, under the title "Revisions in Australia's balance of payments (BOP) statistics".

ABS (2001), "Quality measures for systems of economic accounts". J. Zarb, Analytical Services Branch, Methodology Division, ABS, June.

BEA (1987), "Evaluation of the GNP estimates". A. H. Young (with contributions by C. S. Carson, F. de Leeuw and R. P. Parker), August.

BEA (1993), "Reliability and accuracy of the quarterly estimates of GDP". A. H. Young, October.

BEA (1998), "Reliability of the quarterly and annual estimates of GDP and gross domestic income". B. T. Grimm and R. P. Parker, December.

BEA (2002), "Reliability of GDP and related NIPA estimates". D. J. Fixler and B. T. Grimm, January.

Diebold, F. X. (2001), *Elements of Forecasting,* 2nd ed. (Cincinnati: South-Western).

ECB (2001), "Trade-off between timeliness and accuracy: ECB requirements for general economic statistics", ECB Monthly Bulletin, April.

ECB (2004), "Harmonisation of revision practices for the euro area/EU b.o.p and i.i.p. statistics", mimeo, CMFB, May.

IMF (2002), "Assessing accuracy and reliability: A note based on approaches used in national account and balance of payments statistics". C. S. Carson and L. Laliberté, Statistics Department working paper, February.

IMF (2003), Data Quality Assessment Framework for balance of payments statistics, Statistics Department, July.

Joint ECB-Eurostat Task Force on Quality (2003), "Interim report on the quality assessment of balance of payments and international investment position statistics", CMFB website, November.

ONS (2000), "Revisions analysis of initial estimates of key economics indicators and GDP components". A. Barklem, *Economic Trends,* No 556, March.

ONS (2001), "Revisions analysis of initial estimates of annual constant price GDP and its components". P. Symons, *Economic Trends,* No 568, March.

Statistics Netherlands (2001), "Some elements of a quality framework for CMFB statistics". S. Keuning and S. Algera, October, mimeo.

Statistics New Zealand (1996), "Revisions in the New Zealand balance of payments". S. Nesbit, paper for the BOPCOM meeting, Canberra, 21-25 October 1996.

Stewart, T. R. and C. M. Lusk (1994), "Seven components of judgmental forecasting skill: Implications for research and the improvement of forecasts", *Journal of Forecasting,* No 13, pp. 579-99.

World Bank (1998), "The World Bank's unified survey projections: How accurate are they? An ex-post evaluation of US91-US97". J. Verbeek, December.

EUROPEAN CENTRAL BANK OCCASIONAL PAPER SERIES

1 "The impact of the euro on money and bond markets" by J. Santillán, M. Bayle and C. Thygesen, July 2000.

2 "The effective exchange rates of the euro" by L. Buldorini, S. Makrydakis and C. Thimann, February 2002.

3 "Estimating the trend of M3 income velocity underlying the reference value for monetary growth" by C. Brand, D. Gerdesmeier and B. Roffia, May 2002.

4 "Labour force developments in the euro area since the 1980s" by V. Genre and R. Gómez-Salvador, July 2002.

5 "The evolution of clearing and central counterparty services for exchange-traded derivatives in the United States and Europe: a comparison" by D. Russo, T. L. Hart and A. Schönenberger, September 2002.

6 "Banking integration in the euro area" by I. Cabral, F. Dierick and J. Vesala, December 2002.

7 "Economic relations with regions neighbouring the euro area in the 'Euro Time Zone'" by F. Mazzaferro, A. Mehl, M. Sturm, C. Thimann and A. Winkler, December 2002.

8 "An introduction to the ECB's survey of professional forecasters" by J. A. Garcia, September 2003.

9 "Fiscal adjustment in 1991-2002: stylised facts and policy implications" by M. G. Briotti, February 2004.

10 "The acceding countries' strategies towards ERM II and the adoption of the euro: an analytical review" by a staff team led by P. Backé and C. Thimann and including O. Arratibel, O. Calvo-Gonzalez, A. Mehl and C. Nerlich, February 2004.

11 "Official dollarisation/euroisation: motives, features and policy implications of current cases" by A. Winkler, F. Mazzaferro, C. Nerlich and C. Thimann, February 2004.

12 "Understanding the impact of the external dimension on the euro area: trade, capital flows and other international macroeconomic linkages" by R. Anderton, F. di Mauro and F. Moneta, March 2004.

13 "Fair value accounting and financial stability" by a staff team led by A. Enria and including L. Cappiello, F. Dierick, S. Grittini, A. Maddaloni, P. Molitor, F. Pires and P. Poloni, April 2004.

14 "Measuring financial integration in the euro area" by L. Baele, A. Ferrando, P. Hördahl, E. Krylova, C. Monnet, April 2004.

15 “Quality adjustment of European price statistics and the role for hedonics” by H. Ahnert and G. Kenny, May 2004.

16 “Market dynamics associated with credit ratings: a literature review” by F. Gonzalez, F. Haas, R. Johannes, M. Persson, L. Toledo, R. Violi, M. Wieland and C. Zins, June 2004.

17 “Corporate ‘excesses’ and financial market dynamics” by A. Maddaloni and D. Pain, July 2004.

18 “The international role of the euro: evidence from bonds issued by non-euro area residents” by A. Geis, A. Mehl and S. Wredenborg, July 2004.

19 “Sectoral specialisation in the EU: a macroeconomic perspective” by MPC task force of the ESCB, July 2004.

20 “The supervision of mixed financial services groups in Europe” by F. Dierick, August 2004.

21 “Governance of securities clearing and settlement systems” by D. Russo, T. Hart, M. C. Malaguti and C. Papathanassiou, October 2004.

22 “Assessing potential output growth in the euro area: a growth accounting perspective” by A. Musso and T. Westermann, January 2005.

23 “The bank lending survey for the euro area” by J. Berg, A. van Rixtel, A. Ferrando, G. de Bondt and S. Scopel, February 2005.

24 “Wage diversity in the euro area: an overview of labour cost differentials across industries” by V. Genre, D. Momferatou and G. Mourre, February 2005.

25 “Government debt management in the euro area: recent theoretical developments and changes in practices” by G. Wolswijk and J. de Haan, March 2005.

26 “The analysis of banking sector health using macro-prudential indicators” by L. Mörttinen, P. Poloni, P. Sandars and J. Vesala, March 2005.

27 “The EU budget – how much scope for institutional reform?” by H. Enderlein, J. Lindner, O. Calvo-Gonzalez, R. Ritter, April 2005.

28 “Reforms in selected EU network industries” by R. Martin, M. Roma, I. Vansteenkiste, April 2005.

29 “Wealth and asset price effects on economic activity”, by F. Altissimo, E. Georgiou, T. Sastre, M. T. Valderrama, G. Sterne, M. Stocker, M. Weth, K. Whelan, A. Willman, June 2005.

30 “Competitiveness and the export performance of the euro area”, by a Task Force of the Monetary Policy Committee of the European System of Central Banks, June 2005.

31 “Regional monetary integration in the member states of the Gulf Cooperation Council (GCC)” by M. Sturm and N. Siegfried, June 2005.

32 "Managing financial crises in emerging market economies: experience with the involvement of private sector creditors" by an International Relations Committee task force, July 2005.

33 "Integration of securities market infrastructures in the euro area" by H. Schmiedel, A. Schönenberger, July 2005.

34 "Hedge funds and their implications for financial stability" by T. Garbaravicius and F. Dierick, August 2005.

35 "The institutional framework for financial market policy in the USA seen from an EU perspective" by R. Petschnigg, September 2005.

36 "Economic and monetary integration of the new Member States: helping to chart the route" by J. Angeloni, M. Flad and F. P. Mongelli, September 2005.

37 "Financing conditions in the euro area" by L. Bê Duc, G. de Bondt, A. Calza, D. Marqués Ibáñez, A. van Rixtel and S. Scopel, September 2005.

38 "Economic reactions to public finance consolidation: a survey of the literature" by M. G. Briotti, October 2005.

39 "Labour productivity in the Nordic EU countries: a comparative overview and explanatory factors – 1998-2004" by A. Annenkov and C. Madaschi, October 2005.

40 "What does European institutional integration tell us about trade integration?" by F. P. Mongelli, E. Dorrucci and I. Agur, December 2005.

41 "Trends and patterns in working time across euro area countries 1970-2004: causes and consequences" by N. Leiner-Killinger, C. Madaschi and M. Ward-Warmedinger, December 2005.

42 "The New Basel Capital Framework and its implementation in the European Union" by F. Dierick, F. Pires, M. Scheicher and K. G. Spitzer, December 2005.

43 "The accumulation of foreign reserves" by an International Relations Committee Task Force, February 2006.

44 "Competition, productivity and prices in the euro area services sector" by a Task Force of the Monetary Policy Committee of the European System of Central banks, April 2006.

45 "Output growth differentials across the euro area countries: Some stylised facts" by N. Benalal, J. L. Diaz del Hoyo, B. Pierluigi and N. Vidalis, May 2006.

46 "Inflation persistence and price-setting behaviour in the euro area – a summary of the IPN evidence", by F. Altissimo, M. Ehrmann and F. Smets, June 2006.

47 "The reform and implementation of the stability and growth pact" by R. Morris, H. Ongena and L. Schuknecht, June 2006.

48 “Macroeconomic and financial stability challenges for acceding and candidate countries” by the International Relations Committee Task Force on Enlargement, July 2006.

49 “Credit risk mitigation in central bank operations and its effects on financial markets: the case of the Eurosystem” by U. Bindseil and F. Papadia, August 2006.

50 “Implications for liquidity from innovation and transparency in the European corporate bond market” by M. Laganá, M. Peřina, I. von Köppen-Mertes and A. Persaud, August 2006.

51 “Macroeconomic implications of demographic developments in the euro area” by A. Maddaloni, A. Musso, P. Rother, M. Ward-Warmedinger and T. Westermann, August 2006.

52 “Cross-border labour mobility within an enlarged EU” by F. F. Heinz and M. Ward-Warmedinger, October 2006.

53 “Labour productivity developments in the euro area” by R. Gomez-Salvador, A. Musso, M. Stocker and J. Turunen, October 2006.

54 “Quantitative quality indicators for statistics – an application to euro area balance of payment statistics” by V. Damia and C. Picón Aguilar, November 2006.

ISSN 1607148-4