REVISIONS TO QUARTERLY GDP ESTIMATES
A COMPARATIVE ANALYSIS FOR SEVEN LARGE OECD COUNTRIES

Nadim Ahmad, Sophie Bournot and Francette Koechlin

Statistics Directorate, OECD

Abstract

This paper examines the revisions histories of seven large OECD economies. Specifically it analyses the size of revisions to 1996-2000 constant price quarter-on-quarter GDP growth rates, comparing the size and direction of these revisions with earlier OECD studies, and concludes that the reliability of first (preliminary) estimates has improved, or at least, not deteriorated, in most countries. It shows that in most countries mean revisions for this data period have been of similar magnitude in all countries, with the exception of Japan, where they have tended to be larger but where recently implemented changes to compilation systems are expected to lead to future improvements. The paper also investigates whether preliminary estimates are systematically lower or higher than later estimates for the period in question. It finds some evidence of this in Canada, France and the UK but it is beyond the scope of this study to determine whether this reflects a systematic bias in data sources and compilation methods rather than one-off revisions such as changes in concepts. Moreover, the size of the sample used in this study is relatively small (20 observations). The paper cautions against the use of bias adjustments in estimating current and future growth rates. Rather, it advocates the use of more comprehensive investigations of the causes of bias so that these can be corrected at source. Revisions analysis databases are important tools in assessing and improving the reliability of economic statistics. In this regard, the OECD Statistics Directorate is contemplating building on the experimental database set up for this study and the paper encourages the development of revisions analysis databases in statistical offices that do not currently compile them.

Note: All quarterly changes in this paper reflect quarter on quarter (seasonally adjusted) growth rates not annualised.

Contact: Nadim.Ahmad@oecd.org

TABLE OF CONTENTS

REVISIONS TO QUARTERLY GDP ESTIMATES
A COMPARATIVE ANALYSIS FOR SEVEN LARGE OECD COUNTRIES

1. Background

1. National Accounts data provide the most comprehensive overview available of developments in national economies. They are of great interest to a wide range of users of economic information, all of whom have a strong interest in the quality of national accounts statistics.

2. There are several dimensions to statistical quality[1] of which accuracy, reliability, and timeliness occupy important places. Accuracy refers to the closeness between the estimated value and the (usually) unknown true value that the statistic was intended to measure. In practical terms, and certainly for GDP, describing accuracy using a single statistic is not possible; since it requires an assessment of many potential sources of error across datasets. Reliability on the other hand usually refers to the closeness of the initial estimated value to subsequent (revised) estimated values; which is measurable - by assessing the size of subsequent revisions to the data. While large (small) revisions do not necessarily imply large (small) inaccuracies of data[2], there is of course a link – the more comprehensive the data sources used in the initial estimate the higher the accuracy and the lower the probability of subsequent revisions (higher quality) - and the assessment of the timing and size of revisions to statistical estimates has long attracted the interest of analysts and statisticians.

3. Timeliness is equally important. Monetary policy, for example, needs to respond to the latest picture of the economy. In an ideal world the economic statistics that are used to inform policy would be made available almost simultaneously to the period to which they refer (and better still beforehand). This of course is not practically possible. With very few exceptions, key economic statistics are based on many data sources that require some time for collection, assimilation and validation before they can be published.

4. Clearly there's a trade-off between accuracy/reliability and timeliness of statistical estimates, and national statistical offices need to develop publication policies that provide the best compromise between the two competing needs. Excluding revisions that occur because of changes in definitions or methodology, the most accurate and reliable statistics for GDP, for example, only occur after all available data sources have been utilised and (preferably) integrated within a supply-use framework. Typically this only happens two to three years after the period to which the data refers; sometimes even more. This is of limited use for most policy needs. On the other hand, GDP estimates that are produced literally days after the period to which they refer, and that are based on very little real data, will also not be able to satisfy policy needs if they are systematically and significantly revised in due course; in other words, not reliable and of low accuracy.

[1] See various papers and presentations in OECD/IMF 2003 Workshop on Assessing and Improving Statistical Quality, accessible at http://www.oecd.org/topicstatsportal/0,2647,en_2825_497146_1_1_1_1_1,00.html.

[2] For example, large revisions to data might reflect changes in definitions, which is not a reflection of data inaccuracies. Alternatively small revisions may merely reflect a revisions policy that restricts the size of revisions or indeed eliminates the possibility of revisions completely.

5. That all said, the pressure on many statistical offices in recent years has been in the direction of improving timeliness. All other things being equal one would expect this to lead to some deterioration in the accuracy and reliability of first estimates (comparing the first published estimate with the 'final' estimate, say, three years down the line). However this is not necessarily the case as statistical offices have also invested in resources to improve accuracy by improving the coverage and timeliness of surveys used to estimate GDP.

6. One way of establishing the reliability of preliminary (first or earliest) estimates of economic statistics is to compare them against their final estimates. This approach is commonly referred to as revisions analysis. It is important to note however that observations on accuracy can only be inferred implicitly (and asymmetrically) from such an analysis. For example small revisions do not necessarily imply high (initial) accuracy, (they may for example reflect a lack of exhaustive annual data) although large revisions do tend to point to low (initial) accuracy. However the benefits of revisions analysis extend beyond determining whether preliminary estimates provide a reliable assessment of the activity to which they refer, or their relevance. Revisions analysis can also serve as a tool which, in itself, can inform and potentially improve the accuracy of subsequent preliminary estimates. For example revisions analysis may reveal a systematic bias between final and preliminary estimates, a fact, which could be accounted for in compiling future preliminary estimates.

7. This paper carries out revisions analysis in G7 countries. It looks exclusively at quarterly GDP (quarter-on-quarter growth), a series with particular policy relevance, and which numerous studies have investigated[3].The present study follows the common line of analysis used in these earlier studies and presents indicators of the size and timing of revision to quarterly GDP growth rates in these countries. It does so using monthly the *OECD's Main Economic Indicators* publication whose back-issues were exploited for this purpose. In that sense it is important to state that the revisions analysis presented below does not necessarily reflect revisions to 'flash' or the very first official release of quarterly GDP growth rates (which usually come out within a month or two after the period to which they refer, and which do not systematically appear in the MEI publication).

8. The objectives of this document are threefold

First, to feed into the discussion (including methodology) about revisions and revision analysis by providing an up-to-date picture, albeit limited to a sub-set of OECD countries and to aggregate GDP; providing an important tool for international comparisons in the process.

Second, to provide some indications for the interpretation of the results; and

Third, to encourage the establishment and maintenance of databases in statistical offices that do not currently do so, including the OECD Statistics Directorate, to help monitor revisions to key economic series on an ongoing basis.

9. The results presented here are preliminary in the sense that the analysis could be expanded and extended to a larger number of countries and to a broader set of variables. Note should also be made of the fact that a comprehensive analysis of revisions across countries would necessarily require a full consideration of the data sources, production processes and revisions policies used in each country. This requires considerable additional metadata, for example the causes of revisions; which is beyond the scope of this current study.

[3] For example OECD (1989), OECD (1995), Öller and Hansson (2002); Fixler and Grimm (2002), Cook (2004).

10. The paper continues by providing a brief overview of the factors that lead to revisions, followed by a definition of the term bias used in this paper and a description of the data sources and method used in this study. Section 5 describes the timeliness of estimates used in this study. Section 6 discusses the types of indicators used to measure revisions and to assess reliability, including some commentary on caveats and how they should be interpreted. Section 7 presents the results before ending with some conclusions.

2. Defining Revisions

11. It is instructive to begin by saying a few words on revisions more generally. As alluded to above, revisions occur for many different reasons, not all of which reflect data inaccuracies. A common source of revision for example reflects changes in definitions. For example in the latest version of the international system of national accounts (SNA93) a number of conceptual changes were made that extended the coverage of GDP. This affected both levels and growth. For example the recommendation to capitalise software had a significant impact on GDP levels and growth rates in some countries. Methodological changes, for example moving to chain-linked measures, are another source of revisions that tell us little about data inaccuracies.

12. At the recent OECD-ONS joint Workshop[4] on revisions it was agreed that a breakdown of revisions by type and source of revision would enable users to better understand why revisions had occurred, for example, whether they were the result of fundamental changes to concepts or compilation, or for example, because later estimates reflected the incorporation of more recent and comprehensive data. The following list provides a description of the 5 main sources of revision, with detailed examples given in some cases.

A. Replacement of early source data with later improved and more comprehensive data

A1. As indicator data evolve
data replacing forecasts
increased response rates
revised source data
seasonal adjustment

A2. As benchmark data become available
annual surveys, tax data, government expenditure, etc.
population census

A3. As data sources are improved
new survey or admin data sources appear/developed
improved survey forms

B. Methodological changes/improvements

B1. As compilation/balancing methods change
moving to supply-use tables on annual/quarterly basis.
moving to chain-linking
changing benchmarking techniques for quarterly estimates

B2. As compilation methods/balancing methods are used

[4] http://www.oecd.org/document/23/0,2340,fr_2825_495684_33729303_1_1_1_1,00.html.

re-basing – e.g. 5-yearly
Supply-use balancing (see also A2)

C. As accounts are brought in to line with conceptual targets

SNA93, ESA95
allocation of FISIM
capitalisation of software

D. Updating seasonal adjustment factors

E. Correcting Errors/Mistakes

13. Such a breakdown not only helps to illustrate why revisions have occurred but it also helps to explain whether the revisions reflect, for example, conceptual/definitional changes (category C), and, so, are one-off in nature, or whether they reflect, more generally, inaccuracies in the data sources, for example categories A1 and A2, and, so, may continue to occur in the future without remedial action. Certainly, if one were investigating bias in revisions with a view to introducing a bias adjustment, one would wish to exclude from the analysis one-off revisions such as changes in definitions or methods and even mistakes. Indeed, of the revisions identified above, only A1, A2, B2 and D can really say something about potential bias over time, as revisions from these sources can be expected to continue, assuming all other things remain equal (for example that the quality of data does not improve). Unfortunately fully isolating these types of revisions is non-trivial, and beyond the scope of this study.

14. This is an important point as the period of attention in this study concerns mainly 1996-2000 data, a period when many statistical offices moved from SNA 68 to SNA 93, and, in some cases, also moved to annual chain-linking, so, some caution is needed in interpretation. If, for example, the change from SNA68 to SNA93 led to systematic upward revisions to GDP growth say, a country that moved to SNA93 in 1999 would have had higher revisions than if it had made the move in 1996 (or earlier), all other things being equal. This is one of the reasons that the study concentrates on revisions to growth rates rather than levels, which can be expected to be more greatly affected by definitional changes.

3. Bias – Meaning and Use

15. Revisions are normal features of any statistical compilation process that estimates values for variables whose source data gradually increases/improves over time, where the definition of the variable is subject to change, or where methodological changes occur. Estimates of GDP and GDP growth rates are a prime example of this. Users require reliable and timely estimates of economic activity. However, comprehensive data sources are generally not available until one or two years after the period to which they refer (sometimes more); and even then the methodologies used in estimation may change. Early estimates of GDP growth rates therefore, are usually based on less information.

16. One of the main purposes of revisions analysis is to establish whether the size of revisions is systematically biased in any particular direction. The mere observation that the mean revision over a period of time is non-zero is not sufficient to establish this. Bias should strictly refer to a situation where the mean revision is statistically different from zero; given no changes in definitions or methodologies. This is an important qualification as changes in definitions or methodologies have, really, nothing to do with the underlying stochastic process that causes revisions to occur; indeed definitional or methodological changes are often directional in nature. For example, the move from SNA68 to SNA93 generally increased GDP. But this does not imply that the likely direction, if any, of future revisions - the key interest of statistical offices and users alike - will also be upwards.

17. Revisions analysis therefore is really a means of establishing whether revisions, excluding those that are one-off in nature, are biased; and so will probably continue into the future without corrective action. In this study we avoid using the term bias in analysing countries' revisions performance for two reasons. The first reflects the fact that we are not in a position to identify one-off revisions, such as those related to the move to SNA93. The second reflects the fact that the level at which significance can be established is a matter of judgement – some studies refer to 1% levels of significance others refer to 5%.

18. Many other studies in this area, and indeed official press releases on revisions, refer to the mean revision as the mean bias; whether or not it is statistically significant. We feel that this is not helpful. The term bias implies that the revisions are significantly different from zero, giving users the, perhaps, false impression that better estimates of GDP could be made by adding on a 'bias adjustment'; often the mean revision. Indeed a dictionary definition of bias reads as "A statistical sampling or testing error caused by systematically favouring some outcomes over others" (Source: Dictionary.com).

19. The recommendation of this paper and the OECD-ONS Workshop is that statistical offices should give some indication of the average size of revisions over some fixed period of time (say 5 years) but to use the term bias sparingly[5], and if so, only where the mean revision is statistically significant from zero; preferably after adjusting for one-off revisions. Where this is the case the statistical office should ideally provide some further information on the nature of the bias and what, if any, action/investigation is to be taken.

4. Data sources and methods

20. The OECD's monthly Main Economic Indicators (MEI)[6] database and publication served as the source for the present analysis. Observations relate to the rate of change of quarterly GDP[7] at constant prices for the G-7 countries, for 1996-2000 data as published in the MEI between May 1996 and June 2004. The study identifies as first estimates the first rate of quarter-on-quarter GDP growth published by MEI. As shown below, comparing Tables 1 and 2, this is not necessarily the same as 'flash' or the first official release of these estimates. Revisions are based on the difference between these first estimates as shown in the MEI publication and "final" estimates.

21. Defining final estimates is non-trivial. For many countries, quarterly GDP data undergo changes many years after the period to which they refer – as would be expected for methodological or definitional changes say. As such, this study uses four alternative "final" estimates, each representing the best available estimate at a given point in time: the figure that is available in the December MEI publication one year after, two years after and three years after the reference quarter, respectively and the very latest estimate made in June 2004. December was chosen, in the first three cases, so that all quarterly estimates of revisions for a given year reflected any annual revisions (e.g. supply-use balancing, benchmarking or annual methodological changes) that occurred in the years after the preliminary estimate was made. The corresponding revision measures are labelled T+1, T+2, T+3 and Latest in what follows. To make things fully clear, T+1, for example, is not the value after 12 months but the value in December of the following year to which the statistic refers and Latest refers to the June 2004 estimate.

22. Given the available dataset from 1996Q1 to 2004Q1, the latest reference period for which a T+3 revision indicator can be calculated is the fourth quarter of 2000. The set of reference periods becomes potentially larger when the T+2 measure is employed (1996Q1 to 2001Q4) and up to 2002Q4 for the T+1

[5] In fact the issue of whether the term bias should be used at all was left unresolved.

[6] Monthly Economic Indicators is published each month. More information can be found at http://www.oecd.org/document/48/0,2340,en_2649_201185_1912816_1_1_1_1,00.html .

[7] This study compares quarter on quarter constant price growth rates, not annualised. Some other studies, e.g. Grimm and Fixler illustrate quarterly revisions on an annualised basis.

measure but to ensure consistency of the averages, the results shown below for revisions up to T+1 and T+2 use the same reference period as T+3; unless otherwise specified. This is not true however when Latest (June 2004) is used.

23. The specific way in which final estimates are defined in the present study (as the best available estimate at a particular point in time) may (probably will) deviate from revision measures employed at the national level by statistical offices (this is also true for the first estimate). Indeed, some countries may attempt to remove definitional and methodological revisions from their analysis to isolate those that say something about data accuracy and the estimation process. Consequently, results from this study may not be directly comparable with those from other work.

5. Timeliness

24. Table 1 below provides an overview of the time that elapses between the reference period and the availability of the first estimate (in the MEI) for the seven countries investigated. For example, estimates of the growth rate of Canadian GDP in the first quarter are available the following June. From Table 1 it is also apparent that, overall, the United States and the United Kingdom release quarterly data to the MEI publication quicker than other countries who generally release their quarterly data one month later. Moreover timeliness in most countries has increased over the past years.

Table 1: First published estimates in MEI of quarterly GDP data in G-7 countries

	Q1	Q2	Q3	Q4	Year
Canada	**June** except in 1999 (July)	**September**	**December** except in1997 (January)	**March t+1**	**March t+1**
France	**June** except in 1997 (July) and in 1999 (august)	**September** except in 2000 and 2001 (october)	**December** except in1997 (January)	**March t+1**	**March t+1**
Germany	**June** from 2001 (July in 96, 97, 99 and 2000)	**October** until 1999 **September** since 2000	**December** since 1998 (January t+1 before)	**March t+1** except in 96 and 98 (April t+1)	**March t+1** except in 96 and 98 (April t+1)
Italy	**June** since 2001 (may, july or august for years prior to 2001)	From August to November but mainly **October**	**December** since 2000 (January or February t+1 before)	From March t+1 to June t+1 but **March t+1** from 2001	**March or April t+1**
Japan	**July** until 1999 **June** since 2000	**October** until 2001 **September** since 2002	January or December but mainly **December**	**April** until 2001 **March** since 2002	**April** until 2001 **March** since 2003
United Kingdom	**June** until 2000 **May** since 2001	**September** until 2000 **August** since 2001	From November to January t+1 but mainly **December**	**February or March t+1**	**February or March t+1**
United States	**May**	August or September but mainly **August**	**November** except in 1999 (December)	**February t+1** since 1998 (March and January before)	**February t+1** since 1997

25. As stated above, this study takes as the first (preliminary) estimate the first estimate published with the OECD's MEI publication. This may not be the same as the first (preliminary, flash) estimate officially released by each country's statistical office. Table 2 below, which shows the official release date for different vintages of GDP illustrates this point. It shows that for Canada the first MEI estimates are based on estimates published 60 days after the period to which they refer, for France 50 days after, Germany 55 days, Italy and Japan 43 to 70 days (depending on the MEI publication date), for the UK 23 to 56 days, depending on the quarter and, for the US, 30-57 days, depending on the quarter.

26. This helps to illustrate a couple of points. The first being the difficulty in making comparisons of revisions across countries, where the very first (flash, preliminary) estimate is produced and published at different times (and, for this study, where the vintage of the first estimate used in the MEI publication also varies). The second point, that follows from this, is that all other things equal, one would expect the size of

revisions shown in this study to be larger for those countries that publish the most timely estimates. Of course, all other things are not equal. For example, the quantity/coverage of data used in the US's first estimate may actually exceed that of another country's second estimate. The main point however is that cross-country comparisons of revisions will always be fraught with difficulties without a full assessment of metadata and revisions policies, which is beyond the scope of this study, hence the need to consider the results/comparisons in this context.

Table 2: Official Release of Quarterly GDP Estimates in the G-7
Days after the end of the Quarter[(a)]

	First Release	Second Release	Third Release
Canada	60		
France	43	50	90
Germany	43	55	
Italy	43	70	
Japan	46	70	
United Kingdom	23	56	88
United States	30	57	86

(a) The table shows release dates at most 90 days after the end of the quarter. In Canada for example the second release occurs more than 90 days after the end of the quarter.

6. Indicators

27. Several summary indicators are used in this study; similar to measures used in previous studies. The main indicators are described below:

Mean Revision, measured as $\frac{1}{n}\sum(F-P)$ where P is the preliminary estimate and F is the final estimate for each reference period; n stands for the number of observations. The primary interest of this measure lies in its sign: a positive sign indicates that, on average, first releases of quarterly GDP quarter-on-quarter constant price growth rates have been under-estimated, a negative sign points to an over-estimation. Large revisions of opposite sign compensate each other in this measure, and, consequently, its size, beyond determining the average direction of revisions, is of limited use. (This measure is often referred to as 'average bias' in other studies)

Relative Mean Revision, measured as $\sum(F-P)/\sum F$, which normalises the mean revision measure using the final rates of GDP growth. This measure's main prognostic is to account for the possibility of larger errors during high-growth periods, better facilitating international comparisons, for example, between high growth and low growth countries, and comparisons over time periods. However, the same caveats apply as for the mean revision measure.[8] ***Mean absolute***

[8] A mathematical aspect of this formula that is worth commenting on concerns its implicit weighting. $\sum(F-P)/\sum F = \sum\{(F_i-P_i)/F_i * (F_i/\sum F)\}$, and, so, it measures the relative mean revision for each individual observation weighted by its contribution to (the sum of) growth. In other words the measure gives greater weight to single normalised observations in high growth periods, which matters if there is a correlation between the size of the revision and the growth rate (but is less relevant where a relationship does not exist). Despite this, the measure has analytical usefulness and delivers, in practice, more meaningful results than $\frac{1}{n}\sum(F_i-P_i)/F_i$, since, in periods of no growth (or very close to zero) the latter will deliver relatively meaningless results.

revision, measured as $\frac{1}{n}\sum \left| F - P \right|$. This measure is more useful than the mean revision to gauge the size of revisions because it avoids offsetting effects on the indicator from negative and positive revisions. Expressed in absolute percentage points, it indicates the average size of revisions, but it cannot provide an indication of directional bias, if any.

Relative mean absolute revision, measured as $\sum \left| F - P \right| / \sum \left| F \right|$. This measure corrects the mean absolute revision for the size of growth and, so, takes account of the fact that revisions might be expected to be larger in periods of high GDP growth than in periods of slow growth.

Standard deviation of revisions, measured as the average distance from the mean revision, i.e., $\left(\frac{\sum (D - \overline{D})^2}{n-1} \right)^{1/2}$, where D=F-P and $\overline{D} = \sum (F_i - P_i)/n$. The standard deviation measures the dispersion of the series of revisions around their mean; a high standard deviation indicates volatility of the revisions between periods.

Number of times where F>P: this indicator counts the occurrences of positive revisions. By implication, all other cases represent negative or no revisions. It complements the mean revision measure in that it provides an un-weighted indication concerning the distribution of the sign of revisions.

F and P different signs: this indicator counts the occurrences when preliminary and final values are different in sign. Although strictly speaking, not a quality indicator, a negative (positive) preliminary growth figure followed by a positive (negative) final figure is often perceived by users as a particularly unsatisfactory, and important, type of revision. Obviously, when growth rates are low, say 0.1 percent per quarter, the probability that F and P have different signs is likely to be higher than when growth rates are significantly higher or lower, and this needs to be kept in mind, particularly where cross-country comparisons are concerned.

Unbiasedness: the mere observation that the mean revision is positive or negative is not sufficient to determine systematic or predictable bias. Random adjustments to initial growth rates of GDP are expected. Consequently over any given period (especially short periods) the observed mean revision (as opposed to the expected mean revision) is likely to be non-zero. To be biased however it is required that the expected mean revision is non-zero. In other words the observed mean revision needs to be statistically different from zero. The unbiasedness statistic we present here is the t-statistic: the ratio of the mean revision to the standard deviation of the mean. The standard t-test assumes that revisions are independent of each other which may not be the case, particularly given the time-series nature of revisions. Some studies overcome this by using a modified t-test which takes into account any serial correlation (Jenkinson and Studdard, 2004). (It's important to note however that even if a bias can be established in historic data it does not necessarily suggest that a bias adjustment should be made for future periods).

An extra set of supplementary statistics is included in the annex to carry out some secondary analysis. These statistics compare the absolute size of revisions between T+1 and T+2 ($\sum \left| T+2 - T+1 \right|$) and T+2 and T+3 ($\sum \left| T+3 - T+2 \right|$), and can be used to assess whether the size of revisions for any particular quarter reduces over time, as one might expect.

7. Results

Comparisons across countries and with previous OECD studies

28. Despite its more limited sample (5 years), overall, the results of this study broadly mirror those obtained from earlier OECD studies (Table 3). With the exception of Germany, which tended to slightly overestimate the preliminary estimates of growth over the period (1996-2000), all other countries tended to underestimate preliminary estimates of growth. The mean revisions are generally small but in some cases (see Table 5) they are statistically different from zero at the 1% and 5% levels of significance. What is remarkable is the fact that the sign of the mean revision has remained (mostly) positive for such a sustained period.

Table 3 – Comparisons of OECD revisions analysis studies - 1966-2000

Revision Statistic	Year of Study	Revision Period	Final Estimate	Canada	France	Germany	Italy	Japan	UK	US
Average GDP growth (constant prices)	*2005*	*1996-00*		1.05	0.74	0.44	0.50	0.51	0.75	0.98
	1995[(a)]	*1980-93*		0.57	0.45	0.48	0.45	0.85	0.58	0.55
	1989[(b)]	*1980-87*		0.75	0.44	0.37		0.98	0.47	0.64
Mean revision (constant prices)	*2005*	*1996-00*	Latest	**0.20**	**0.10**	**-0.08**	**0.13**	**0.22**	**0.16**	**0.06**
			T+3	**0.19**	**0.08**	**-0.09**	**0.13**	**0.35**	**0.15**	**0.04**
			(T+1)	***(0.02)***	***(0.06)***	***(-0.01)***	***(0.03)***	***(-0.04)***	***(0.07)***	***(0.02)***
	1995	*1980-93*	Latest	0.08	0.05	0.05	0.10	-0.01	0.18	0.04
	1989	*1980-87*	T+1	0.03	0.03	0.19		0.03	0.12	0.08
	1979[(c)]	*1966-75*	T+1	0.04		0.12		0.22	0.01	0.02
Mean absolute revision (constant prices)	*2005*	*1996-00*	Latest	**0.28**	**0.27**	**0.40**	**0.39**	**1.02**	**0.34**	**0.38**
			T+3	**0.23**	**0.32**	**0.39**	**0.29**	**0.79**	**0.19**	**0.29**
			(T+1)	***(0.18)***	***(0.11)***	***(0.17)***	***(0.26)***	***(0.51)***	***(0.17)***	***(0.27)***
	1995	*1980-93*	Latest	0.39	0.29	0.6	0.38	0.5	0.8	0.42
	1989	*1980-87*	T+1	0.26	0.22	0.57		0.25	0.53	0.31
	1979	*1966-75*	T+1	0.59		0.56		0.73	0.77	0.23

(a) See OECD (1995). The 1995 study defined final estimates as the latest published estimates. Estimates for Canada, France, Germany and the US run from Q1/1980 to Q4/1993; Q2/1980 to Q4/1993 for Japan; Q1/1982 to Q4/1993 for the UK; and Q1/1987 to Q4/1993 for Italy.
(b) See OECD (1989). The 1989 study took as final estimates those published one year later.
(c) See also OECD (1989), where the earlier 1979 study is cited.
Note: The 1979 OECD study tended to use less timely preliminary estimates than those used in subsequent studies. For example the 1989 study for the US used preliminary estimates produced four weeks after the period to which they referred compared to 6 weeks in the 1979 study. This is generally the case when comparing the earlier studies as the tendency has been to release preliminary estimates quicker. Recall however that the estimates used in this study were obtained from the OECD's MEI publication and so it is possible that, in some cases, the estimates used here are less timely than in the earlier studies.

29. Assuming that the different definitions used in the studies above for preliminary and final estimates do not significantly distort comparisons, a few additional observations can be made. Even if comparisons are made using latest estimates (June 2004) as final, where they can be expected to be least favourable, a comparison of mean absolute revisions suggests that the reliability of preliminary estimates has shown a marked improvement in Canada, Germany, and the UK. In France Italy and the US the levels

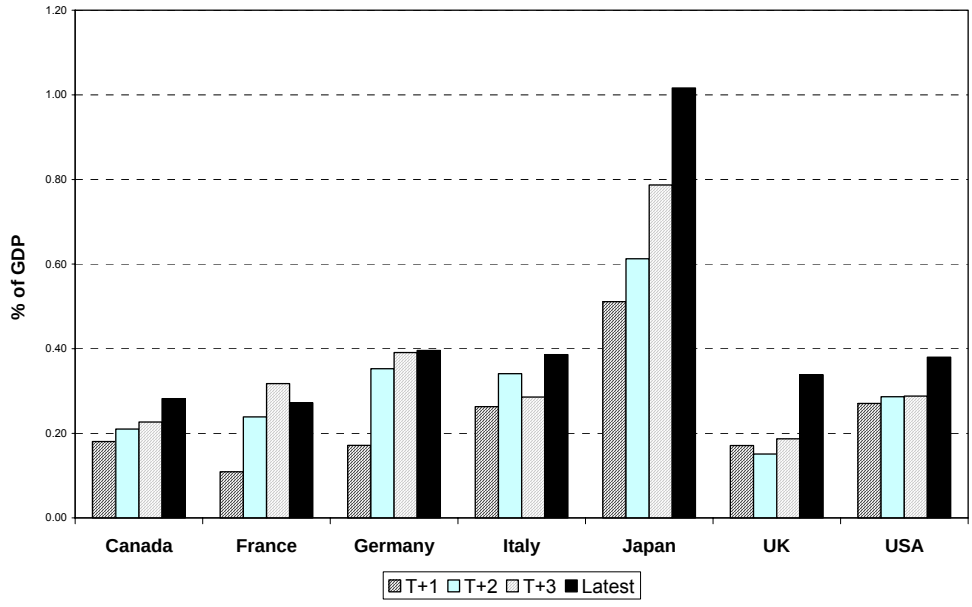
are roughly unchanged (but considerably better using T+1 statistics). In Japan however the estimates point to a fall in reliability, particularly when compared to the 1980-1987 period.

30. In this context it is important to recall that the period studied in this paper includes a time when countries would have been incorporating SNA changes which complicate comparisons. Indeed, all other things equal, one might have expected that estimates of mean absolute revisions would have been slightly higher in the latest period, certainly compared to the post 1980 periods (one cannot ignore the possibility that revisions data for 1966-1975 may include significant SNA68 revisions). Given that possibility it is perhaps surprising that more countries did not exhibit noticeable declines in reliability.

31. The implicit improvement in reliability in the UK's statistics stands out in Table 3. Of the surveyed countries it has gone from having the largest mean absolute revision (0.8) in the 1980-1993 period to the smallest mean revision at T+3 (0.19) in the most recent period, 1996-2000. Although the table also indicates that revisions after T+3 in the UK are larger than in most other countries (see also Figure 1) the size of the mean absolute revision (comparing P with latest estimates) is still significantly smaller at 0.34 than it was in earlier studies and comfortably within the central range for G-7 countries[9]. Towards the end of the 1980s the UK Government became increasingly concerned about the quality of government statistics, in particular GDP, and initiated a review of government statistics (The Pickford Review, 1989). This made a number of recommendations for improving the accuracy of government statistics and was followed by some other initiatives to improve quality. Many business inquiries were put on a more robust footing based on an improved business register, run on a statutory basis using larger and better designed samples with frequency improved to quarterly or monthly. National accounts compilation processes also improved with greater use of supply-use balancing.

32. Figure 1 below shows the mean absolute revision by country, comparing the mean absolute revision made between the preliminary estimate and the T+1, T+2, T+3 and Latest estimates for the period 1996-2000.

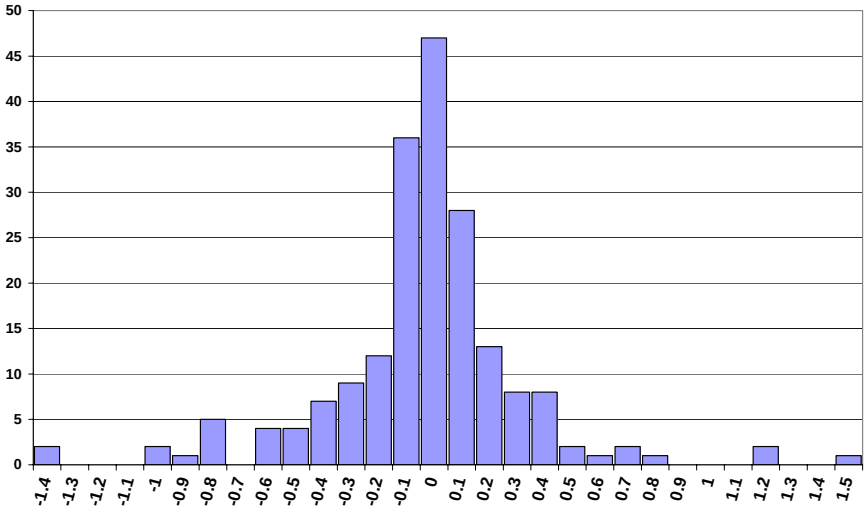
Figure 1: Mean Absolute Revisions in constant price quarter-on-quarter GDP growth rates (1996-2000) - % of GDP



[9] Further information on the analyses of revisions and revisions policies in France, the Netherlands, Sweden, the UK and the US can be found in the bibliography

33. It shows that the reliability of quarterly GDP estimates in G7 countries is fairly similar, with the exception of Japan where revisions are significantly higher. Figure A.10 in the annex, showing the distribution of revisions in Japan, confirms that revisions in Japan appear to follow a markedly different pattern than in the rest of the G-7 (see Figures A.2, A.4, A.6, A.8, A.12 and A.14). In most other G7 countries these distributions tend to follow, broadly, normal distributions, but, in Japan, revisions are much more widely spread. Figure 2 below shows the distribution of the revision in all 7 countries at T+1, including Japan. With a few exceptions, all of the observations above (less than) 0.7 (-0.7) reflect Japanese revisions. This is also reflected in the unusually high standard deviation of revisions for Japan (see Table A.5). The extreme outliers of -1.4 and 1.5 are revisions for Italy. These are discussed in more detail in the Annex.

Figure 2: Distribution of Revisions in constant price quarter-on-quarter GDP growth rates (T+1-Preliminary) – G7, 1996-2000



Note: '0' includes all revisions less than 0.05 and greater than -0.05; '0.1' includes revisions greater than or equal to 0.05 and less than 0.15; '0.2' includes revisions greater than or equal to 0.15 and less than 0.25; etc.

34. We know that in Japan the compilation methods for quarterly GDP estimates were significantly modified in mid 2002, with the publication of the second quarter of 2002. This resulted in revisions going back as far as 1994 that produced arguably more interpretable observations than the old series. It is thought that the new system will result in smaller revisions although it is early to assess this expectation. The fact that compilation processes can and do change is an important consideration. In this context, for Japan in particular but also for all other countries, national accountants and users of economic statistics should note that past revisions are not necessarily a guide to future revisions, and that the figures quoted in this paper reflect revisions policies and compilation practices in place during the period in question. Having said that, for Japan, restricting the revisions analysis to cover the period up to, but not including changes made after Q2 2002, does not make an appreciable difference. For example, the mean absolute revision for T+2 and T+3 for the quarters in 1996-1999 and 1996-1998 is 0.64 and 0.65 respectively, compared to 0.61 and 0.79 for quarters in 1996-2000; (the figures for T+1 are the same). A comparison of mean absolute revisions between T+3 and end-December 2001 makes better reading at 0.38, however this statistic includes only 8 quarters (1996 and 1997), moreover, for 1997 data the size of revisions were zero in all quarters possibly indicating that the revisions window was closed in 2001 for 1997 and earlier data.

35. Additionally it's important to note that the preliminary estimates of quarterly GDP for Japan are largely based on household surveys. Supply side estimates, which are generally considered to be smoother

than demand side estimates, are only available later in Japan. This may help to explain the very large revisions observed in Japan's quarterly GDP statistics.

36. Returning to Figure 1, in most countries the size of the mean absolute revision between P and T+1 is smaller than that between P and T+2, which in turn is smaller than that between P and T+3; as would be expected given the nature of revisions. In the UK and Italy however the T+2 data suggest that the revisions made between T+1 and T+2 move the estimate of GDP growth further away from its T+3 position compared to the T+1 estimates; although the change is marginal. That said, the T+2 data for Italy are closer to the Latest estimates than the T+3 data.

37. In Germany and France the T+1 estimates tend to be significantly different to the final T+3 (and T+2) estimates. In other countries however (except Japan) T+1 estimates are very close to the final T+3 estimates.

38. The size of the mean absolute revision between P and T+1, T+2, and T+3 is very similar in the US. But revisions between P and Latest (June 2004) are noticeably different. This reflects changes made in the January 2004 MEI publication; reflecting in turn the comprehensive revisions made to the US[10] national accounts in December 2003. Comprehensive revisions generally occur every 5 years in the US, at which time, the opportunity is taken to update definitions, improve methodologies, correct errors and benchmark to the input-output tables. In the last comprehensive revision, changes were made in a number of areas including: definitions (e.g. implicit services provided by property and casualty insurance were recognised and the treatment of insured losses have been improved; eliminating large swings in measured insurance services associated with catastrophic losses such as those of September 11th); methodology (e.g. changes to the methods used to estimate motor vehicles dealers' margins); and benchmarking (to the 1997 input-output tables.

Testing for bias

39. Table 4 below compares final estimates at Latest, T+3, T+2 and T+1, with preliminary estimates. It shows that at the T+3 stage, final estimates were higher than preliminary estimates 18 times out of 20 in Italy and 17 and 15 times in Canada and UK respectively, suggesting that the tendency is clearly to revise up (between P and T+3) on most occasions in these countries. That said, the Latest (June 2004) estimates suggest that this tendency is less marked at this stage.

Table 4: Frequency (out of 20) that final estimate (F)>P

	F=T+1	F=T+2	F=T+3	F=Latest
Canada	12	10	17	15
France	13	12	11	12
Germany	11	10	8	8
Italy	12	11	18	12
Japan	12	12	13	13
UK	13	10	15	13
US	13	9	10	13

40. The T+3 t-statistics in Table 5 below suggest that, in Canada and the UK, the preliminary estimates are statistically significant at the 1% and 5% levels but not Italy, despite the fact that it had the highest number of positive revisions at the T+3 stage.. For the UK, the observation of statistical significance is consistent with the UK's Office for National Statistics own view that mean revisions to data in recent years have been statistically significant: (see George, 2004). Nonetheless, although the

[10] See http://www.bea.doc.gov/bea/dn/2003benchmark/CR2003content.htm for more information.

indications are that bias exists, when comparing P and T+3, it is difficult for this particular study to be categorical about this given the limited analysis undertaken here and the relatively small sample size, especially bearing in mind the definition of bias we use; namely, that there must be statistical significance in the mean revisions after adjusting for one-off revisions such as the move to SNA93 (November 1997 in Canada, September 1998 in the UK) and the move to chain-linking (in the UK and Canada). Certainly the best assessment of bias will necessarily be made by individual statistical offices as they will have at hand, or at least be able to produce, an inventory of the reasons for revisions. Moreover the analysis shows that although the size of the mean revision between P and Latest is marginally larger in the UK, (0.16), compared to the revision between P and T+3 (0.15), the t-statistic for mean revisions (1.8) is below the 5% significance level.

Table 5: t-Statistics for Mean Revisions of 1996-2000 data

	T+1	T+2	T+3	Latest
Canada	0.4	0.5	3.7	3.2
France	2.4	2.2	1.0	1.5
Germany	-0.1	-0.6	-0.9	-0.8
Italy	0.3	0.4	1.3	1.0
Japan	-0.3	0.9	1.5	0.8
UK	1.6	1.1	3.1	1.8
US	0.2	0.2	0.4	0.5

41. Table 5 shows that revisions made in France between P and T+1 and T+2 are also statistically significant at the 5% level but not the 1% level. The appearance of statistical significance at the 95% level in French revisions is somewhat surprising given the statistics showing the not unusually high number of times revisions were positive (13 out of 20 for T+1 and 12 out of 20 for T+2) but this may reflect the move to SNA93 and re-basing that occurred in May 1999.

Should Bias Adjustments be made?

42. In general, Statistical Offices are discouraged from making bias adjustments at the level of GDP even if it can be established that the mean revisions are statistically significant from zero after making adjustments for one-off revisions. This partly reflects the fact that GDP consists of many separate components and, so, for overall coherence any bias adjustment would preferably be made at the component level too. But it also reflects the fact that an observation of bias in the past does not necessarily suggest that a bias will continue into the future, particularly if past revisions have not been adjusted for one-off revisions, such as the move to a new SNA or methodology; since these revisions provide no information on the likely future direction of revisions.

43. The best way to deal with statistical bias is to investigate the source data and estimation methods, so establishing why the bias has occurred. For example, in some countries, statistical registers are only updated annually, and, so, newly formed (and importantly fast growth) companies may not be picked up in the short-term inquiries. If the source of bias can be understood it should be rectified if at all possible.

8. Conclusions

44. Some care is needed in comparing country performances of revisions. In general, each statistical office will have its own unique revisions strategy and plans for methodological changes. It seems unlikely that for any particular (and short) period of time these strategies and plans will coincide. This study is based on a relatively short time-period covering only 20 observations. Apart from limiting the scope for country comparisons this will also limit the strength of conclusions concerning efficiency, bias, and reliability of the estimates. Nevertheless, caveats aside, the study shows that in most countries mean

revisions for this data period have been of similar magnitude, with the exception of Japan, where they have tended to be larger but where recently implemented changes to compilation systems are expected to lead to future improvements. Furthermore, a comparison with earlier OECD studies indicates that the reliability of quarterly growth estimates has increased over the last ten to twenty years; in some cases significantly. This is to be welcomed.

45. The study does show however that mean revisions made between P and T+3 for Canada and the UK and P and T+1 and T+2 for France are statistically significant. What this says about bias however is not obvious. It's important to recall that the period covered coincided with large changes in methodologies and definitions in all three countries. Adjusting for these "one-off" changes is beyond the scope of this study but in doing-so statistical significance may be removed. A full assessment of whether bias does exist is best made by each statistical office, since they will have full access to the nature of revisions. Where this can be confirmed, statistical offices should seek to identify the causes of the bias and rectify the problem at its source rather than introduce a bias adjustment. With this in mind it should be recalled that past revisions are not necessarily a guide to future revisions, particularly if past revisions reflect methodological or conceptual changes and especially if changes in compilation processes and survey design/coverage have been introduced during or after the period studied.

46. Earlier OECD studies examined the influence of the economic cycle but were generally not conclusive on this issue; partly because they required estimates of the output gap (against which revisions were regressed), which itself is prone to significant measurement difficulties. Because of the much shorter time period covered in this study, this has not been repeated here. Other studies, notably Fixler and Grimm investigated revisions around turning points. Fixler and Grimm concluded that, for the US, there was a tendency to overstate declines immediately before troughs and understate growth immediately before recoveries. Again, because of the short time period covered, it has not been possible to produce this analysis (meaningfully) here but it is hoped that both of these areas of analysis will feature in future work on this subject as resources allow.

47. Although the time period covered in this report is relatively short, it does illustrate a number of potential benefits from using revisions analysis. Generally, preliminary estimates have a tendency to underestimate final GDP estimates in most countries but the size of revision is not, generally, statistically significant and their potential to inform GDP estimation in itself appears to be limited. However, the benefit of using revisions analysis as a tool to assess the reliability of GDP estimates is clearer. In addition, by extending the analysis to include more sophisticated analysis than that shown here, for example by investigating the relationships between revisions and GDP growth rates or the output gap, or by using the so-called beta and rho tests[11] to test the efficiency of preliminary national accounts estimates, the usefulness of revisions analysis increases.

48. Certainly it would seem that some further work in this area would be of benefit. The analysis in the annex reveals that it is not unusual for small/insignificant changes in annual growth rates to lead to relatively large increases in quarterly growth rates for the same year in question. This suggests that the impact on revisions of changes in seasonal adjustment procedures or because of benchmarking constraints may be significant; although it is difficult to establish this without adjusting for any methodological changes that may have occurred. This is of potential concern. Certainly users are unlikely to fully comprehend why estimates of activity in say 2002 might have a (significant) impact on estimates in 2001, or earlier years, but this may in practice occur due to the mechanical nature of some seasonal adjustment and benchmarking techniques. However on a more positive note the analysis (see statistical annex)

[11] The beta test is conducted by an OLS regression of the revision on a constant and the preliminary estimate while the rho test involves a regression of the current period's revision on a constant and the previous period's revisions.

indicates that revisions to annual growth rates after T+3 (and T+4) are generally very small or zero, excluding those revisions that occur because of changes in definitions or methodologies.

49. The OECD Statistics Directorate is contemplating expanding the revisions database, produced for the purposes of this study, to include all OECD countries, with a view to updating this analysis at a later stage, including perhaps an analysis of the expenditure components of GDP. These developments will be of particular interest, not only because they expand the coverage of the database but also because they will help us to investigate a number of other issues, for example, whether countries with high exposure to trade in services (where measurement is thought to be weak) tend to have higher revisions than those with less exposure. Finally, in concluding, the paper strongly encourages those national statistical offices, that have not already done so, to set up revisions databases, as they are important tools in the assessment and improvement of the reliability of GDP.

ANNEX – REVISIONS BETWEEN PERIODS

Revisions between periods: P and T+1; T+1 and T+2; and T+2 and T+3

50. Comparisons of revisions between periods also provide a rich source of information on revisions (Table 6). In Canada for example the size of the mean absolute revision between P and T+1, P and T+2 and P and T+3 was 0.18, 0.21, and 0.23 respectively (Table A1); suggesting that the size of the revisions got smaller over time. However, a look at revisions between T+1 and T+2 and T+2 and T+3 suggests that this has not been the case. For Canada, the mean absolute revision between T+1 and T+2, $|T1 - T2|$, was 0.18 and 0.17 for $|T2 - T3|$. (See also Tables A2, A5, A8, A11, A14, A17, and A20).

Table 6: Mean Absolute Revisions of quarterly constant price GDP between revision periods – (1996-2000), % of GDP

	Between P and T+1	Between T+1 and T+2	Between T+2 and T+3	Between P and T+3
Canada	0.18	0.18	0.17	**0.23**
France	0.11	0.18	0.18	**0.32**
Germany	0.17	0.22	0.18	**0.39**
Italy	0.26	0.19	0.22	**0.29**
Japan	0.51	0.31	0.53	**0.79**
UK	0.17	0.17	0.16	**0.19**
US	0.27	0.15	0.10	**0.29**

51. In fact, in nearly all of the countries, the size of the mean absolute revisions between T+1 and T+2 and T+2 and T+3 were little different from the mean absolute revision at T+1. The sole exception being the US, where the inter-period mean absolute revision showed a noticeable fall over time: 0.27, 0.15, and 0.10. That is not to say however that the mean absolute revision between T+2 and T+3 should necessarily be smaller than that between P and T+1, as the size of revisions between periods should normally reflect the availability of new data and supply-use balancing, which might only become available at T+3 or even later. Nonetheless the point is that converging mean absolute revisions might not necessarily reflect smaller inter-period revisions. At least for quarterly data that is revised up to three years after the period to which it refers.

Revisions between P and latest published estimates

52. Comparisons of revisions between T+3 and the latest official estimates also prove to be of interest. Table 7 below compares the mean absolute revision between T+3 and the latest estimate (June 2004) for each year (1996-2000) and country. A priori, the pattern that one would expect to see would be a tailing off of revisions towards the end of the period as 2000 Q4 data in December 2003 (T+3) would only have undergone an extra two quarters of revisions compared to, say, T+3 data for 1996 Q4, which would have undergone an extra 14 quarters. Because of this, Table 7 shows the mean absolute revision between T+3 and June 2004 separately for each year. The mean absolute revision between P and June 2004, which is also shown, is similarly affected but less so, since, for example, the mean absolute revision for 2000 Q4 data, in this instance, will reflect revisions over 14 quarters compared to only 2 between T+3 and June 2004.

Table 7: Mean absolute revisions in constant price quarter-on-quarter GDP growth rates
Latest (June 2004) minus T+3 - % of GDP

	1996	1997	1998	1999	2000	1996-2000 (T+3-P)	1996-2000 (Latest- P)
Canada	0.12	0.10	0.14	0.11	0.08	**0.23**	**0.28**
France	0.27	0.17	0.09	0.00	0.11	**0.32**	**0.27**
Germany	0.10	0.10	0.07	0.10	0.00	**0.39**	**0.40**
Italy	0.25	0.22	0.14	0.17	0.09	**0.29**	**0.39**
Japan	0.73	1.18	0.91	1.12	0.36	**0.79**	**1.02**
UK	0.22	0.55	0.32	0.16	0.00	**0.19**	**0.34**
US	0.07	0.17	0.14	0.15	0.33	**0.29**	**0.38**

53. The table shows that in most countries the mean absolute revision between T+3 and latest for any given year is generally smaller than the mean absolute revision up to T+3. However that is not to say that mean absolute revisions between periods (T+4-T+3, T+5-T+4 etc) necessarily get smaller over time, since revisions can be expected to occur indefinitely, as long as concepts and methodologies change too; as can be expected, and shown and discussed in more detail in Table 8 below. Conclusions for the last two years (1999 and 2000) in Table 7 should be made cautiously as they may just reflect revisions policies and the fact that little time has elapsed between T+3 estimates and June 2004.

54. Not all countries have relatively small mean absolute revisions after T+3. In both Japan and the UK mean absolute revisions between T+3 and June 2004 were bigger than the average mean absolute revision between P and T+3 over the entire period, in three of the five years investigated. (For the UK the fact that revisions in the UK were larger at the later stages of production than in earlier stages was also noted in studies of revisions analysis conducted by the UK Office for National Statistics, see for example, Akritidis 2003, and George 2004).

55. Comparisons of mean revisions (not absolute) between T+3 and June 2004 on the whole demonstrate no statistically significant directional bias (Table 8). Although, the revisions for Canada in 1997 and Italy in 1997 and 1998 are statistically significant. The most extreme value of mean revision for all of the countries is -0.3 for Japan in 2000. Typically the average for each year falls between +/- 0.1.

Table 8: Mean revisions to constant price quarterly growth rates – Latest (June 2004) minus T+3
(mean revisions to annual growth rates in brackets)

	1996	1997	1998	1999	2000
Canada	0.07 *(-0.10)*	-0.10 *(-0.20)*	0.05 *(0.19)*	0.06 *(0.18)*	-0.04 *(-0.09)*
France	-0.07 *(0.00)*	0.12 *(-0.10)*	0.05 *(0.10)*	0.00 *(0.00)*	0.02 *(0.00)*
Germany	0.00 *(0.00)*	0.00 *(0.00)*	0.07 *(0.00)*	0.00 *(0.00)*	0.00 *(0.00)*
Italy	-0.05 *(0.20)*	0.22 *(0.20)*	-0.14 *(0.00)*	0.02 *(0.00)*	-0.05 *(-0.09)*
Japan	-0.24 *(-1.70)*	-0.12 *(0.10)*	0.05 *(-0.09)*	-0.03 *(-0.58)*	-0.32 *(0.00)*
UK	0.02 *(0.10)*	-0.03 *(-0.20)*	0.04 *(0.19)*	0.02 *(0.36)*	0.00 *(0.00)*
US	0.07 *(0.00)*	-0.03 *(0.09)*	-0.05 *(-0.10)*	0.10 *(0.35)*	0.00 *(-0.10)*

56. Where small changes in mean revisions of annual data lead to large revisions in mean absolute revisions in quarterly data it is likely that this reflects methodological changes, for example estimating constant price government output using an output method, or changes in benchmarking and/or seasonal adjustment routines; as typically little new (sub-annual) data appears over two years after the date referred to. For example, from Table 8, the mean revision between T+3 and June 2004 for 1998 (annual data) in Japan was a relatively small -0.09 but the corresponding mean absolute revision for quarterly data was 0.9 (Table 7). This reflects a change in quarterly growth rates from -1.0, -0.5, 0.1 and 0.1 in Q1 to Q4 respectively to -0.9, -1.2, 0.9 and 0.1. This may reflect a change in methodology, seasonality or benchmarking routines or, given the fact that the significant changes occur to Q2 and Q3 data, it may even reflect the correction of an error. A comparison of revisions to non-seasonally adjusted data should be able to shed further light on this issue for all countries but this is beyond the scope of this paper

57. A move to chain-linking[12] may also play an explanatory role when these incidences occur but it is unlikely that this would result in significant changes to quarterly growth if annual growth rates were little affected, although much depends on how benchmarking is performed.

Mean Absolute Revisions between periods over time

58. Table 9 below extends the analysis shown in Table 7 above and shows, for all countries, the mean absolute revision for quarterly data in 1996 as the vintage of the data changes. (Tables A2, 5, 8, 11, 14, 17 and 20, show the same analysis for other years too). It clearly illustrates that revisions continue to occur many years after the period to which they refer. Indeed, in Japan, Italy and the UK, the mean absolute revision for 1996 quarterly data between December 2002 and December 2003 were of roughly the same order of magnitude as revisions in previous revision periods.

59. The large revisions for Italy in nearly all the revisions periods appear to typify the difficulties of measuring GDP around turning points (see also Fixler and Grimm, 2002), especially when the direction of growth is particularly volatile (see Figure A7); indeed revisions to 1996 data do not appear to be typically representative (Table A.8). The large revision for the UK between December 2002 and 2003 reflects the move to chain-linking and methodological changes introduced in the autumn of 2003 and the relatively large revision to US data between December 2003 and December 2004 reflects the comprehensive revisions made in December 2003 (appearing in the January 2004 MEI publication).

60. Not too much should be read into the zero estimates for Italy, Canada and the UK in the last period as these may merely reflect the timing of annual updates in each country (that is, they probably occur after June).

Table 9: Mean Absolute Revisions (in quarter-on-quarter constant price GDP growth) for 1996 - % of GDP

Revisions between	Canada	France	Germany	Italy	Japan	UK	US
P and Dec 97	0.03	0.10	0.14	0.77	0.36	0.22	0.27
Dec 97 and Dec 98	0.13	0.08	0.21	0.21	0.52	0.27	0.17
Dec 98 and Dec 99	0.19	0.37	0.29	0.21	0.15	0.18	0.12
Dec 99 and Dec 00	0.12	0.00	0.17	0.10	0.75	0.00	0.07
Dec 00 and Dec 04	0.10	0.15	0.18	0.30	0.00	0.12	0.00
Dec 01 and Dec 02	0.05	0.05	0.00	0.20	0.41	0.10	0.00
Dec 02 and Dec 03	0.00	0.05	0.00	0.30	0.12	0.34	0.00
Dec 03 and Jun 04	0.00	0.07	0.05	0.00	0.37	0.00	0.15

[12] Fixler and Grimm show that moving to chain-linked indices removes a systematic major source of error in fixed-base series.

61. Although revisions to quarterly data continue well after the date to which they refer it is important not to lose sight of what the main policy purpose of quarterly growth rates is: namely, to provide timely information about the economy – Is it performing above/below trend growth? Is growth accelerating/decelerating? Is it contracting? In this regard policy makers are more likely to be concerned with historical changes to quarterly GDP growth rates[13], as indicated above, if they are driven by changes in the longer term (namely, annual) picture, and this does not appear to be the case, as shown in Table 10 below, which shows that the size of annual mean revisions is generally zero, or very small after T+3 for 1996. Tables A3, 6, 9, 12, 15, 18 and 21, confirm that this is also generally true for other years, with a few exceptions for some countries in some years for T+4 and T+5 revisions.

Table 10: Mean Revisions (in year-on-year constant price GDP growth) for 1996 - % of GDP

Revisions between	Canada	France	Germany	Italy	Japan	UK	US
P and Dec 97	0.00	0.19	-0.01	0.00	-0.01	0.21	0.33
Dec 97 and Dec 98	-0.27	0.02	-0.07	-0.04	1.50	0.21	0.68
Dec 98 and Dec 99	0.49	-0.45	-0.50	0.24	0.05	0.04	0.25
Dec 99 and Dec 00	-0.20	0.00	0.00	0.20	-1.60	0.00	-0.10
Dec 00 and Dec 04	0.10	0.00	0.00	0.00	0.00	0.00	0.00
Dec 01 and Dec 02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dec 02 and Dec 03	0.00	0.00	0.00	0.00	-0.10	0.10	0.00
Dec 03 and Jun 04	0.00	0.00	0.00	0.00	0.00	0.00	0.10

[13] Constructing a series of preliminary estimates for the 1996-2000 quarterly data and comparing these with the very latest estimates of the same quarters in June 2004 makes interesting reading. This produces a correlation coefficient of 0.80 for Canada, 0.73 for France, 0.69 for Germany, 0.54 for Italy, 0.49 for Japan, 0.17 for the UK, and 0.39 for the US.

STATISTICAL ANNEX

In what follows the indicators shown in Section 7 are presented for each country in tabular format together with some graphical illustrations of the distribution of revisions at T+1 (figures A2, 4, 6, 8, 10, 12 and 14), and a comparison of GDP growth with revisions at between P and T+1, T+1 and T+2, T+2 and T+3 and T+3 and June 2004, (figures A1, 3, 5, 7, 9, 11, and 13).

Note that references to the size of revisions in the figures below showing the distribution of revisions should be interpreted as follows: 0' includes all revisions less than 0.05 and greater than -0.05; '0.1' includes revisions greater than or equal to 0.05 and less than 0.15; '0.2' includes revisions greater than or equal to 0.15 and less than 0.25; etc.

CANADA

Table A1: Indicators

	1996Q1-2000Q4			until 2002 Q4	until 2001 Q4
	T+1	**T+2**	**T+3**	**T+1**	**T+2**
Average GDP growth rate	0.88	0.89	1.05	0.78	0.80
Deviation					
Mean revision 1/n∑(F-P)	0.02	0.03	0.19	0.00	0.04
Relative mean revision ∑(F-P)/∑F	0.03	0.03	0.18	0.00	0.05
Mean absolute revision 1/n (∑|F-P|)	0.18	0.21	0.23	0.17	0.22
Relative mean absolute revision ∑|F-P|/∑|F|	0.20	0.24	0.22	0.22	0.27
Mean absolute revision between two successive periods	0.18	0.18	0.17		
Standard deviation	0.27	0.26	0.23	0.25	0.27
Tendency					
F>P: Nb of times	12	10	17	15	13
F and P different sign	0	0	0	0	0
Number of observations	[20]	[20]	[20]	[28]	[24]

Table A2: Revisions Triangle – Canada
Mean Absolute Revisions (in quarter-on-quarter Constant price GDP growth) by year - % of GDP

Revisions between	Reference Period				
	1996	**1997**	**1998**	**1999**	**2000**
P and Dec 97	0.03				
P or Dec 97 and Dec 98	0.13	0.14			
P or Dec 98 and Dec 99	0.19	0.25	0.18		
P or Dec 99 and Dec 00	0.12	0.10	0.11	0.19	
P or Dec 00 and Dec 04	0.10	0.07	0.23	0.14	0.36
Dec 01 and Dec 02	0.05	0.02	0.14	0.15	0.27
Dec 02 and Dec 03	0.00	0.00	0.00	0.11	0.17
Dec 03 and Jun 04	0.00	0.00	0.00	0.00	0.08

Table A3: Revisions Triangle - Mean Revisions (in year-on-year constant price GDP growth) - % of GDP, Canada

Revisions between	Reference Period				
	1996	**1997**	**1998**	**1999**	**2000**
P and Dec 97	0.00				
P or Dec 97 and Dec 98	-0.27	-0.02			
P or Dec 98 and Dec 99	0.49	0.13	0.15		
P or Dec 99 and Dec 00	-0.20	0.50	0.18	0.35	
P or Dec 00 and Dec 04	0.10	-0.20	0.66	0.52	-0.22
Dec 01 and Dec 02	0.00	0.00	0.19	0.26	0.15
Dec 02 and Dec 03	0.00	0.00	0.00	0.18	0.68
Dec 03 and Jun 04	0.00	0.00	0.00	0.00	-0.09

Figure A1: Quarterly GDP Growth and mean revisions: 1996 to 2000, Canada - % of GDP

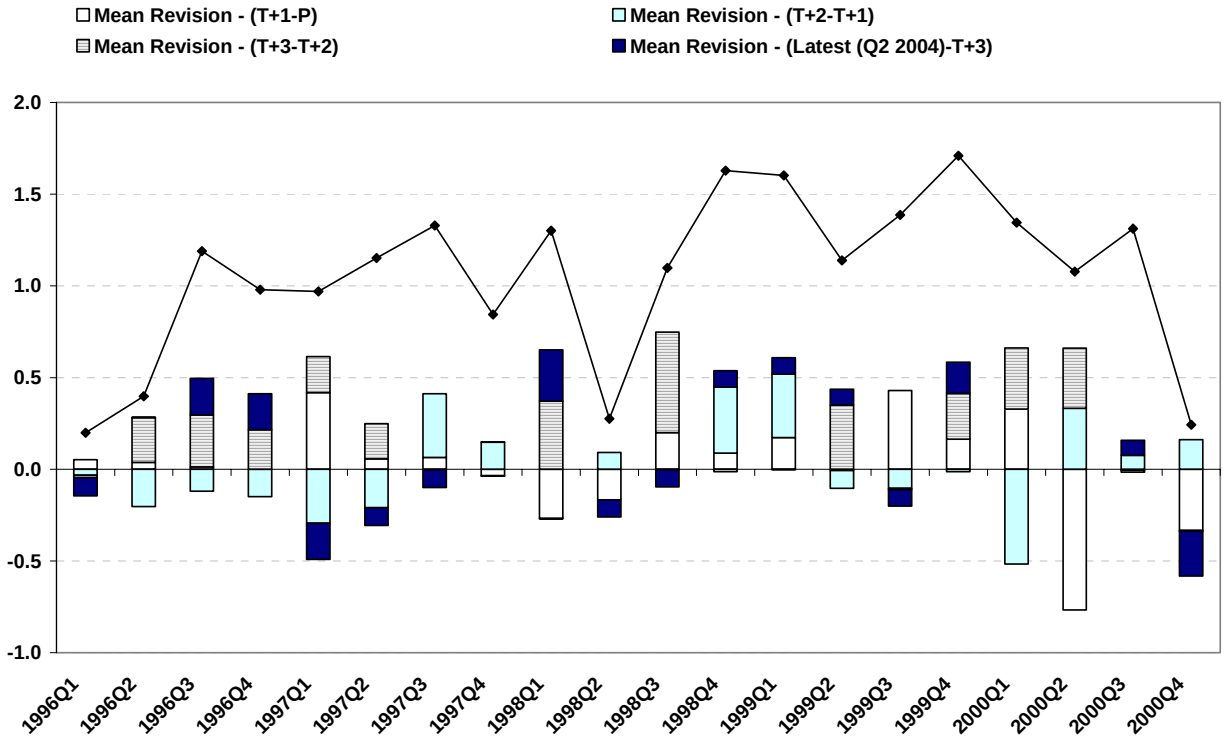
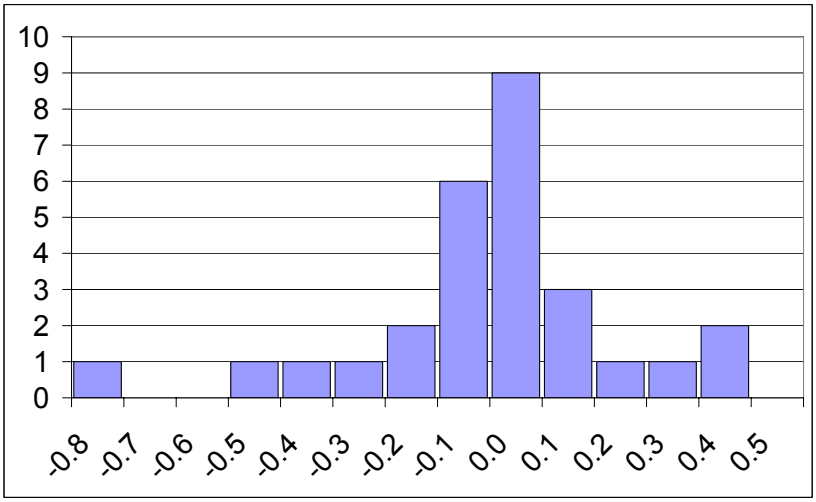


Figure A2: Distribution of Revisions (Q1 1996- Q4 2002) - Canada



Note (1): 0' includes all revisions less than 0.05 and greater than -0.05; '0.1' includes revisions greater than or equal to 0.05 and less than 0.15; '0.2' includes revisions greater than or equal to 0.15 and less than 0.25; etc.

FRANCE

Table A4: Indicators

	1996Q1-2000Q4			until 2002 Q4	until 2001 Q4
	T+1	**T+2**	**T+3**	**T+1**	**T+2**
Average GDP growth rate	0.88	0.89	1.05	0.78	0.80
Deviation					
Mean revision 1/n∑(F-P)	0.06	0.12	0.08	0.02	0.08
Relative mean revision ∑(F-P)/∑F	0.09	0.15	0.11	0.03	0.12
Mean absolute revision 1/n (∑|F-P|)	0.11	0.24	0.32	0.14	0.22
Relative mean absolute revision ∑|F-P|/∑|F|	0.15	0.30	0.43	0.22	0.30
Mean absolute revision between two successive periods	0.11	0.18	0.18		
Standard deviation	0.12	0.25	0.37	0.19	0.25
Tendency					
F>P: Nb of times	13	12	11	15	12
F and P different sign	0	0	1	2	0
Number of observations	[20]	[20]	[20]	[28]	[24]

Table A5: Revisions Triangle – France
Mean Absolute Revisions (in quarter-on-quarter Constant price GDP growth) by year - % of GDP

Revisions between	Reference Period				
	1996	**1997**	**1998**	**1999**	**2000**
P and Dec 97	0.10				
P or Dec 97 and Dec 98	0.08	0.07			
P or Dec 98 and Dec 99	0.37	0.36	0.06		
P or Dec 99 and Dec 00	0.00	0.10	0.05	0.18	
P or Dec 00 and Dec 04	0.15	0.07	0.21	0.14	0.13
Dec 01 and Dec 02	0.05	0.02	0.12	0.16	0.29
Dec 02 and Dec 03	0.05	0.07	0.09	0.05	0.07
Dec 03 and Jun 04	0.07	0.10	0.07	0.05	0.11

Table A6: Revisions Triangle - Mean Revisions (in year-on-year constant price GDP growth) - % of GDP, France

Revisions between	Reference Period				
	1996	**1997**	**1998**	**1999**	**2000**
P and Dec 97	0.19				
P or Dec 97 and Dec 98	0.02	-0.11			
P or Dec 98 and Dec 99	-0.45	-0.34	0.20		
P or Dec 99 and Dec 00	0.00	0.00	-0.19	0.19	
P or Dec 00 and Dec 04	0.00	0.00	0.29	-0.01	0.27
Dec 01 and Dec 02	0.00	-0.10	0.00	0.28	0.63
Dec 02 and Dec 03	0.00	0.00	0.10	0.00	0.09
Dec 03 and Jun 04	0.00	0.00	0.00	0.00	0.00

Figure A3: Quarterly GDP Growth and mean revisions: 1996 to 2000, France - % of GDP

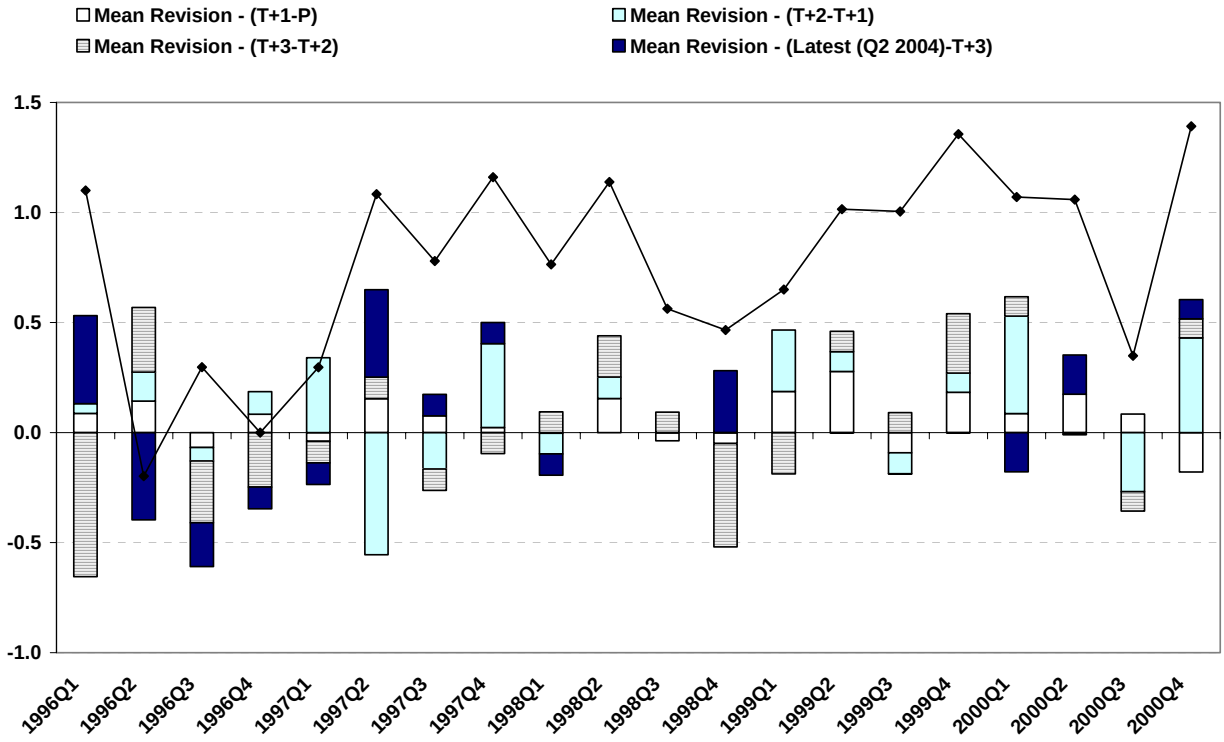
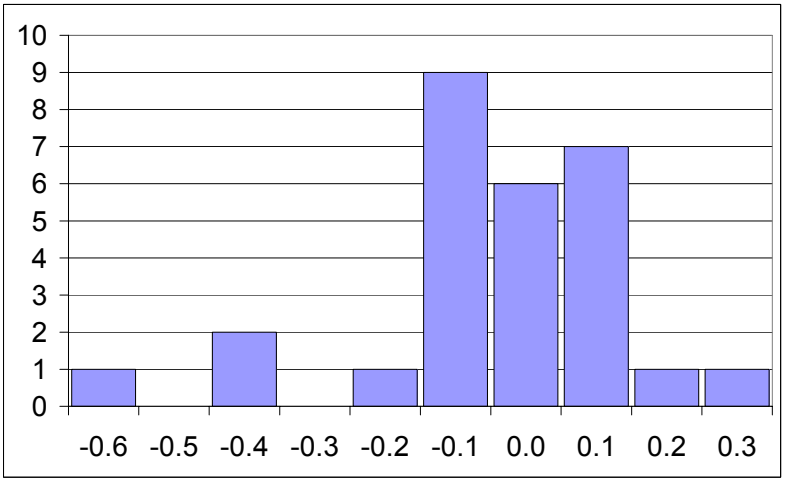


Figure A4: Distribution of Revisions (Q1 1996- Q4 2002) - France



See Note (1), Canada

GERMANY

Table A7: Indicators

	1996Q1-2000Q4			until 2002 Q4	until 2001 Q4
	T+1	**T+2**	**T+3**	**T+1**	**T+2**
Average GDP growth rate	0.52	0.47	0.44	0.39	0.42
Deviation					
Mean revision 1/n∑(F-P)	-0.01	-0.06	-0.09	-0.01	-0.02
Relative mean revision ∑(F-P)/∑F	-0.02	-0.12	-0.21	-0.02	-0.05
Mean absolute revision 1/n (∑|F-P |)	0.17	0.35	0.39	0.14	0.32
Relative mean absolute revision ∑|F-P |/∑ |F |	0.30	0.60	0.58	0.30	0.60
Mean absolute revision between two successive periods	0.17	0.22	0.18		
Standard deviation	0.25	0.43	0.46	0.21	0.41
Tendency					
F>P: Nb of times	11	10	8	14	13
F and P different sign	0	3	3	0	3
Number of observations	[20]	[20]	[20]	[28]	[24]

Table A8: Revisions Triangle – Germany
Mean Absolute Revisions (in quarter-on-quarter Constant price GDP growth) by year - % of GDP

Revisions between	Reference Period				
	1996	**1997**	**1998**	**1999**	**2000**
P and Dec 97	0.14				
P or Dec 97 and Dec 98	0.21	0.08			
P or Dec 98 and Dec 99	0.29	0.34	0.26		
P or Dec 99 and Dec 00	0.17	0.22	0.19	0.17	
P or Dec 00 and Dec 04	0.18	0.12	0.12	0.22	0.21
Dec 01 and Dec 02	0.00	0.05	0.14	0.21	0.14
Dec 02 and Dec 03	0.00	0.07	0.07	0.10	0.07
Dec 03 and Jun 04	0.05	0.00	0.00	0.00	0.00

Table A9: Revisions Triangle - Mean Revisions (in year-on-year constant price GDP growth) - % of GDP, Germany

Revisions between	Reference Period				
	1996	**1997**	**1998**	**1999**	**2000**
P and Dec 97	-0.01				
P or Dec 97 and Dec 98	-0.07	0.02			
P or Dec 98 and Dec 99	-0.50	-0.94	-0.35		
P or Dec 99 and Dec 00	0.00	0.00	-0.10	0.10	
P or Dec 00 and Dec 04	0.00	0.00	-0.10	0.29	0.09
Dec 01 and Dec 02	0.00	0.00	0.00	0.19	-0.19
Dec 02 and Dec 03	0.00	0.00	0.00	0.00	0.00
Dec 03 and Jun 04	0.00	0.00	0.00	0.00	0.00

Figure A5: Quarterly GDP Growth and mean revisions: 1996 to 2000, Germany - % of GDP

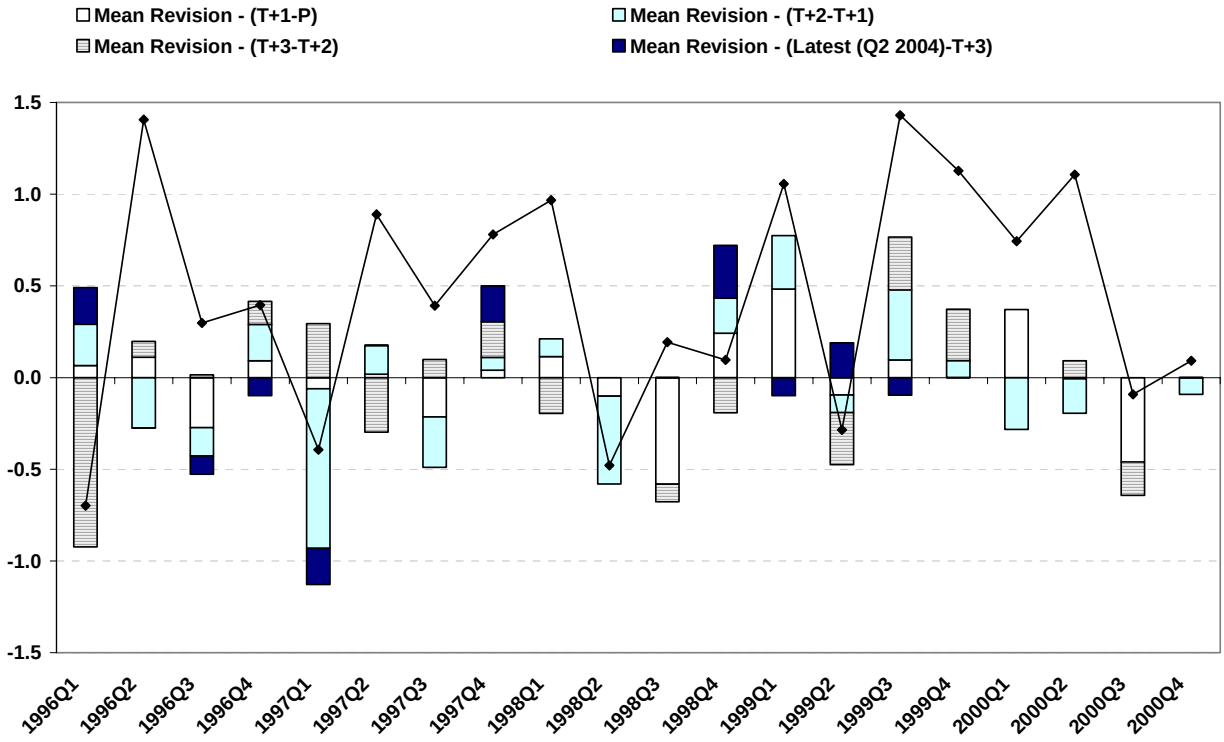
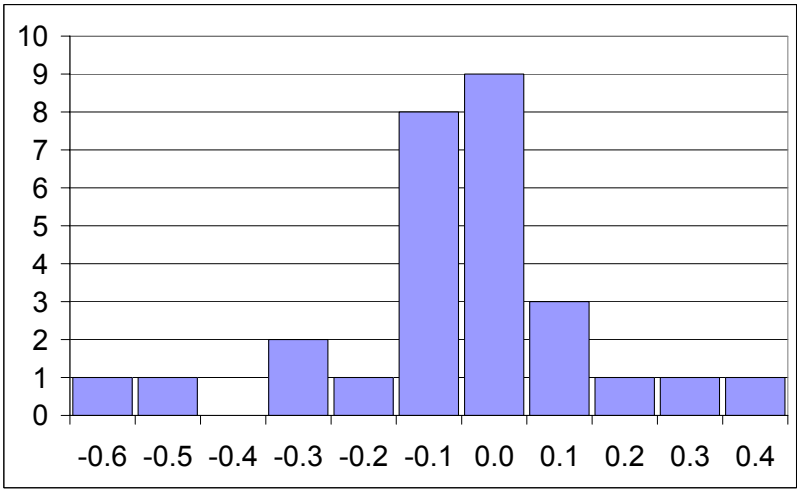


Figure A6: Distribution of Revisions (Q1 1996- Q4 2002) - Germany



See Note (1), Canada

ITALY

Table A10: Indicators

	1996Q1-2000Q4			until 2002 Q4	until 2001 Q4
	T+1	**T+2**	**T+3**	**T+1**	**T+2**
Average GDP growth rate	0.40	0.42	0.50	0.34	0.38
Deviation					
Mean revision 1/n∑(F-P)	0.03	0.05	0.13	0.02	0.04
Relative mean revision ∑(F-P)/∑F	0.07	0.11	0.26	0.06	0.12
Mean absolute revision 1/n (∑|F-P |)	0.26	0.34	0.29	0.23	0.30
Relative mean absolute revision ∑|F-P |/∑ |F |	0.44	0.54	0.44	0.47	0.54
Mean absolute revision between two successive periods	0.26	0.19	0.22		
Standard deviation	0.50	0.57	0.46	0.43	0.52
Tendency					
F>P: Nb of times	12	11	18	15	13
F and P different sign	3	2	3	5	2
Number of observations	[20]	[20]	[20]	[28]	[24]

Table A11: Revisions Triangle – Italy
Mean Absolute Revisions (in quarter-on-quarter Constant price GDP growth) by year - % of GDP

Revisions between	Reference Period				
	1996	**1997**	**1998**	**1999**	**2000**
P and Dec 97	0.77				
P or Dec 97 and Dec 98	0.21	0.14			
P or Dec 98 and Dec 99	0.21	0.24	0.21		
P or Dec 99 and Dec 00	0.10	0.22	0.08	0.07	
P or Dec 00 and Dec 04	0.30	0.17	0.26	0.24	0.12
Dec 01 and Dec 02	0.20	0.02	0.05	0.19	0.18
Dec 02 and Dec 03	0.30	0.18	0.10	0.17	0.21
Dec 03 and Jun 04	0.00	0.00	0.00	0.00	0.09

Table A12: Revisions Triangle - Mean Revisions (in year-on-year constant price GDP growth) - % of GDP, Italy

Revisions between	Reference Period				
	1996	**1997**	**1998**	**1999**	**2000**
P and Dec 97	0.00				
P or Dec 97 and Dec 98	-0.04	0.00			
P or Dec 98 and Dec 99	0.24	-0.03	-0.12		
P or Dec 99 and Dec 00	0.20	0.29	0.29	0.00	
P or Dec 00 and Dec 04	0.00	0.20	0.29	0.18	0.00
Dec 01 and Dec 02	0.00	0.00	0.00	0.00	-0.09
Dec 02 and Dec 03	0.00	0.00	0.00	0.00	0.37
Dec 03 and Jun 04	0.00	0.00	0.00	0.00	-0.09

Figure A7: Quarterly GDP Growth and mean revisions: 1996 to 2000, Italy - % of GDP

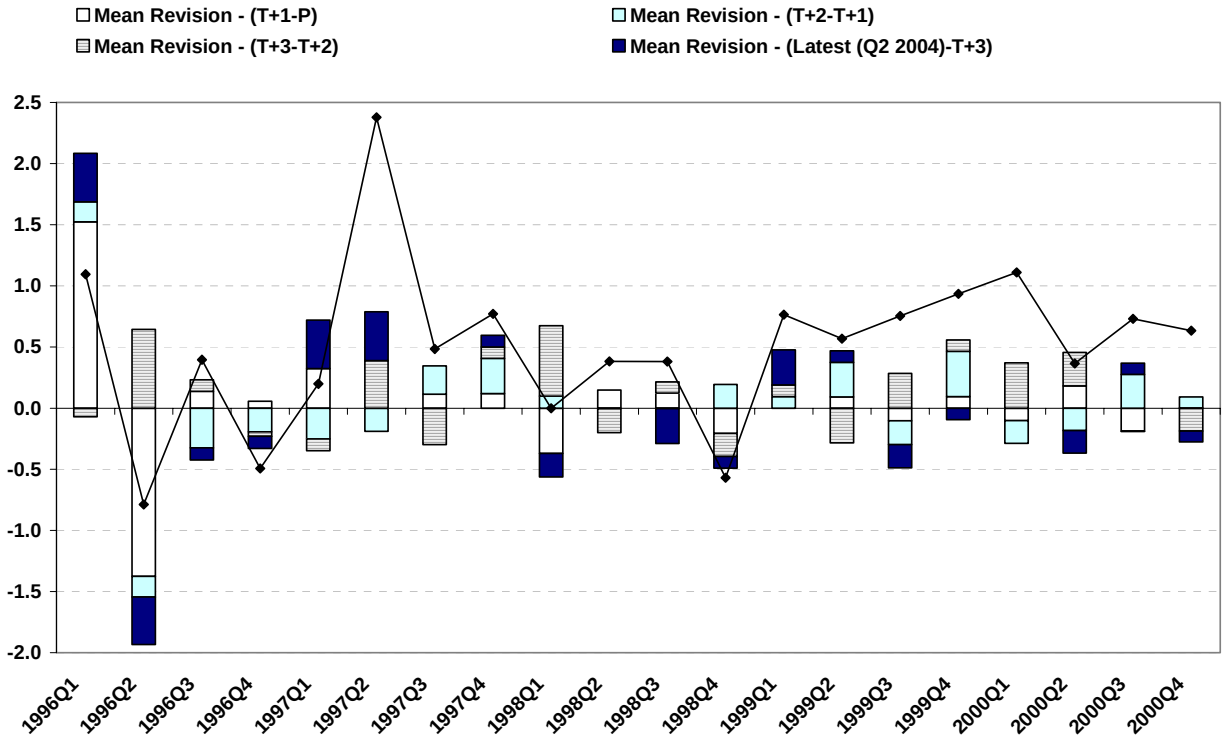
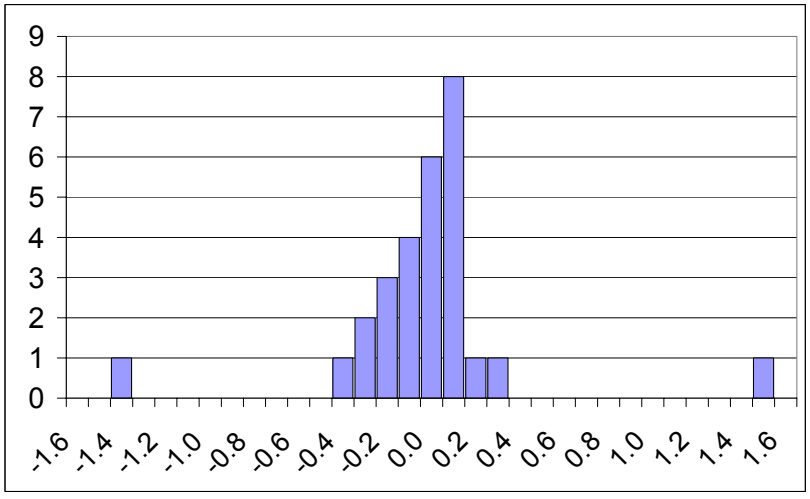


Figure A8: Distribution of Revisions (Q1 1996- Q4 2002) - Italy



See Note (1), Canada

The distribution for Italy requires some commentary. The extreme observations above (1.5 and -1.4) relate to T+1 revisions of data occurred in Q1 1996 and Q2 1996. It's not evident why revisions to this period should have been so large but it may reflect the difficulties of estimation when growth moves from positive to negative (or vice-versa) as was the case for Italy in this period. Indeed revisions were made to these two quarters as recently as July 2003. June 2003 estimates were revised from 0.8% growth in Q1 and -0.6% in to 1.1% and -0.8% respectively. These compare with the T+3 estimates of 0.7 and -0.4.

JAPAN

Table A13: Indicators

	1996Q1-2000Q4			until 2002 Q4	until 2001 Q4
	T+1	**T+2**	**T+3**	**T+1**	**T+2**
Average GDP growth rate	0.11	0.30	0.51	0.09	0.15
Deviation					
Mean revision 1/n∑(F-P)	-0.04	0.15	0.35	-0.04	0.14
Relative mean revision ∑(F-P)/∑F	-0.40	0.49	0.69	-0.50	0.89
Mean absolute revision 1/n (∑|F-P |)	0.51	0.61	0.79	0.57	0.61
Relative mean absolute revision ∑|F-P |/∑ |F |	0.51	0.65	0.65	0.59	0.65
Mean absolute revision between two successive periods	0.51	0.31	0.53		
Standard deviation	0.68	0.73	1.01	0.72	0.71
Tendency					
F>P: Nb of times	12	12	13	16	14
F and P different sign	1	4	6	2	5
Number of observations	[20]	[20]	[20]	[28]	[24]

Table A14: Revisions Triangle – Japan
Mean Absolute Revisions (in quarter-on-quarter Constant price GDP growth) by year - % of GDP

Revisions between	Reference Period				
	1996	**1997**	**1998**	**1999**	**2000**
P and Dec 97	0.36				
P or Dec 97 and Dec 98	0.52	0.37			
P or Dec 98 and Dec 99	0.15	0.29	0.42		
P or Dec 99 and Dec 00	0.75	1.12	0.40	0.90	
P or Dec 00 and Dec 04	0.00	0.00	0.00	0.00	0.51
Dec 01 and Dec 02	0.41	0.70	0.55	0.75	0.36
Dec 02 and Dec 03	0.12	0.35	0.45	1.03	0.66
Dec 03 and Jun 04	0.37	1.51	0.77	0.62	0.36

Table A15: Revisions Triangle - Mean Revisions (in year-on-year constant price GDP growth) - % of GDP, Japan

Revisions between	Reference Period				
	1996	**1997**	**1998**	**1999**	**2000**
P and Dec 97	-0.01				
P or Dec 97 and Dec 98	1.50	0.53			
P or Dec 98 and Dec 99	0.05	0.10	0.35		
P or Dec 99 and Dec 00	-1.60	0.22	1.49	0.48	
P or Dec 00 and Dec 04	0.00	0.00	0.00	0.00	-0.10
Dec 01 and Dec 02	0.00	0.00	0.00	-0.10	0.76
Dec 02 and Dec 03	-0.10	0.10	-0.09	-0.58	0.59
Dec 03 and Jun 04	0.00	0.00	0.00	0.00	0.00

Figure A9: Quarterly GDP Growth and mean revisions: 1996 to 2000, Japan - % of GDP

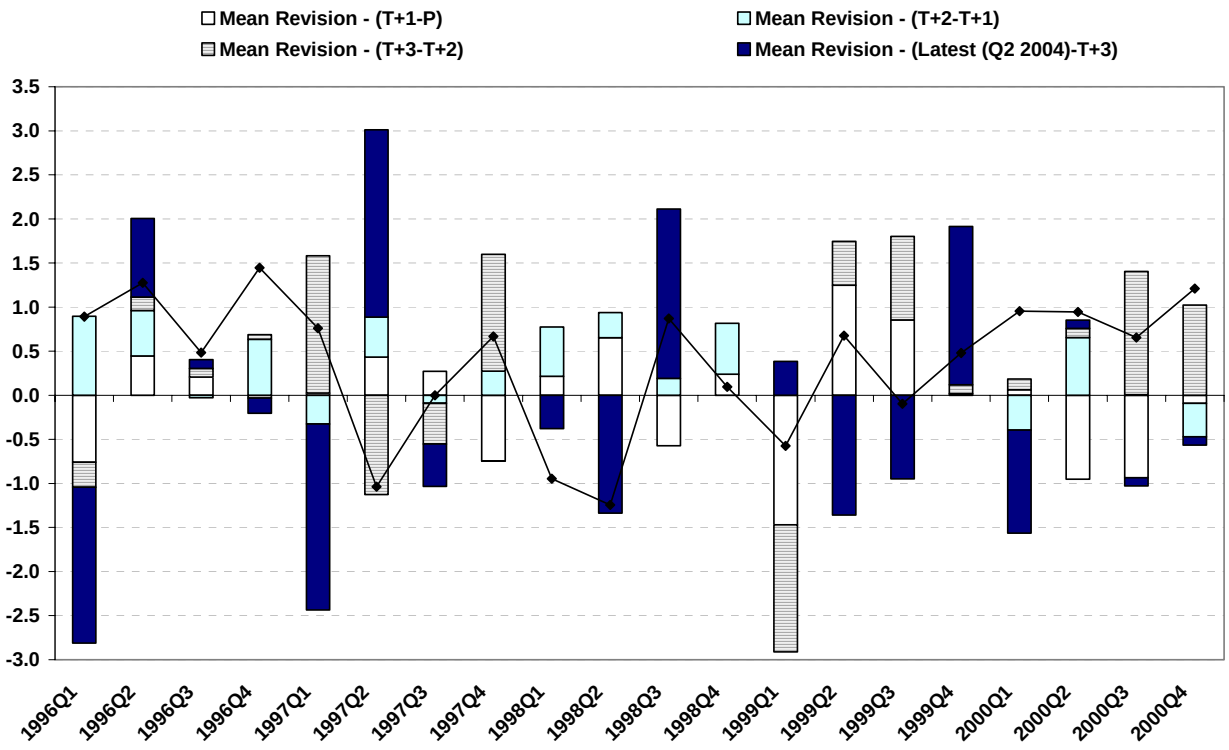
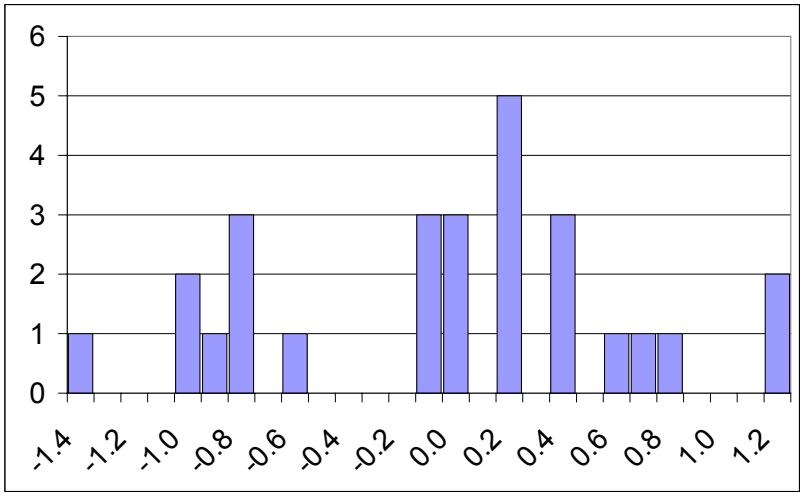


Figure A10: Distribution of Revisions (Q1 1996- Q4 2002) - Japan



See Note (1), Canada

UNITED KINGDOM

Table A16: Indicators

	1996Q1-2000Q4			until 2002 Q4	until 2001 Q4
	T+1	**T+2**	**T+3**	**T+1**	**T+2**
Average GDP growth rate	0.68	0.65	0.75	0.61	0.62
Deviation					
Mean revision 1/n∑(F-P)	0.07	0.05	0.15	0.06	0.06
Relative mean revision ∑(F-P)/∑F	0.11	0.08	0.20	0.10	0.10
Mean absolute revision 1/n (∑|F-P|)	0.17	0.15	0.19	0.17	0.17
Relative mean absolute revision ∑|F-P|/∑|F|	0.25	0.23	0.25	0.28	0.28
Mean absolute revision between two successive periods	0.17	0.17	0.16		
Standard deviation	0.21	0.20	0.21	0.20	0.22
Tendency					
F>P: Nb of times	13	10	15	17	13
F and P different sign	0	0	0	0	0
Number of observations	[20]	[20]	[20]	[28]	[24]

Table A17: Revisions Triangle – UK
Mean Absolute Revisions (in quarter-on-quarter Constant price GDP growth) by year - % of GDP

Revisions between	Reference Period				
	1996	**1997**	**1998**	**1999**	**2000**
P and Dec 97	0.22				
P or Dec 97 and Dec 98	0.27	0.20			
P or Dec 98 and Dec 99	0.18	0.18	0.16		
P or Dec 99 and Dec 00	0.00	0.00	0.12	0.18	
P or Dec 00 and Dec 04	0.12	0.24	0.14	0.23	0.09
Dec 01 and Dec 02	0.10	0.05	0.09	0.20	0.07
Dec 02 and Dec 03	0.34	0.50	0.28	0.16	0.26
Dec 03 and Jun 04	0.00	0.00	0.00	0.00	0.00

Table A18: Revisions Triangle - Mean Revisions (in year-on-year constant price GDP growth) - % of GDP, UK

Revisions between	Reference Period				
	1996	**1997**	**1998**	**1999**	**2000**
P and Dec 97	0.21				
P or Dec 97 and Dec 98	0.21	-0.01			
P or Dec 98 and Dec 99	0.04	0.04	0.08		
P or Dec 99 and Dec 00	0.00	0.00	0.47	0.17	
P or Dec 00 and Dec 04	0.00	0.00	0.28	0.09	-0.09
Dec 01 and Dec 02	0.00	0.00	0.00	0.18	0.17
Dec 02 and Dec 03	0.10	-0.20	0.19	0.36	0.79
Dec 03 and Jun 04	0.00	0.00	0.00	0.00	0.00

Figure A11: Quarterly GDP Growth and mean revisions: 1996 to 2000, UK - % of GDP

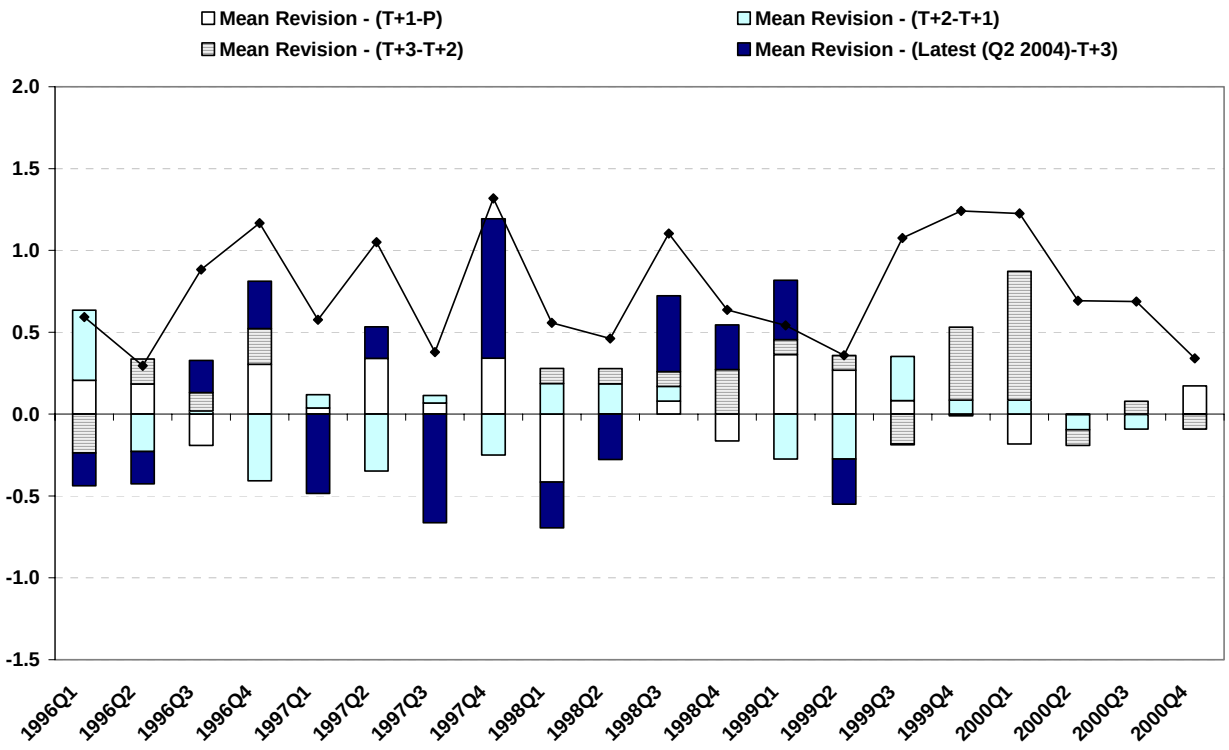
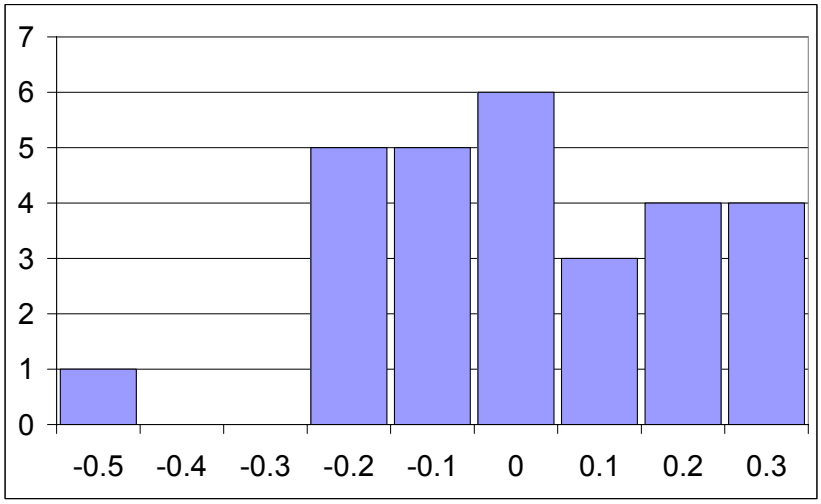


Figure A12: Distribution of Revisions (Q1 1996- Q4 2002) - UK



See Note (1), Canada

UNITED STATES

Table A19: Indicators

	1996Q1-2000Q4			until 2002 Q4	until 2001 Q4
	T+1	**T+2**	**T+3**	**T+1**	**T+2**
Average GDP growth rate	0.96	0.96	0.98	0.79	0.80
Deviation					
Mean revision 1/n∑(F-P)	0.02	0.02	0.04	-0.01	0.00
Relative mean revision ∑(F-P)/∑F	0.02	0.02	0.04	-0.01	0.00
Mean absolute revision 1/n (∑|F-P|)	0.27	0.29	0.29	0.27	0.31
Relative mean absolute revision ∑|F-P|/∑|F|	0.28	0.30	0.30	0.32	0.37
Mean absolute revision between two successive periods	0.27	0.15	0.10		
Standard deviation	0.34	0.37	0.37	0.35	0.40
Tendency					
F>P: Nb of times	13	9	10	14	10
F and P different sign	0	0	0	3	3
Number of observations	[20]	[20]	[20]	[28]	[24]

Table A20: Revisions Triangle – US
Mean Absolute Revisions (in quarter-on-quarter Constant price GDP growth) by year - % of GDP

Revisions between	Reference Period				
	1996	**1997**	**1998**	**1999**	**2000**
P and Dec 97	0.27				
P or Dec 97 and Dec 98	0.17	0.32			
P or Dec 98 and Dec 99	0.12	0.11	0.25		
P or Dec 99 and Dec 00	0.07	0.07	0.11	0.23	
P or Dec 00 and Dec 04	0.00	0.00	0.18	0.17	0.29
Dec 01 and Dec 02	0.00	0.00	0.00	0.13	0.16
Dec 02 and Dec 03	0.00	0.00	0.00	0.00	0.00
Dec 03 and Jun 04	0.15	0.17	0.14	0.15	0.33

Table A21: Revisions Triangle - Mean Revisions (in year-on-year constant price GDP growth) - % of GDP, US

Revisions between	Reference Period				
	1996	**1997**	**1998**	**1999**	**2000**
P and Dec 97	0.33				
P or Dec 97 and Dec 98	0.68	0.16			
P or Dec 98 and Dec 99	0.25	0.50	0.46		
P or Dec 99 and Dec 00	-0.10	0.00	0.00	0.18	
P or Dec 00 and Dec 04	0.00	0.00	-0.09	-0.17	-0.75
Dec 01 and Dec 02	0.00	0.00	0.00	0.00	-0.43
Dec 02 and Dec 03	0.00	0.00	0.00	0.00	0.00
Dec 03 and Jun 04	0.10	0.09	-0.10	0.35	-0.10

Figure A13: Quarterly GDP Growth and mean revisions: 1996 to 2000, US - % of GDP

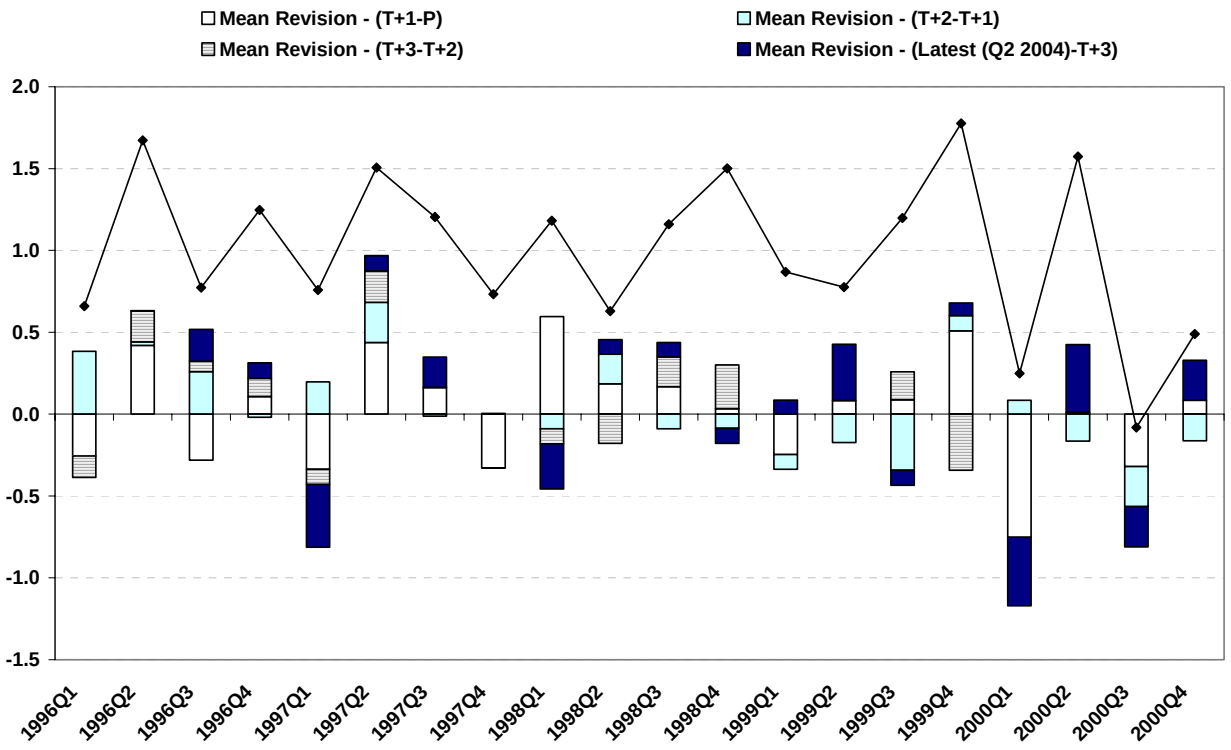
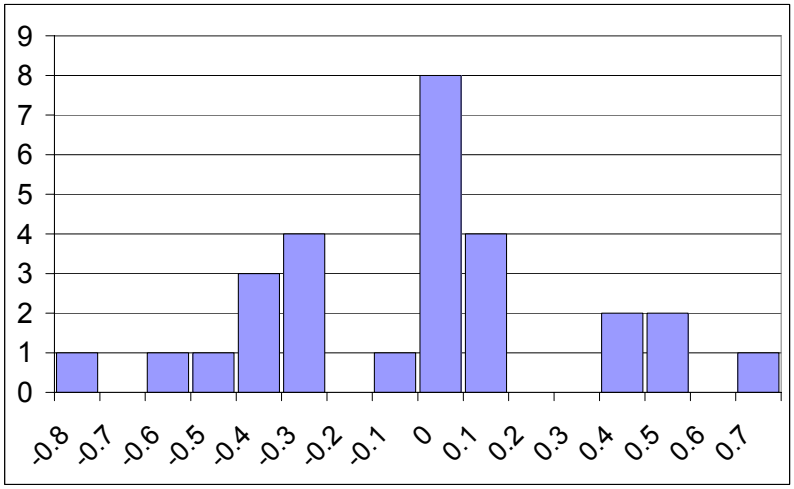


Figure A14: Distribution of Revisions (Q1 1996- Q4 2002) - US



See Note (1), Canada, Canada

BIBLIOGRAPHY

Akritidis, (2003); "Revisions to Quarterly GDP Growth and Expenditure Components" *(ONS Articles Database)*

Cook, Len (2004); "Revisions to statistics: their role in measuring economic progress"; *Economic Trends* No 603.

Faust. Jon, John H. Rogers and Jonathan H. Wright (2000): "News and Noise in G-7 GDP Announcements"; Board of Governors of the Federal Reserve System, *International Finance Discussion Papers, Number 690, December 2000.*

Fixler, Dennis and Bruce T. Grimm (2002); "Reliability of GDP and Related NIPA Estimates"; *Survey of Current Business*, January 2002

George, Emily (2004): "Revisions to Quarterly GDP growth and its Production and Expenditure components" *(ONS Articles Database)*

Gregoir, S. and R. Lacroix: "Les Revisions des Comptes Trimestriels" INSEE; Background Paper to OECD-ONS Workshop, Paris, October 2004.

Gros, Emmanuel and Corrine Prost (2002); "Are annual revisions to the national accounts cyclical?"; *Conjecture in France, December 2002*

Jenkinson, Graham and Nigel Studdard (2004)" ONS Policy on Standards for presenting revisions in time series First Releases"; *Economic Trends, March 2004*

Kazemier, Brugt, Henk Nijmeijer and Remko Hijman (2004); "How to judge the reliability of provisional National Accounts"; Paper prepared for the European Conference on Quality and Methodology in Official Statistics, Mainz, May, 2004.

OECD (1989); "Annual Revisions to Quarterly National Accounts"; Meeting of National Accounts Experts.

OECD (1995); "The Reliability of Quarterly National Accounts in Seven Major Countries": A User's Perspective"; Ad-Hoc Expert Group on Main Economic Indicators (MEI 30th Anniversary Meeting).

Öller, Lars-Erik and Karl-Gustav Hansson (2002); "Revisions of Swedish National Accounts 1980-1998 and an international comparison"; Statistics Sweden.

Cabinet Office UK, The Pickford Review of *Government Economic Statistics* 1988

Young, Allan H. (1996) "Reliability and Accuracy of Quarterly GDP Estimates: A review." Pages 423-449, *The New System of National Accounts*, edited by John Kendrick.