A Look at Data Revisions in the Quarterly National Accounts

*By Colin Bermingham**

ABSTRACT

The paper presents a real time database of economic time series for Ireland. The database contains a record of what was considered official data at each point in time. The database is used to describe the properties of revisions to the growth rates of GDP and its expenditure components in the Quarterly National Accounts. The revisions to GDP growth, although significant in an absolute sense, are small relative to average growth in the sample. The revisions to the growth rates of the expenditure components of GDP are larger and more varied. It is found that revisions to GDP growth have a predictable element that can used to forecast final GDP growth.

1. Introduction

The situation facing the economic practitioner has changed quite dramatically over the last few decades. Advances in computing have allowed increasingly sophisticated mathematical and statistical techniques to be applied to data in order to test economic hypotheses. Despite these advances, the validity of any econometric analysis is still predicated on the integrity of the underlying data. The practitioner must use data from a reputable source and analyse the properties of that data to determine its suitability prior to use. Recently the issue of data revisions has received more attention as a number of related academic papers have been published.

National statistical agencies are the main providers of the data used in economic analysis. In Ireland, every quarter sees the release of new data on Gross Domestic Product (GDP) and its various expenditure components from the Central Statistics Office (CSO) in the Quarterly National Accounts (QNA). The latest QNA figures obviously relate to a pretty recent quarter and are necessarily provisional. As more data become available over time, the CSO can calculate a more accurate estimate of that specific quarter's GDP. Thus, the numbers first published are subject to revision in subsequent quarters and, in practice, several revisions often take place. In some instances, revisions take place as new methods of calculating figures are implemented.

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Data revisions have important implications for such seemingly diverse activities as economic forecasting and historical economic analysis. The implications of data revisions for forecasting are probably more obvious – how can you construct a forecast of GDP growth for tomorrow if you can't rely on today's figure? Assessing forecasting accuracy is also hindered if data observations held back to test forecast accuracy are subject to revision. Although slightly less obvious, it is clear that the analysis of historical economic decisions is also affected by data revisions. An economist examining the current version of historical data might argue that interest rates were increased in error ten years ago given the state of the economy at the time. However, the current version of the data might differ considerably to the data that was available when that decision was being made. The monetary policy pursued may have been appropriate given the perception of the economy based on the data available at the time. In this manner, the analysis of economic history can also be affected by data revisions.

Given the practical implications of data revisions, a number of questions spring to mind. How reliable are the initial estimates of any given figure? On average, how far into the past are the data revised? Is there a pattern to the revisions that could be exploited to forecast future revisions? Although statistical agencies have always revised data, it is only recently that economists have started to construct real-time databases that allow questions of this nature to be answered in a comprehensive manner. The Philadelphia Federal Reserve Bank has constructed a real time database of economic time series for the U.S. and a number of academic papers have been written that make use of the database. Outside the US, the Bank of England, the Reserve Bank of New Zealand and the Bundesbank are some of the central banks that have made real-time databases publicly available.

A real-time database is a record of what data were available at each point in time – it provides a snapshot of official data for every period. The data for a specific month or quarter is called a vintage. Vintages are defined according to when the data were released. The data for the January 2005 vintage relates to data that was available by the first month of 2005 but, due to reporting lags, the dataset for this vintage might only contain data up to November 2004. Over the past year, we have constructed a real-time database for Ireland at the Bank. In this article, I briefly outline the various sources of data revisions. I describe the construction of the database and document the data included. Basic calculations are performed that answer some of the questions that were posed above.

2. Sources of Data Revisions

Data revisions can be traced to two distinct sources. The most common type of data revision is due to additional economic information becoming available over time. The second type of revision results from changes in the methodology used to compile the data. This can include changes of base year, definitional changes for variables and the use of new weighting systems. The first type of data revision is usually termed an ‘‘informative’’ revision in the literature because it incorporates additional economic information. In contrast, the second type of revision is termed an ‘‘uninformative’’ revision. Informative revisions receive more attention than uninformative revisions on the basis that there might some predictable element to informative revisions.

In most countries, the first estimate of GDP for a given quarter is released a fixed amount of days after the end of that quarter. For example, the United States releases initial estimates of GDP 30 days after the end of the quarter. The average is 56 days across the G-7 as a whole. The users of data often request that data are released in as short a time frame as possible but there is an inevitable trade-off between timeliness and accuracy that cannot be avoided. In Ireland, there is not a fixed amount of days after which initial GDP estimates are released. Since QNA have been released, the preliminary estimate of GDP has been released 147·5 days following the end of the quarter on average. The release has become significantly more timely, however, as the CSO has continued to streamline the collection, calculation and dissemination process. For seven of the last nine quarters, the preliminary GDP figure has related to a quarter that had ended less than a hundred days earlier. As such, it’s fair to say that the initial GDP estimate is usually released sometime around the end of the following quarter. Based on a cursory examination of the real-time data from other countries, it would appear that the initial estimate of GDP in Ireland compares favourably with other national statistical agencies in terms of accuracy.

There is a specific pattern to GDP revisions. Each standard release of the QNA contains revisions to the data for the current year. This means that revisions are generally limited to the three most recent quarters. Once per year, and usually in July, the CSO publish an annual release on the National Income and Expenditure (NIE) Accounts on the same day as one of the quarterly releases. This quarterly release contains revisions to GDP and its components for several years into the past, as the quarterly figures are amended to reconcile with the new annual estimates in the NIE publication. Thus, on average, only one quarterly release per year contains revisions stretching back more than a few quarters. The revisions to the quarterly data from this annual realignment can stretch back five to six years as ongoing inquiries by the CSO continue to improve the quarterly estimates.

3. Constructing the Real-Time Database

The first step in constructing a real-time database is deciding whether the database should be monthly or quarterly. Any real-time database will include both monthly and quarterly data. If a quarterly database is constructed, the monthly data is compacted. This results in some information being lost. If a monthly database is constructed, there will be no additional quarterly information in eight months of the year. Once the database has been constructed for a given data frequency, it is a fairly trivial exercise to construct a second version for another data frequency. For this reason, both monthly and quarterly real-time datasets have been constructed for most variables in the database for Ireland.

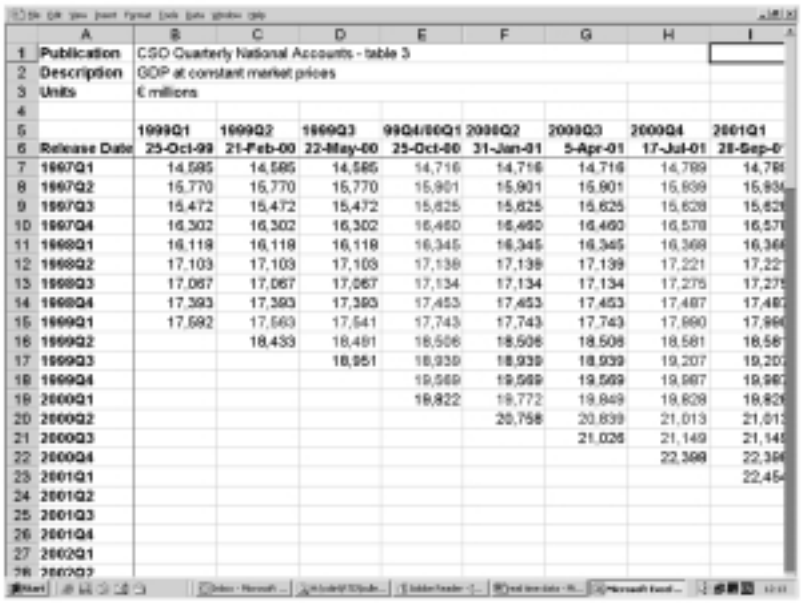
In order to assign data into the various vintages, a cut-off date is needed. The cut-off for monthly data is the last day of the previous month. Suppose the CSO release data on the 14th February 2005. These data are included in March 2005 vintage of data. On the other hand, if the CSO release data on the 1st March 2005, these numbers do not make it into the March 2005 vintage because they were not available by the last day of the previous month. The cut-off date for quarterly vintages is the middle day of the quarter – February 15th for quarter 1, May 15th for quarter 2, August 15th for quarter 3 and November 15th for quarter 4. Data must be released by these dates for inclusion in the corresponding quarter.

At present, the monthly real-time database, which includes many quarterly variables, contains real indicators, nominal indicators, financial variables and macro balances. A number of variables that are not subject to any revision are included for the sake of completeness. Table 1 provides a full list of the variables included in the database. Each variable has its own excel file representing all the different vintages for that variable. These excel files contain basic information about the series including a brief description and the source of the data. The majority of the series included in the database are originally published in either the QNA or the Bank's Monthly Statistics.

Table 1: Variables Included in Real-Time Database

Real Indicators	Nominal Indicators	Monetary and Financial Series
GDP	Nominal GDP	Narrow Money Supply – M1
Personal Consumption	Nominal Personal Consumption	Broad Money Supply – M3
Public Consumption	Nominal Public Consumption	3 Month Interest Rate
Exports	Nominal Exports	10 Year Government Bond Rate
Imports	Nominal Imports	Stock Prices
Capital Formation	Nominal Capital Formation	Current Account Balance
Total Employment	Inflation	Total Loans
Unemployment Rate	Core Inflation	Total Credit
Industrial Production		

Following the example set by the Philadelphia Federal Reserve Bank for the US real-time database, the excel files are organised so that each column in the file represents a vintage. The earliest vintage is in the first column and the most recent vintage in the last column. Each successive vintage has one additional observation giving each file a triangular appearance. The following screenshot shows the format of the database.



	A	B	C	D	E	F	G	H	I
1	Publication	CSO Quarterly National Accounts - table 3							
2	Description	GDP at constant market prices							
3	Units	€ millions							
4									
5		1999Q1	1999Q2	1999Q3	99Q4/00Q1	2000Q2	2000Q3	2000Q4	2001Q1
6	Release Date	25-Oct-99	21-Feb-00	22-May-00	25-Oct-00	31-Jan-01	5-Apr-01	17-Jul-01	28-Sep-01
7	1997Q1	14,585	14,585	14,585	14,716	14,716	14,716	14,789	14,78
8	1997Q2	15,770	15,770	15,770	15,901	15,901	15,901	15,839	15,83
9	1997Q3	15,472	15,472	15,472	15,625	15,625	15,625	15,628	15,62
10	1997Q4	16,302	16,302	16,302	16,460	16,460	16,460	16,578	16,57
11	1998Q1	16,118	16,118	16,118	16,345	16,345	16,345	16,369	16,36
12	1998Q2	17,103	17,103	17,103	17,139	17,139	17,139	17,221	17,22
13	1998Q3	17,067	17,067	17,067	17,134	17,134	17,134	17,275	17,27
14	1998Q4	17,393	17,393	17,393	17,453	17,453	17,453	17,487	17,48
15	1999Q1	17,592	17,563	17,541	17,743	17,743	17,743	17,660	17,66
16	1999Q2		18,433	18,491	18,506	18,506	18,506	18,581	18,58
17	1999Q3			18,951	18,939	18,939	18,939	19,207	19,20
18	1999Q4				19,569	19,569	19,569	19,987	19,98
19	2000Q1				19,822	19,772	19,849	19,828	19,82
20	2000Q2					20,758	20,839	21,013	21,01
21	2000Q3						21,026	21,149	21,14
22	2000Q4							22,398	22,39
23	2001Q1								22,45
24	2001Q2								
25	2001Q3								
26	2001Q4								
27	2002Q1								
28	2002Q2								

The release date determines the vintage. The first release was on 25th October 1999, making 1999Q4 the first vintage. The data in this vintage span the period 1997Q1 – 1999Q1. An excel file of this type exists for every variable in the database.

The construction of the database mainly involved reading through old statistical releases and recording the variable of interest. I would like to thank Anne McGuinness for her research assistance in carrying out the majority of this work. This sort of data entry can be quite prone to error. In order to minimise this sort of error, national accounting identities were used to check that GDP components summed to GDP. This technique was only possible to implement until the Quarter 2, 2005 vintage for real GDP. Volume measures of GDP and its components were calculated using chain-linked indices after then, which meant that the expenditure components no longer summed to GDP figure.[1] For variables for which this sort of calculation were not possible, the accuracy of the data were checked by graphing series and

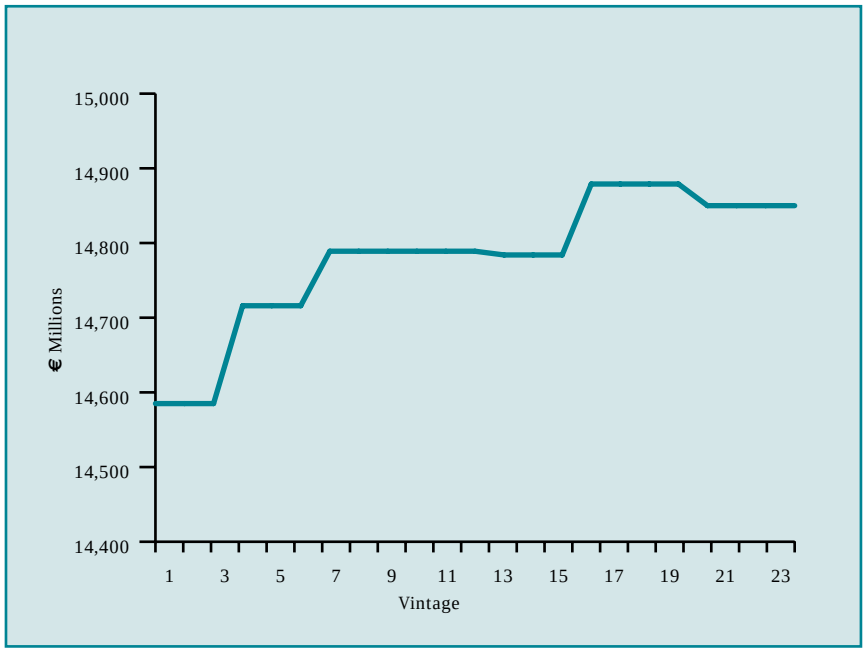
1 For a guide to the implications of using chain aggregated data to construct GDP, see Whelan (2000).

randomly double-checking series for accuracy. Of course, it is possible that there are some remaining errors in the data. However, it is hoped that the error screening process should eliminate most of the errors in the database and that any remaining errors are small.

3. How Big are the Data Revisions?

The first task following the construction of a real-time database is to assess the magnitude of the revisions to the data. I will limit my attention to GDP and its expenditure components for this exercise on the basis that these are the variables that are subject to the largest and most frequent revisions. I also focus on the quarterly version of the database given that these variables are only released on a quarterly basis. For the most part, I will examine how data revisions affect year-on-year growth rates calculated from the data. However, it is interesting to first look at how the revisions affect the actual data values. The following graph indicates how official GDP figures for Quarter 1, 1997 have changed over time. The graph relates to the period prior to the introduction of chain linking and data are not seasonally adjusted.

Figure 1: Revisions to Real GDP for 1997Q1



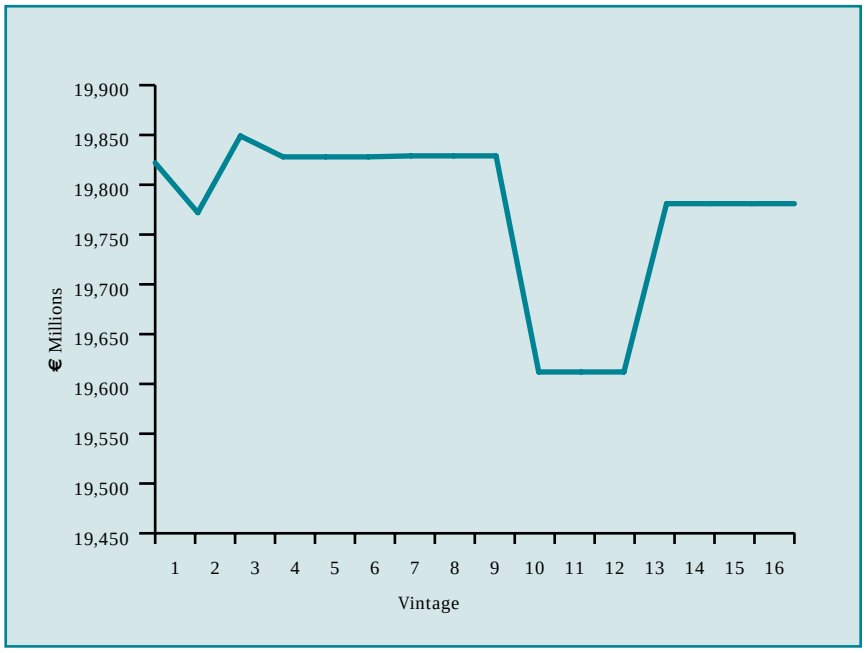
The figure for GDP in the original release, which corresponds to the first vintage, was €14,585m. In the fourth vintage, the figure for GDP was revised upwards to €14,716m suggesting that GDP for the first quarter of 1997 was initially underestimated by €131m. In subsequent periods, there were four additional revisions so that the final figure prior to the introduction to chain linking was €14,850m. This figure suggests real GDP was initially underestimated by €265m or 1·8%.

There are two ways to measure the size of data revisions. The first way is to look at the difference between the current value

of a data point and its value when it was originally released. This is normally called the 'final revision' although the term is slightly misleading in the sense that all data may be subject to further revisions in the future. A potential problem with this approach is that the final revision might be small if positive and negative revisions to the data in different vintages have offset each other. To illustrate this point, consider a graph of the revisions to real GDP for the first quarter of 2000.

The final revision is €96m, suggesting that there have not been large revisions to the data following its initial publication. From the graph, however, it is clear that there have been significant revisions but they have largely offset each other. Thus, although it is an important statistic, to focus only on the final revision can be misleading in certain cases.

Figure 2: Revisions to Real GDP for 2000Q1



A second approach is to look at revisions at a number of specific time horizons. This will give a picture of how revisions are changing over time and how frequently revisions take place. However, this will not necessarily solve the problem of offsetting revisions. To counter this problem, it is possible to look at the difference between data points in successive releases or vintages and calculate the absolute cumulative change. This statistic will not be affected by offsetting revisions because it is based on absolute values. In remainder of this paper, I look at how the growth rates of GDP and its components are revised. Both approaches to measuring revisions are examined for GDP growth. Only statistics on the final revision are reported for its expenditure components.

4. Examining GDP Growth Rate Revisions

The revisions to the growth rates of variables are often of more interest than revisions to the levels. This is chiefly because GDP

and its components are most often reported in the media in terms of growth rates rather than levels. In addition, policy-makers are generally more interested in growth rates. Another consideration in terms of data revisions is that revisions to the levels are likely to grow over time simply because GDP itself is growing over time. This could lead people to believe that the problem was getting worse unless they considered the revision as a percentage of the original GDP figure. A final point to note is that revisions due to methodological changes are likely to affect all data proportionately. Consequently, revisions to growth rates can be small in these instances.

Table 2 presents a number of statistics that shed light on the properties of growth rate revisions. The revisions to the growth rate are considered at specific time horizons. The first row of the table refers to the revision to the growth rate at the one-quarter horizon. This is calculated for every vintage. It gives an indication of how the growth rate of GDP is likely to be revised in the quarter following its initial publication. Similar statistics are provided for other horizons in the next rows of the table. The absolute cumulative revision over all time horizons is also included. Finally, the same statistics are produced for the final revision in the last row.

The first statistic reported is the frequency of revisions. At 0·95 for a 1 Quarter horizon, this indicates that the growth rate of GDP is revised in the quarter following its initial release 95% of the time. Similarly, the second row of the table indicates that GDP is revised two quarters following its release 73% of the time. This statistic can be thought of as a crude estimate of the probability of a revision at a given time horizon. One would expect revisions to become less frequent over longer time horizons. This is confirmed by the first column in the table. The frequency of revisions declines as the time horizons considered increase. The last row indicates that all GDP growth rates considered were revised at some point in time. It can be seen that if we ignore the final revision, the frequency statistic tends towards 0·25 as the time horizon increases. This is due to the pattern of revisions mentioned earlier, with only one set of revisions per year stretching back more than a few quarters. The frequency statistic can be expected to tend towards zero at very long time horizons.

Table 2: Revisions to Real GDP Growth Rates

Revisions from 97Q1-04Q4	Frequency	Average	Mean Absolute Revision (relative to growth)	Range
1 Quarter Horizon	0·95	0·2%	0·6% (7·4%)	–0·9% – 2·4%
2 Quarter Horizon	0·73	0·1%	0·2% (2·9%)	–0·4% – 1·0%
3 Quarter Horizon	0·45	0·1%	0·4% (5%)	–1·6% – 2·9%
4 Quarter Horizon	0·27	0·1%	0·4% (5·2%)	–2·3% – 3·0%
8 Quarter Horizon	0·26	–0·1%	0·1% (2%)	–0·9% – 0·8%
Cumulative Revision	n/a	n/a	2·2% (29·7%)	0·3% – 5·0%
Final Revision	1·00	0·3%	1·5% (19·7%)	–3·6% – 3·2%

The second statistic reported is the average revision. At 0·2% for a 1 Quarter Horizon, this indicates that GDP growth was revised upwards by an average of 0·2% in the quarter following its initial release. The average revision is positive for most time horizons. One question often posed in the literature is whether the revisions to GDP growth depend on the position of economy in the business cycle. The Irish economy has experienced a boom over the period concerned and growth revisions have been positive, providing prima facia evidence to support the hypothesis. In addition, the magnitude of the final revision is positive and statistically significant.[2] This means that GDP growth has been systematically underestimated in the initial release over the period considered. It is still too early to draw definitive conclusions on this issue for Ireland, however, as we have yet to see how revisions behave when the economy is in recession. The economy did experience a slight slowdown in 2001 but there was not a higher incidence of negative revisions during this period.

The table also reports the Mean Absolute Revision (MAR). The average revision is a useful statistic but, in taking an average over the different vintages, positive and negative revisions tend to offset each other and this can mask the real magnitude of the revisions. To counter this problem, the Mean Absolute Revision is calculated – this statistic does not offset positive and negative errors and is a better indicator of the general size of the revisions. The MAR after one quarter is 0·6%. Taken in conjunction with the frequency statistic for this horizon, one can say that there is a 95% chance that the growth rate for GDP will be revised in the quarter following its release and the average size of the revision is 0·6%.

Although 0·6% appears to be a large revision to a year-on-year growth rate, it has to be taken in the context of average GDP growth over the sample period. Average year-on-year growth in GDP was 7·5% in the last vintage prior to chain linking. The figure in brackets in the MAR column expresses the MAR as a percentage of this average growth rate. The MAR for first quarter was 7·4% of average GDP growth. In this context, the first quarter revision is quite small. Looking down the fourth column, it is clear that the revisions at any specific time horizon are small relative to average growth but this is not true in relation to the cumulative revision or the final revision.

The Mean Absolute Cumulative Revision is 2·2%, which is equivalent to almost 30% of the average growth rate over the sample. Thus, if the sign of the revisions is ignored, the total magnitude of successive revisions between the preliminary and final estimate amounts to 2·2% on average. The Mean Absolute Final Revision is 1·5%, which is equivalent to almost 20% of GDP growth over the sample. Thus, on average, the final figure for GDP growth

2 The statistical significance is based on the results of a regression that is reported later.

is roughly 1·5% higher or lower than initially announced. The difference between these two statistics can be taken as a rough estimate of the extent to which there are offsetting revisions to GDP growth between its preliminary announcement and its final value.

A brief examination suggests that the revisions in Ireland are small by international standard. Castle and Ellis (2002) find that the average revision to *quarterly* GDP growth in the UK is 0·2%, with average growth at 0·6%. This puts the average revision at 33% of average growth and the MAR is necessarily higher. It was seen that the MAR for the final revision is 20% of average growth in Ireland. This comparison is not strictly comparing like with like, as one relates to quarterly growth and the other to annual. In addition, the Irish data analysed are not seasonally adjusted. A similar comparison with the results in New Zealand, although again not strictly identical in terms of the revisions measured, also suggests that the MAR is lower in Ireland.

The final column in the table reports the range of revisions. This is another measure of uncertainty but it highlights the extreme revisions rather than the average ones. The smallest range of revisions is for the 2 Quarter Horizon while the largest range is for the final revision. The final revision has been ranged between -3·6% and +3·2%. These represent large revisions to GDP growth, even when expressed as a fraction of average growth over the period. Thus, despite a relatively small MAR, on occasion revisions to GDP growth are large.

5. Examining GDP Expenditure Component Growth Rate Revisions

It is clear that data revisions have a significant impact on GDP growth rates. I will now briefly examine their influence on the growth rates of the main GDP expenditure components. Table 3 reports a similar set of statistics to Table 1 but there are a couple of small differences. Table 3 only reports statistics based on the final revision so the statistics for the expenditure components are comparable to the statistics in the final row of Table 2 for GDP. In addition, because there are always revisions at some point in time, the frequency statistic is not reported. It is replaced with a column that reports the average year-on-year growth rates for the individual components.

Table 3: Revisions to GDP Expenditure Component Growth Rates

Component revisions from 97Q1 -04Q4	Average	Mean Absolute Revision (relative to growth)	Range	Average Quarterly Growth
Personal Consumption	0·3	0·7 (13%)	–1·4 — 1·9	5·6
Public Consumption	1·4	2·3 (36%)	–6·7 — 6·7	6·6
Gross Fixed Capital Formation	1·4	3·8 (48%)	–6·4 — 8·6	7·9
Exports	1·3	1·9 (18%)	–1·7 — 6·4	10·9
Imports	2·1	3·2 (31%)	–5·9 — 7·8	10·1

The last column shows that the growth rates of the GDP components varied considerably over the sample. Recalling that the average growth rate of GDP was 7·5%, it can be seen that consumption growth, both private and public, lagged behind. Investment growth, at 7·9%, was slightly higher than GDP growth. The high growth rates in the tradable sectors are remarkable given that they are average year-on-year figures over an eight-year period.

Concentrating on the revisions, the average revision was positive for all components. It was mentioned that this resulted in a statistically significant positive bias to revisions for GDP growth. The MAR for individual components is generally larger than it is for GDP as a whole, even when expressed as a percentage of the item's growth rate. The MAR for investment was 3·8%, equivalent to 48% of the average growth rate of that component, indicating that initial estimates of investment growth need to be treated with caution. At the other end of the scale, initial estimates of personal consumption growth are quite accurate with a MAR corresponding to only 13% of average growth.

The range of revisions for the individual components varies significantly. In addition to having the lowest MAR, personal consumption growth also has the smallest range of revisions. Conversely, gross fixed capital formation had the largest MAR and range of revisions. The range of revisions for public consumption is larger, however, when expressed as a percentage of average growth.

6. Forecasting Revisions

The properties of revisions to the growth rates of GDP and its expenditure components have been documented up to now. The results in Table 2 suggest that the growth rate of GDP is systematically underestimated on the basis that the average revision is positive for the final growth rate. Of more importance, however, is whether this apparent bias is statistically significant in the sense that there is a predictable element to the revisions that could be used to forecast final GDP growth. This type of forecast differs from a standard forecast. In this case, the aim is to forecast what the final value of GDP growth will be for a recent time period for which there is already a preliminary GDP figure. A standard forecast would aim to forecast GDP growth for some future periods for which no data are available. The predictability of revisions can be tested using the following regression:

$$R_t = \alpha + \beta X_t^p + v_t$$

where X_t^p is the preliminary announcement of GDP growth for period t and R_t is the revision to this growth rate relative to its

final or true value. The final value is taken to be the GDP series from the vintage before the introduction of chain linking. The basic idea behind the regression is to see if the revision to the growth rate can be forecast using the preliminary announcement. Running the regression above yields

$$R_t = \underset{(0{\cdot}0046)}{0{\cdot}0217} + \underset{(0{\cdot}0727)}{0{\cdot}7326}\, X_t^p$$

Standard errors are in parentheses. The coefficients in the regression are statistically significant meaning that the preliminary announcement can be used to forecast the revision and, accordingly, the final GDP growth rate but these results need to be treated with caution for a couple of reasons. The estimates are based on a relatively small number of vintages and a short span of data, which makes the results tentative from a statistical viewpoint. In addition, the sample of data relates to a period when the economy was booming. This raises questions as to whether the predictive relationship might break down when a turning point in the business cycle is reached, as revisions might reverse sign in this situation.

Another drawback to this approach is that the analysis is based on the full sample of data. The final value used in the forecasting regression would not have been available in real time. To mimic the situation faced in real time, forecasts of final GDP growth are estimated recursively with the data available at each point in time. Although the results are not reported here, it is found that it is still possible to improve upon the preliminary estimate of GDP growth using the forecasting regression in the more restrictive real time setting.

7. Summary and Conclusions

Data from the Quarterly National Accounts provide an important measure of the health of the economy. However, due to standard statistical practices, these data are subject to revision. This introduces a certain degree of uncertainty in terms of assessing the current state of the economy and predicting its future performance. The aim of this paper was to provide an idea of the size of data revisions and to see if there is any way that the data revisions could be predicted.

The paper outlines the construction of a real time database of economic time series for Ireland. The database is used to analyse the properties of revisions to the growth rates of GDP and its expenditure components. The final revision to the growth rate of GDP is found to be 1·5%, equivalent to almost 20% of average GDP growth over the sample. The international evidence available, although not strictly comparable, still suggests that revisions of this magnitude are in fact quite modest. The average

revision is also positive, indicating that initial announcements of GDP growth are generally too pessimistic. The revisions to the growth rates of the GDP expenditure components are larger, even when expressed relative to average growth rates. Finally, it is found that there is a predictable element to GDP growth revisions.

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