

OECD / Statistics Directorate

REVISIONS OF QUARTERLY OUTPUT GAP ESTIMATES FOR 15 OECD MEMBER COUNTRIES

Revisions Analysis: Extension to the Original Release Data and Revisions Database

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1. Introduction

This paper examines the revisions histories of fifteen OECD member countries for the first estimates of the quarterly output gap as published in successive semi-annual issues of the OECD publication: *Economic Outlook* (EO) from EO No. 74, published in December 2003, to EO No. 83, published in June 2008.

It is important to underline that other definitions and approaches to calculate the output gap are possible. In this paper only definitions and estimates presented in the OECD Economic Outlook publications are considered.

It is the first time that a real-time output gap revisions database for 15 OECD member countries, based on the OECD EO output gap estimates, has been created, presented and made publically available. This paper and the real-time quarterly output gap revisions database, which is freely available on the OECD website, responds to users' requests and needs.

The present study focused on the quarterly output gap and countries included are those for which the revisions record is long enough to permit sensible statistical analysis. They are: Australia, Canada, Finland, France, Germany, Ireland, Iceland, Italy, Japan, Netherlands, New Zealand, Norway, Sweden, United Kingdom and the USA.

The available revisions database permits us to analyze the size and direction of the revisions for each country and to perform comparisons across countries. Mainly summary statistics are calculated and presented, while deeper analyses has been previously conducted by the OECD Economic Department (see references). This paper concludes that even though revisions are in general quite large and persistent, preliminary estimates are strongly correlated with the successive ones and are reliable predictors of sign and direction of later estimates.

This paper is organized as follows – Section 2 gives a quick overview of the main concepts used. Section 3 presents the different methods to estimate the business cycle and indicates which one has been undertaken by the OECD. Section 4 presents the MEI real-time and revisions databases and the Economic Outlook publications and database, to introduce the real-time and revisions databases already available on the OECD website and to describe the source of data employed in this analysis. Data availability is explained in section 5, while section 6 contains information about the organization of the real-time revision database. Main and summary results for the revision analysis are presented in section 7, 8 and 9. More detailed information on the revision process is presented in the annex.

2. The Business Cycle and the Output Gap

The output gap, as defined by the OECD in the Economic Outlook, is the difference between actual Gross Domestic Product (GDP) and potential GDP as a percent of potential GDP. Potential GDP is the level of output that an economy can produce at a constant inflation rate. However an economy can temporarily produce more than its potential level of output at the cost of creating inflationary pressures. So, while we understand that GDP is compiled according to international guidelines (i.e. SNA93) and is therefore observed the same cannot be said for potential GDP. Not only is the methodology for estimating potential GDP open to discussion with the estimate itself usually depending on the estimate of capital

stock, the potential labour force (which in turn depends on the demographic factors and on the participation rates), the estimate for NAIRU (non-accelerating inflation rate of unemployment or structural rate of unemployment) and the level of labour efficiency.

The output gap is linked to the concepts of 'capacity' and 'demand/supply'. When actual output exceeds the economy's potential, the output gap is positive and, when actual output is below potential output, the output gap is negative. A positive output gap is also referred to as excess demand, while a negative to as excess supply. Therefore in theory when spending in the economy is high in relation to capacity (positive output gap), this tends to put upward pressure on prices and, accordingly inflation will also tend to rise.

The output gap is then a measure of demand/supply imbalances and it can be used as an indicator of the economic cycle. The level and direction of the movement of the output gap may provide indications about prospective inflationary pressures in product markets and, then, it is an important element in defining monetary policies and structural fiscal balances.

It can be understood that the output gap is often subject to considerable revision over time. This is due to the fact that as for any measure of the business cycle potential activity, which is, in this case potential output or potential GDP as a target variable is unobservable (in other words an estimate that can never be fully tested). So the measure of the gap between actual (also subject to an ongoing revision process) and potential output: is not well defined, sensitive to the choice of the estimation technique, and also sensitive to the available dataset – and therefore itself often subject to considerable revision over time. However uncertainty about the size and the movements of the output gap is not the only one which policymakers have to face and it doesn't imply that the output gap and the potential output estimates are not useful, because they still contain information, even if measured with error.

3. Measuring the Business Cycle - Different Approaches an Introduction

As already mentioned, the choice of the approach to estimate the potential output (and NAIRU) is an important point, because potential output and output gap cannot be directly observed, so estimates have to be inferred from the data. In this section a brief and general introduction on different estimation methods developed to measure the business cycle is presented. This part refers to Koske and Pain (2008) and to the OECD Economic Outlook No. 82.

Many methods have been developed and, broadly speaking, they can be divided into two categories: univariate approaches, which rely exclusively on information about GDP to derive potential output, and multivariate structural approaches, which seek to incorporate additional information from other variables.

Univariate approaches determine the cyclical position of the economy on purely statistical grounds, decomposing real GDP (or the unemployment rate in the case of the NAIRU) into permanent and transitory components. Examples include linear and non-linear de-trending methods, the Hodrick-Prescott (HP) filter, the Baxter-King band-pass filter and the Beveridge-Nelson decomposition. Multivariate approaches put more structure behind the derivation of potential output (NAIRU) by taking into account its relationship with other macroeconomic (labour market) variables. Examples include the

multivariate HP filter, multivariate unobserved component models, the production function approach and structural VAR models. Univariate and multivariate methods need not to be mutually exclusive – some of the multivariate methods use filtered series as inputs for estimation (Koske and Pain, 2008).

The output gap estimates published by the OECD and other international organizations such as the European Commission are constructed using estimates of potential output, which is derived using the production function method¹. This method is described in Giorno *et al.* “Potential Output, Output gaps and Structural Budget Balances” OECD Economic Studies, No. 24, 1995/1.²

4. The Original Release Data and Revisions Database, and the Economic Outlook

As with all compilation of statistics there is naturally a trade-off between timeliness and the availability of full information. In compiling the output gap and like any national statistics office, the OECD publishes first released output gap data on a preliminary basis to satisfy user needs for timely information, at a later period these preliminary estimates (versions) are then revised to incorporate information that was not available at the time of the earlier release. Revisions analysis is an approach to assess the quality of this process.

The ‘Original Release Data and Revisions Database’ (<http://stats.oecd.org/mei/default.asp?rev=1>) provides free access to time series data for 21 key economic variables (full list in box below) as originally published in each monthly edition of the MEI from February 1999 onwards. This real-time database enables economists to perform real-time data analysis of econometric models and statisticians to study the magnitude and direction of subsequent revisions to published statistics. Data are available for all OECD countries, selected area aggregations, and the major non-member economies with automated programs to perform revisions analysis provided. The OECD has performed detailed revision analyses for: Gross Domestic Product, Index of Industrial Production and Retail Trade Volume.

¹ The structural rate of unemployment (the NAIRU) is obtained from a multivariate model of price inflation in which structural unemployment is treated as an unobserved component to be estimated.

² Using this methodology two broad changes have been made to the calculation of potential output since the OECD Economic Outlook No.82. First the “smoothing parameter” applied in the calculations has been standardized across OECD member countries. Second, as previously the case for the major seven economies only, the calculations now incorporate trend working hours for other member economies also. See also OECD Economic Outlook Sources and Methods (<http://www.oecd.org/eco/sources-and-methods>).

Real-time revisions data is available for the following short-term economic variables:

- GDP, Total and Expenditure Components
- Index of Industrial Production
- Production in Construction
- Composite Leading Indicators
- Retail Trade Volume
- Consumer Price Index
- Standardised Unemployment Rates
- Civilian Employment
- Hourly Earnings in Manufacturing
- Monetary Aggregates – Broad Money
- International Trade in Goods
- Balance of Payments – Current Account Balance

The introduction of output gap revision analysis is a real forward step in the ongoing OECD project on revision analysis. Output gap estimates are taken from the OECD Economic Outlook (EO) twice a year; June and December. The EO analyses the major economic trends over the coming two or three years and provides in-depth coverage of the main economic policy issues and the policy measures required to foster growth in each member country. Furthermore, it evaluates in detail forthcoming developments in major non-OECD economies.

The EO database contains yearly and seasonally-adjusted quarterly macroeconomic historical data and data for the projection period³. The data subjects covered include: expenditures, foreign trade, output, employment, unemployment, interest rates, exchange rates, the balance of payments, outlays and revenues of government, and the households and government debt.⁴

5. Output Gap Data Availability

The output gap was published for the first time in 1995 in the OECD Economic Outlook No. 60, with at that time only annual and semi-annual data being available. Quarterly output gap estimates were published with the annual and semi-annual estimates in autumn 2003, in OECD Economic Outlook No. 74. After this publication (from the OECD EO No. 75 to present) data have been published on an annual and quarterly base (see table 1).

³ For the projection period quarterly data are available for the G7 countries and the OECD regions, while yearly data are available for all OECD member countries and non-OECD regions. Variables are defined in such a way that they are as homogeneous as possible over the countries; breaks in the series are corrected as far as possible. Sources for the historical data are publications of national statistical agencies and OECD Statistical publications such as Annual and Quarterly National Accounts, Annual Labour Force Statistics and Main Economic Indicators.

⁴ For the non-OECD regions foreign trade and current account series are available.

Table 1: The OECD Economic Outlook (EO) editions containing output gap estimates used in this study

Country/Data frequency	EO Number				# Total EO editions	# Quarterly EO editions	Comment
	A	A+S	A+S+Q	A+Q			
AUS, CAN, FIN, FRA, DEU, IRL, ITA, JPN, NLD, NOR, SWE, GBR, USA	60-65	66-73	74	75-83	24	10	
NZL	61-65	66-73	74	75-83	23	10	No Data EO60
ISL		67-73	75	75-83	17	10	No data EO60-66
CZE				78-83	6	6	No data EO60-77
AUT	60-65 76-83	66-73	74	75	24	1	
DNK	60-65 75-80	66-74		81-83	24	3	
GRC	60-65 76-83	66-74		75	24	1	
POL				82-83	2	2	No data EO60-81
BEL, CHE, ESP, PRT	60-65 75-83	66-74			24		
HUN, LUX	78-83				6		No data EO60-77
KOR, MEX, SVK, TUR							No data

Legend: A-Annual, S-Semi annual, Q-Quarterly

Table 1 shows how different data frequency (annual, semi-annual and quarterly) are allocated among the OECD EO publications containing output gap data and across countries. The table also summarizes how many OECD EO publications are available for each country and which ones contain quarterly data. Countries are sorted in descending order by number of OECD EO publications with quarterly data available.

The created real-time revision database then considers output gap data starting from OECD EO No. 74, which is when quarterly data became available. The possibility to link quarterly to semi-annual data has been investigated, but the estimation method to calculate semi-annual data is so different across countries that it makes it virtually impossible to link semi-annual to quarterly data. The OECD Economic Department has previously calculated some backward projections and calculates forward projections. Forward projections can be of 2 or 3 years and their length can vary over time. Backward projections have been calculated for some countries with output gap data, however due to the time pasted and lack of metadata it is impossible to identify these countries and data in order to separate estimates from projections.

Considering all the available data, for many countries time series go back to 1970Q1. The countries considered in this paper were those for which estimates are available at least 3 years after the first one: Australia, Canada, Finland, France, Germany, Ireland, Iceland, Italy, Japan, Netherlands, New Zealand, Norway, Sweden, United Kingdom and the USA. Moreover, by including Germany⁵, 1991Q1 estimate will be considered as the starting point of the revision analysis. See table 2 for more details.

⁵ Germany (code DEU) was created on 3 October 1990 by the ascension of the Democratic Republic of Germany to the then Federal Republic of Germany (DEW).

Table 2: Data and revisions availability for the quarterly output gap in the OECD EO database used in this study

Country	Data		Revision
	EO Editions	Starting vintage	Starting vintage
Australia (AUS)	74-83	70Q1	70Q1
Canada (CAN)	74-78, 83	66Q1	66Q1
	79-83	66Q2	66Q2(Y3)
Finland (FIN)	74-83	75Q4	75Q4
France (FRA)	83	70Q4	71Q1
	74-82	71Q1	
Germany (DEU)	74-79	70Q1	91Q1
	77-83	91Q1	70Q1(Y1_P)
Iceland (ISL)	74-76	71Q1	77Q2
	77-83	77Q2	71Q1(Y1_P)
Ireland (IRL)	76-82	78Q2	78Q2
	74-75, 83	78Q3	
Italy (ITA)	74-76	63Q1	70Q1
	77-78	65Q1	
	79-82	65Q3	
	83	68Q3	
Japan (JPN)	74-76	70Q1	70Q1
	80-83	70Q1	
	79	72Q1	
	77-78	75Q1	
Netherlands (NLD)	83	70Q1	71Q4
	76-82	71Q4	
	74-75	72Q1	
New Zealand (NZL)	76-78	79Q4	70Q1
	74, 79-83	80Q1	79Q4(Y1_P)
	75	80Q2	
Norway (NOR)	76	65Q4	66Q3(Y1)
	74-75	66Q3	67Q4(Y2)
	77-78	67Q4	77Q4(Y3)
	79-83	77Q4	
Sweden (SWE)	76-80	66Q2	66Q2
	74-75	66Q3	66Q3(Y3)
	81-83	69Q1	
United Kingdom (GBR)	75-78	70Q1	70Q1(Y1_P)
	79-83	70Q4	70Q4
	74	79Q1	
United States (USA)	74-75	67Q1	64Q2
	76-82	64Q2	
	83	65Q2	

Notation: P-First published estimate of the output gap, Y1-Estimate published 1 year later, Y2-Estimate published 2 years later, Y3-Estimate published 3 years later, Y1_P-Revision between Y1 and P.

6. Organisation of the Output Gap Real-Time Revision Database

The detailed results of this analysis are available as a series of two spreadsheets for each country on the OECD website⁶. As was done for the constant price, seasonally adjusted quarter-on-quarter GDP growth rates in 2005 analysis (Di Fonzo, 2005b), data have been organized as suited for the revisions analysis. Using the Australian output gap dataset as an example, the database of the output gap in levels (table 3) of the revisions spreadsheet is extracted (table 4) and then used to calculate summary statistics on revisions for various comparisons as shown in table 5.

Notation used in the rest of the paper:
P: First published estimate of output gap
L: Latest published estimate of output gap (at least 3 years after the first)
Y1: Estimate published 1 year later
Y2: Estimate published 2 years later
Y3: Estimate published 3 years later
Y1_P: Revision between Y1 and P
Y2_P: Revision between Y2 and P
Y3_P: Revision between Y3 and P
L_P: Revision between L and P

Table 3: An excerpt from the output gap revisions database: level estimates

Australian Output Gap, Common sample (Levels).

Relating to period	91 Q1	91 Q2	91 Q3	91 Q4	92 Q1	92 Q2	92 Q3	92 Q4	93 Q1	93 Q2	93 Q3	93 Q4	94 Q1	94 Q2
First estimate	-3.9	-4.9	-5.7	-5.8	-5.4	-5.7	-5.4	-4.4	-3.6	-3.7	-4.6	-3.1	-2.3	-1.8
1 year later	-4.4	-5.4	-6.0	-6.4	-5.9	-6.1	-5.5	-4.6	-3.8	-4.0	-4.7	-3.5	-2.4	-2.0
2 years later	-4.6	-5.6	-6.1	-6.4	-6.0	-6.1	-5.7	-4.6	-3.9	-4.1	-4.8	-3.5	-2.5	-2.1
3 years later	-4.0	-5.0	-5.6	-5.9	-5.6	-6.1	-5.5	-4.6	-4.1	-4.2	-5.1	-3.8	-2.8	-2.6
Latest estimate	-1.3	-2.2	-2.8	-3.2	-2.9	-3.3	-3.0	-2.1	-1.6	-1.9	-2.8	-1.7	-0.8	-0.8
EO74_Dec03	-3.9	-4.9	-5.7	-5.8	-5.4	-5.7	-5.4	-4.4	-3.6	-3.7	-4.6	-3.1	-2.3	-1.8
EO75_Jun04	-3.3	-4.5	-5.1	-5.4	-5.0	-5.3	-4.7	-3.8	-3.1	-3.3	-4.0	-2.7	-1.7	-1.3
EO76_Dec04	-4.4	-5.4	-6.0	-6.4	-5.9	-6.1	-5.5	-4.6	-3.8	-4.0	-4.7	-3.5	-2.4	-2.0
EO77_Jun05	-4.5	-5.5	-6.1	-6.4	-6.0	-6.1	-5.6	-4.6	-3.9	-4.0	-4.8	-3.5	-2.5	-2.1
EO78_Dec05	-4.6	-5.6	-6.1	-6.4	-6.0	-6.1	-5.7	-4.6	-3.9	-4.1	-4.8	-3.5	-2.5	-2.1
EO79_Jun06	-4.5	-5.4	-6.1	-6.5	-6.1	-6.6	-6.0	-5.1	-4.6	-4.7	-5.5	-4.3	-3.3	-2.9
EO80_Dec06	-4.0	-5.0	-5.6	-5.9	-5.6	-6.1	-5.5	-4.6	-4.1	-4.2	-5.1	-3.8	-2.8	-2.6
EO81_Jun07	-4.2	-5.0	-5.7	-6.2	-5.8	-6.2	-5.8	-4.8	-4.3	-4.4	-5.2	-4.0	-3.0	-2.7
EO82_Dec07	-4.2	-5.0	-5.6	-6.1	-5.8	-6.2	-5.8	-4.8	-4.3	-4.4	-5.2	-4.1	-3.0	-2.8
EO83_Jun08	-1.3	-2.2	-2.8	-3.2	-2.9	-3.3	-3.0	-2.1	-1.6	-1.9	-2.8	-1.7	-0.8	-0.8

⁶ http://www.oecd.org/document/1/0,3343,en_2649_34245_41054465_1_1_1_1,00.html

Table 4: An excerpt from the output gap revisions database: Revisions spreadsheet

Australian Output Gap, Revisions spreadsheet.

Relating to Period	First estimate	Estimate published 1 year later	Estimate published 2 years later	Estimate published 3 years later	Latest estimate	Latest estimate published at least 3 years later
1999Q3	2.0	1.0	1.0	0.7	0.1	0.1
1999Q4	2.2	1.5	1.8	1.6	0.6	0.6
2000Q1	1.5	1.3	1.4	1.5	0.7	0.7
2000Q2	2.2	1.9	2.0	1.9	1.0	1.0
2000Q3	1.3	1.1	1.4	1.2	0.3	0.3
2000Q4	-0.2	-0.4	0.0	-0.7	-1.4	-1.4
2001Q1	-0.1	-0.2	0.0	-0.4	-1.4	-1.4
2001Q2	0.2	0.3	0.4	-0.4	-1.4	-1.4
2001Q3	0.4	0.6	0.8	-0.2	-1.1	-1.1
2001Q4	0.9	0.9	1.1	0.1	-0.7	-0.7
2002Q1	0.4	0.8	1.0	0.2	-0.7	-0.7
2002Q2	0.3	1.0	1.4	0.5	-0.2	-0.2
2002Q3	0.4	1.1	1.5	0.7	-0.2	-0.2
2002Q4	-0.1	0.4	1.1	0.1	-0.6	-0.6
2003Q1	-0.3	0.4	1.2	0.2	-0.4	-0.4
2003Q2	-1.2	-0.3	0.5	-0.6	-0.8	-0.8
2003Q3	0.5	1.0	0.8	0.4	-0.1	-0.1
2003Q4	0.9	1.7	1.4	1.3	0.8	0.8
2004Q1	0.5	1.2	0.6	0.8	0.6	0.6
2004Q2	0.3	0.9	0.1	0.5	0.4	0.4
2004Q3	0.1	0.3	0.2	0.4	0.4	0.4
2004Q4	-0.8	0.0	-0.2	0.0	0.0	0.0
2005Q1	-0.2	-0.8	-0.3		0.0	
2005Q2	0.1	-0.2	0.4		0.7	
2005Q3	-0.3	0.2	0.5		0.5	
2005Q4	-0.7	-0.1	0.6		0.6	
2006Q1	-0.9	-0.4			0.2	
2006Q2	-1.4	-0.8			0.0	
2006Q3	-1.1	-0.2			-0.2	
2006Q4	-0.9	0.0			0.0	
2007Q1	0.0				0.6	
2007Q2	0.1				0.8	
2007Q3	1.1				1.1	
2007Q4	0.9				0.9	

Table 5: An excerpt from the output gap revisions database: Summary statistics⁷

Australian Output Gap, Common Sample, Comparisons

Summary statistics	Y1_P	Y2_P	Y3_P	L_P	Y2_Y1	Y3_Y2	L_Y3	Y3_Y1
Sample	91.1-06.4	91.1-05.4	91.1-04.4	91.1-04.4	91.1-05.4	91.1-04.4	91.1-04.4	91.1-04.4
n	64	60	56	56	60	56	56	56
Mean absolute revision	0.437	0.494	0.570	1.159	0.223	0.442	1.124	0.385
Mean revision (Rbar)	-0.076	-0.079	-0.437	0.098	0.049	-0.310	0.534	-0.294
Standard dev(Rbar) - HAC formula	0.111	0.125	0.108	0.316	0.057	0.091	0.304	0.066
Mean squared revision	0.253	0.370	0.454	1.949	0.093	0.276	2.031	0.190
Relative mean absolute revision	0.258	0.266	0.297	1.104	0.120	0.230	1.070	0.201
t-stat	-0.683	-0.637	-4.059	0.308	0.863	-3.402	1.758	-4.432
t-crit	1.998	2.001	2.004	2.004	2.001	2.004	2.004	2.004
Is mean revision significant?	NO	NO	YES	NO	NO	YES	NO	YES
Correlation	0.975	0.969	0.974	0.891	0.992	0.987	0.916	0.992
Min Revision	-1.0	-1.0	-1.4	-1.9	-0.8	-1.2	-1.0	-0.8
Max Revision	1.0	1.7	0.7	3.0	0.8	0.6	2.8	0.5
Range	1.9	2.7	2.1	4.9	1.6	1.8	3.8	1.3
% Later > Earlier	31.3	33.3	21.4	42.9	43.3	21.4	50.0	19.6
% Sign(Later) = Sign(Earlier)	90.6	86.7	87.5	82.1	90.0	87.5	87.5	91.1
Variance of Later estimate	4.962	5.668	4.987	1.153	5.668	4.987	1.153	4.987
Variance of Earlier estimate	4.508	4.803	5.114	5.114	5.262	5.946	4.987	5.581
UM %	2.26	1.70	42.00	0.49	2.57	34.81	14.05	45.52
UR %	0.94	3.53	1.64	87.30	5.05	19.73	76.83	11.48
UD %	96.80	94.77	56.36	12.21	92.38	45.46	9.12	43.00

⁷ See Di Fonzo (2005 b) page. 28-29 for the definitions of UM, UR and UD.

7. Main Results

The main results on the size of revisions to the first estimate of quarterly output gap as published on successive issues of EO from December 2003 to June 2008 are presented in this section. The results show the preliminary estimates of the output gap of a particular quarter are highly correlated with subsequent estimates for the same period. The correlation is never below 0.75, when considering revisions to the first estimate, or 0.78, when considering revisions of subsequent estimates, and it can be higher than 0.99. However revisions are often, on average, statistically significant, which means that they are seldom random.

Table 6: Correlations of revisions to the first estimate

To the first estimates	1 year later	2 years later	3 years later	Latest
AUS	0.98	0.97	0.97	0.89
CAN	0.97	0.99	0.96	0.98
DEU	0.94	0.75	0.75	0.78
FIN	0.99	0.99	0.98	0.98
FRA	0.94	0.96	0.96	0.94
GBR	0.97	0.97	0.96	0.92
IRE	0.90	0.89	0.95	0.93
ISL	0.78	0.78	0.83	0.85
ITA	0.83	0.80	0.83	0.91
JPN	0.96	0.95	0.94	0.94
NLD	0.98	0.98	0.91	0.86
NOR	0.95	0.93	0.93	0.93
NZL	0.99	0.99	0.98	0.98
SWE	0.93	0.94	0.97	0.92
USA	0.89	0.89	0.80	0.76

Table 7: Correlations of revisions of subsequent estimates

Comparison of successive revisions	Y1_P	Y2_Y1	Y3_Y2	L_Y3
AUS	0.98	0.99	0.99	0.92
CAN	0.97	0.99	0.98	0.99
DEU	0.94	0.87	0.99	0.99
FIN	0.99	1.00	0.99	0.99
FRA	0.94	0.94	0.94	0.90
GBR	0.97	0.99	0.98	0.93
IRE	0.90	0.98	0.99	0.98
ISL	0.78	0.97	0.89	0.94
ITA	0.83	0.97	0.96	0.95
JPN	0.96	0.99	0.96	0.99
NLD	0.98	0.99	0.97	0.91
NOR	0.95	0.99	0.99	0.99
NZL	0.99	1.00	0.99	0.99
SWE	0.93	1.00	0.98	0.95
USA	0.89	1.00	0.95	0.99

The output gap is, in general, subject to quite sizable and persistent revisions over time, which is understandable given its difficulty to define, measure, and calculate. These results are consistent with previous analyses made by Koske and Pain (2008) on real-time annual revisions of output gap for 21 OECD member countries; by Orphanides and Van Norden (2002) and by Bernhardsen *et al.* (2004), who examine data revisions to output gap estimates for the USA and Norway respectively; and by Cunningham and Jeffrey (2007) with estimates of GDP growth in the UK.

All of these studies conclude that revisions are large and persistent. However revisions from successive estimates are usually smaller than revisions to preliminary estimates. Mean absolute revisions of quarterly output gap are presented in a graphical form for revisions to the preliminary estimate and of subsequent estimates in figure 1 and 2. The United Kingdom always shows small revisions, while Ireland and Iceland tend to show the highest values. However for Iceland, the Y3_Y2, revisions are not statistically significant.

Figure 1: Revisions to the first estimate of the quarterly output gap in EO. Mean absolute revision

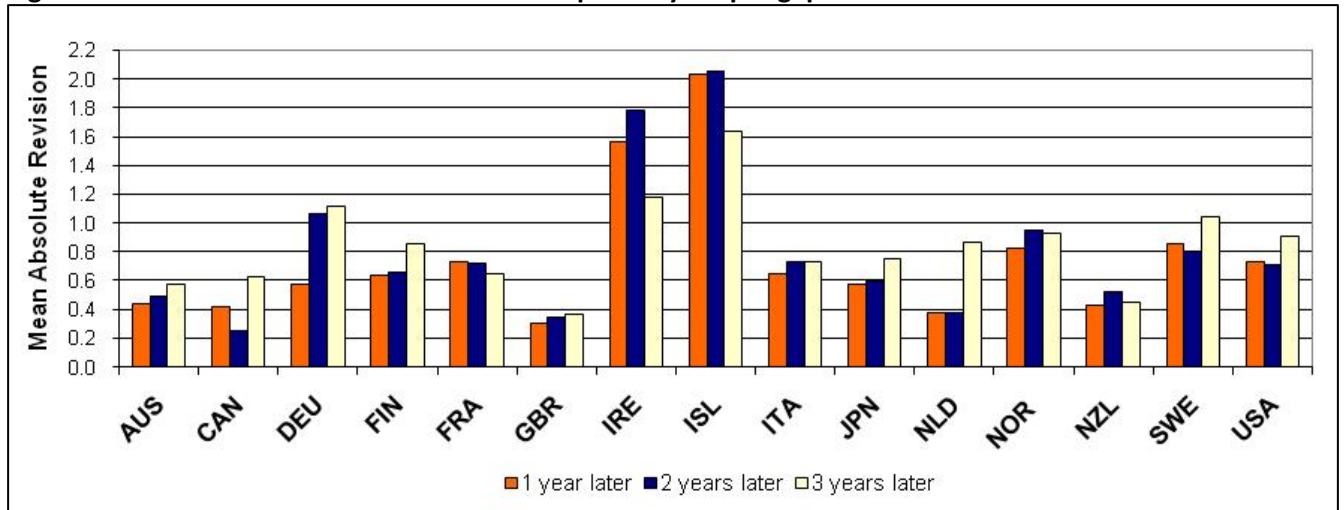
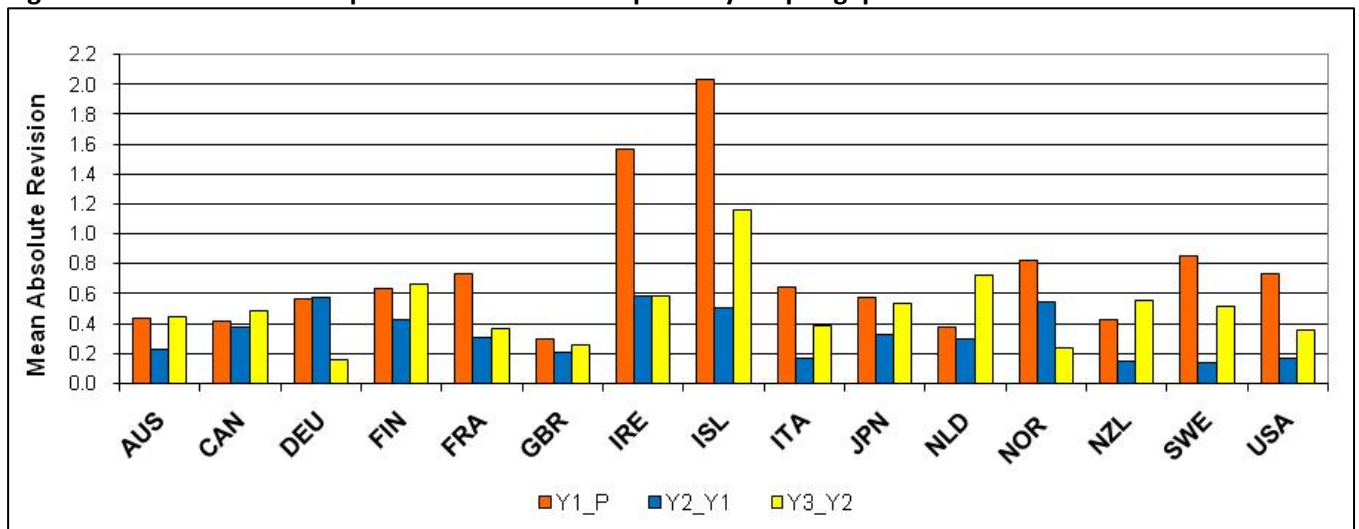
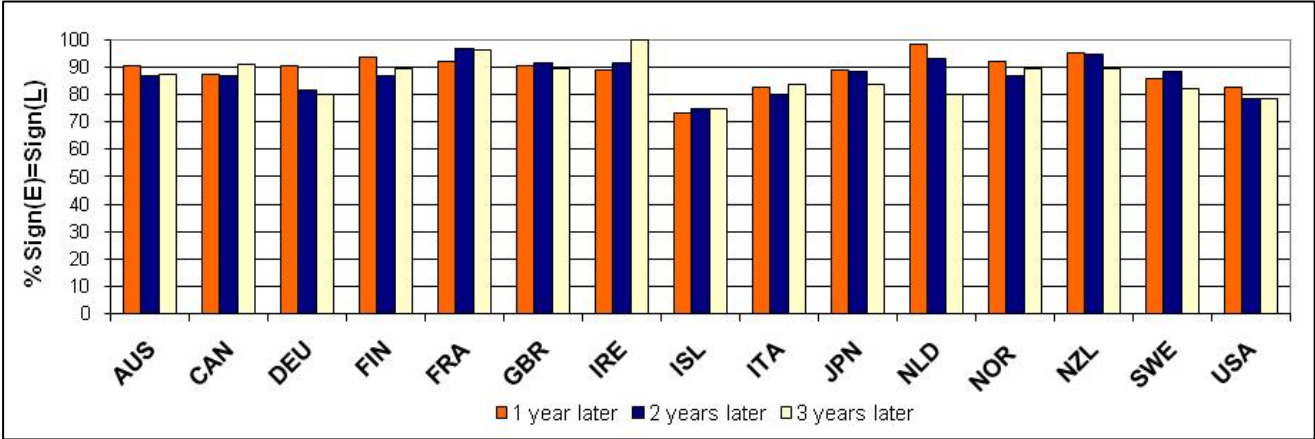


Figure 2: Revisions of subsequent estimates of the quarterly output gap in EO. Mean absolute revision



Nevertheless the preliminary estimates of the level of the output gap are reliable indicators of the direction of the output gap. For almost all the countries, in more than 80% of the available observations the sign of the preliminary estimate of the output gap in a particular year is the same as the revised estimate for that year published one, two or three years later. This can be seen in figure 3, where the statistic “% of Sign(E)=Sign(L)” is presented.

Figure 3: Summary indices of revisions to the first published estimates. % of Sign(E)=Sign(L)



In conclusion even though revisions to the output gap are in general quite large and persistent, preliminary estimates are strongly correlated with the successive ones and are reliable predictors of sign and direction of later estimates. This indicates that they may still provide indications about prospective inflationary pressures in product markets and, therefore may be used in defining monetary policies and structural fiscal balances.

These results are consistent with the ones found by Koske and Pain (2008). Further details can be found in the Annex.

8. Summary Results for the Output Gap Revisions Analysis

The statistical indices used to lead the revisions analysis of the quarterly output gap are:

- Mean revision

$$\bar{R} = \frac{1}{n} \sum_{t=1}^n (\underline{L}_t - E_t) = \frac{1}{n} \sum_{t=1}^n R_t$$

where \underline{L}_t is the later estimate, E_t is the earlier estimate, $R_t = \underline{L}_t - E_t$ is the revision and n is the number of observations.

- *Mean absolute revision*

$$MAR = \frac{1}{n} \sum_{t=1}^n |\underline{L}_t - E_t| = \frac{1}{n} \sum_{t=1}^n |R_t|$$

This statistic measures the dimension of the revision R_t . If small it means that there are reliable estimates.

- *Mean squared revision*

$$MSR = \frac{1}{n} \sum_{t=1}^n (\underline{L}_t - E_t)^2 = \frac{1}{n} \sum_{t=1}^n R_t^2$$

It gives information about the “dispersion” of the estimates.

In this analysis a simple and robust approach is used. It is based on the Heteroskedasticity Autocorrelation consistent estimate’s variance proposed by Newey and West (1987) to evaluate the significance of the mean revision calculating a t test, as it has been done previously for GDP q-o-q growth rates.

- *Relative mean absolute revision*

$$RMAR = \frac{\sum_{t=1}^n |\underline{L}_t - E_t|}{\sum_{t=1}^n |\underline{L}_t|} = \frac{\sum_{t=1}^n |R_t|}{\sum_{t=1}^n |\underline{L}_t|}$$

This indicator allows us to assess the relative robustness of two estimates. It measures the proportion of E_t revised in \underline{L}_t .

- $\% \text{Sign}(\underline{L}) = \% \text{Sign}(E)$

It gives information about the percentage of quarters for which the earlier estimate of output gap has the same sign as the later one. Other useful statistics are the range of revisions and the amount of positive and negative revisions.

9. Revisions Analysis of the Output Gap for the 15 Selected OECD Member Countries

Summary indices of the revisions to the first published estimates for the common period (starting quarter: 1991Q1) under analysis are presented in the following tables, while graphs are shown in the Annex. Below are summary indices of revisions to the first published estimates versus estimates 1 year later, 2 years later, 3 years later, and latest estimates.

Table 8: Summary indices of revisions to the first published estimates

Y1_P

<i>Summary statistics</i>	AUS	CAN	DEU	FIN	FRA	GBR	IRE	ISL	ITA	JPN	NLD	NOR	NZL	SWE	USA
sample	91.1-06.4	91.1-06.4	91.1-06.4	91.1-06.4	91.1-06.4	91.1-06.4	91.1-06.4	91.1-06.4	91.1-06.4	91.1-06.4	91.1-06.4	91.1-06.4	91.1-06.4	91.1-06.4	91.1-06.4
n	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64
mean absolute revision	0.4369	0.4200	0.5691	0.6319	0.7342	0.2981	1.5636	2.0351	0.6462	0.5702	0.3769	0.8193	0.4279	0.8504	0.7324
mean revision (Rbar)	-0.0757	-0.2533	0.4524	-0.1997	0.6913	0.1031	-1.1342	-0.5005	0.1320	0.0810	0.1948	-0.5790	0.3551	-0.6642	-0.6640
st. dev(Rbar) - HAC formula	0.1107	0.1081	0.1423	0.1525	0.1017	0.0719	0.3142	0.5830	0.1818	0.1462	0.0870	0.1743	0.0986	0.2141	0.1732
mean squared revision	0.2529	0.2586	0.5569	0.5417	0.7027	0.1166	4.0038	6.6469	0.6131	0.4579	0.2093	1.0352	0.3061	1.4389	0.9539
relative mean absolute revision	0.2582	0.2589	0.3814	0.1633	0.5494	0.2760	0.6273	0.6622	0.5025	0.3304	0.2037	0.3746	0.2254	0.3456	0.5748
t-stat	-0.9834	-2.3438	3.1785	-1.3093	6.8006	1.4330	-3.6101	-0.8585	0.7258	0.5541	2.2384	-3.3213	3.6009	-3.1029	-3.8329
t-crit	1.9983	1.9983	1.9983	1.9983	1.9983	1.9983	1.9983	1.9983	1.9983	1.9983	1.9983	1.9983	1.9983	1.9983	1.9983
Is mean revision significant?	NO	YES	YES	NO	YES	NO	YES	NO	NO	NO	YES	YES	YES	YES	YES
Correlation	0.9750	0.9665	0.9405	0.9897	0.9416	0.9713	0.8993	0.7780	0.8327	0.9583	0.9815	0.9531	0.9858	0.9274	0.8869
Min Revision	-0.9616	-0.9599	-0.5804	-1.7366	-0.5839	-0.8691	-5.0795	-5.0487	-1.1378	-1.8488	-0.4895	-2.7202	-0.2734	-4.0812	-2.0294
Max Revision	0.9619	0.6173	1.5649	1.3623	1.8359	0.6176	4.9285	6.2529	1.9641	1.4474	1.5227	0.8602	1.5023	0.9378	0.3757
Range	1.9235	1.5772	2.1453	3.0989	2.4198	1.4867	10.0080	11.3017	3.1019	3.2962	2.0122	3.5804	1.7757	5.0190	2.4051
% Later > Earlier	31.3	26.6	65.6	42.2	93.8	62.5	17.2	56.3	50.0	68.8	67.2	31.3	75.0	26.6	25.0
% Sign(Later) = Sign(Earlier)	90.6	87.5	90.6	93.8	92.2	90.6	89.1	73.4	82.8	89.1	98.4	92.2	95.3	85.9	82.8
Variance of Later estimate	4.9618	2.8702	2.9791	19.1355	1.7067	1.8054	9.2212	12.0605	1.9336	4.5298	4.6090	6.6002	6.2338	7.0142	1.3442
Variance of Earlier estimate	4.5076	2.9246	2.9375	15.9910	1.9789	1.8676	13.7471	15.8479	1.2230	3.0795	4.2455	4.5809	5.7383	5.4250	2.2609
UM %	2.2630	24.8142	36.7524	7.3615	68.0047	9.1073	32.1275	3.7679	2.8410	1.4322	18.1304	32.3844	41.1890	30.6609	46.2166
UR %	0.9395	2.0468	1.4740	20.1545	4.4411	3.2479	23.8310	24.6139	0.4403	17.6934	1.0382	9.1785	1.4164	1.1208	23.6959
UD %	96.7975	73.1390	61.7735	72.4840	27.5542	87.6448	44.0415	71.6182	96.7187	80.8744	80.8314	58.4372	57.3945	68.2184	30.0874

Y2_P

<i>Summary statistics</i>	AUS	CAN	DEU	FIN	FRA	GBR	IRE	ISL	ITA	JPN	NLD	NOR	NZL	SWE	USA
sample	91.1-05.4	91.1-05.4	91.1-05.4	91.1-05.4	91.1-05.4	91.1-05.4	91.1-05.4	91.1-05.4	91.1-05.4	91.1-05.4	91.1-05.4	91.1-05.4	91.1-05.4	91.1-05.4	91.1-05.4
n	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60
mean absolute revision	0.4941	0.2551	1.0610	0.6604	0.7187	0.3428	1.7778	2.0571	0.7281	0.5946	0.3729	0.9476	0.5199	0.8060	0.7125
mean revision (Rbar)	-0.0794	0.0684	0.7691	0.1285	0.6995	0.2469	-1.2186	-0.6581	0.1558	0.2101	0.0408	-0.2946	0.4547	-0.6916	-0.5644
st. dev(Rbar) - HAC formula	0.1246	0.0686	0.2083	0.1476	0.0969	0.0733	0.2853	0.5356	0.1910	0.1346	0.0972	0.2275	0.0992	0.1794	0.1546
mean squared revision	0.3704	0.1055	1.9673	0.6135	0.7056	0.1861	4.4437	7.1570	0.8014	0.4716	0.2059	1.4881	0.4303	1.3134	0.8258
relative mean absolute revision	0.2662	0.1498	0.7844	0.1707	0.6004	0.3317	0.6005	0.6354	0.5406	0.3556	0.2087	0.3926	0.2486	0.3170	0.5579
t-stat	-0.6372	0.9960	3.6932	0.8706	7.2199	3.3685	-4.2709	-1.2289	0.8155	1.5609	0.4201	-1.2945	4.5846	-3.8545	-3.6508
t-crit	2.0010	2.0010	2.0010	2.0010	2.0010	2.0010	2.0010	2.0010	2.0010	2.0010	2.0010	2.0010	2.0010	2.0010	2.0010
Is mean revision significant?	NO	NO	YES	NO	YES	YES	YES	NO	NO	NO	NO	NO	YES	YES	YES
Correlation	0.9685	0.9879	0.7543	0.9869	0.9635	0.9680	0.8935	0.7787	0.8043	0.9461	0.9755	0.9281	0.9851	0.9372	0.8942
Min Revision	-0.9705	-0.3897	-5.4516	-1.7134	-0.2151	-0.5837	-4.7120	-5.6426	-1.1555	-1.6356	-0.6599	-3.5031	-0.2461	-3.7658	-1.8638
Max Revision	1.7453	0.7664	2.6623	1.6144	1.5633	0.8326	6.1081	6.8580	2.0829	1.2634	1.0390	1.8381	1.4307	0.7486	0.5975
Range	2.7158	1.1561	8.1139	3.3278	1.7783	1.4163	10.8201	12.5006	3.2384	2.8990	1.6989	5.3412	1.6767	4.5144	2.4613
% Later > Earlier	33.33	48.33	83.33	55.00	91.67	68.33	16.67	45.00	50.00	71.67	56.67	48.33	75.00	20.00	31.67
% Sign(Later) = Sign(Earlier)	86.67	86.67	81.67	86.67	96.67	91.67	91.67	75.00	80.00	88.33	93.33	86.67	95.00	88.33	78.33
Variance of Later estimate	5.6679	3.5643	2.3233	18.5189	1.3003	1.7576	12.1701	12.7602	2.1920	4.0018	4.1885	8.1856	6.9619	6.7859	1.4260
Variance of Earlier estimate	4.8026	3.0387	3.1028	15.2772	2.1013	1.9682	14.6448	16.6929	1.2893	3.2606	4.1534	6.0800	5.4930	2.3664	
UM %	1.7014	4.4309	30.0700	2.6924	69.3405	32.7728	33.4169	6.0521	3.0282	9.3623	0.8092	5.8306	48.0489	36.4218	38.5796
UR %	3.5292	14.0772	19.0247	18.6577	17.4507	7.6906	11.3414	23.7638	0.3809	1.5996	0.8363	17.9010	4.1408	0.7263	26.8077
UD %	94.7694	81.4919	50.9053	78.6499	13.2087	59.5366	55.2416	70.1841	96.5908	89.0381	98.3545	76.2685	47.8103	62.8519	34.6126

Y3_P

<i>Summary statistics</i>	AUS	CAN	DEU	FIN	FRA	GBR	IRE	ISL	ITA	JPN	NLD	NOR	NZL	SWE	USA
sample	91.1-04.4	91.1-04.4	91.1-04.4	91.1-04.4	91.1-04.4	91.1-04.4	91.1-04.4	91.1-04.4	91.1-04.4	91.1-04.4	91.1-04.4	91.1-04.4	91.1-04.4	91.1-04.4	91.1-04.4
n	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56
mean absolute revision	0.5697	0.6252	1.1124	0.8565	0.6480	0.3618	1.1805	1.6368	0.7300	0.7468	0.8610	0.9298	0.4471	1.0378	0.9121
mean revision (Rbar)	-0.4366	-0.2024	0.8396	-0.1408	0.6025	0.0363	-0.7908	-0.5002	0.3189	0.4718	-0.6296	-0.4627	0.0215	-1.0189	-0.5959
st. dev(Rbar) - HAC formula	0.1076	0.1652	0.2109	0.2231	0.0971	0.0873	0.2438	0.4389	0.1999	0.1701	0.1673	0.2119	0.1122	0.1132	0.2140
mean squared revision	0.4539	0.5586	2.1164	1.1413	0.5586	0.1802	2.1901	5.4862	0.9243	0.8541	0.9829	1.4377	0.2746	1.4619	1.2488
relative mean absolute revision	0.2967	0.2834	0.8948	0.1929	0.4815	0.2865	0.3844	0.5277	0.5126	0.3951	0.5460	0.3834	0.2388	0.3739	0.6562
t-stat	-4.0593	-1.2249	3.9809	-0.6311	6.2059	0.4161	-3.2439	-1.1397	1.5949	2.7726	-3.7627	-2.1842	0.1920	-9.0043	-2.7847
t-crit	2.0040	2.0040	2.0040	2.0040	2.0040	2.0040	2.0040	2.0040	2.0040	2.0040	2.0040	2.0040	2.0040	2.0040	2.0040
Is mean revision significant?	YES	NO	YES	NO	YES	NO	YES	NO	YES	YES	YES	YES	NO	YES	YES
Correlation	0.9740	0.9583	0.7530	0.9806	0.9609	0.9563	0.9461	0.8276	0.8252	0.9418	0.9145	0.9332	0.9781	0.9654	0.8041
Min Revision	-1.3972	-1.3696	-5.8096	-2.0402	-0.3880	-0.8561	-4.0194	-5.9833	-0.8615	-1.4211	-1.6386	-3.4061	-1.1758	-1.3350	-2.0569
Max Revision	0.7275	0.8965	2.7970	3.2449	1.4376	0.8307	4.3371	6.0390	2.2643	2.2382	1.5839	1.3771	0.9937	0.3520	0.9670
Range	2.1247	2.2661	8.6066	5.2851	1.8256	1.6868	8.3565	12.0223	3.1258	3.6593	3.2224	4.7832	2.1695	3.4870	3.0239
% Later > Earlier	21.43	41.07	89.29	39.29	89.29	51.79	19.64	57.14	46.43	75.00	19.64	37.50	55.36	5.36	32.14
% Sign(Later) = Sign(Earlier)	87.50	91.07	80.36	89.29	96.43	89.29	100.00	75.00	83.93	83.93	80.36	89.29	89.29	82.14	78.57
Variance of Later estimate	4.9868	4.9201	1.9953	21.0377	1.6566	1.9768	12.7089	10.5529	2.5169	5.0392	3.1751	7.9955	5.8743	6.2364	1.6082
Variance of Earlier estimate	5.1138	3.1864	3.2523	15.5073	2.2471	2.0853	14.8510	16.5747	1.3672	3.4811	3.5622	4.8450	6.3140	5.7986	2.5284
UM %	41.9963	7.3337	33.3075	1.7367	64.9777	0.7330	28.5529	4.5601	11.0011	26.0571	40.3339	14.8932	0.1689	71.0153	28.4347
UR %	1.6406	20.7737	25.8626	27.4567	12.3110	5.4947	10.5620	34							

L_P

Summary statistics	AUS	CAN	DEU	FIN	FRA	GBR	IRE	ISL	ITA	JPN	NLD	NOR	NZL	SWE	USA
sample	91.1-04.4	91.1-04.4	91.1-04.4	91.1-04.4	91.1-04.4	91.1-04.4	91.1-04.4	91.1-04.4	91.1-04.4	91.1-04.4	91.1-04.4	91.1-04.4	91.1-04.4	91.1-04.4	91.1-04.4
n	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56
mean absolute revision	1.1592	0.5005	1.2600	0.8949	1.4314	0.7766	1.0251	1.5798	0.6200	0.9370	1.0698	1.2684	0.4536	0.7921	0.9339
mean revision (Rbar)	0.0975	0.0339	0.9912	0.7454	1.4314	0.7270	-0.6308	-0.7348	0.5540	0.7725	-0.7260	-0.9377	-0.0515	-0.0808	-0.3435
st. dev(Rbar) - HAC formula	0.3162	0.1299	0.1977	0.1414	0.1239	0.1496	0.3016	0.3846	0.1152	0.1461	0.2204	0.2682	0.1294	0.1972	0.2358
mean squared revision	1.9494	0.3221	2.2916	1.1050	2.3517	0.9773	2.5616	5.2444	0.6236	1.1012	1.4941	2.5937	0.3774	0.9224	1.1870
relative mean absolute revision	1.1035	0.2408	1.1926	0.2476	1.3699	0.9524	0.3995	0.5168	0.5135	0.5336	0.6742	0.4849	0.2590	0.4021	0.7445
t-stat	0.3085	0.2609	5.0125	5.2709	11.5490	4.8585	-2.0913	-1.9104	4.8109	5.2873	-3.2941	-3.4960	-0.3982	-0.4096	-1.4563
t-crit	2.0040	2.0040	2.0040	2.0040	2.0040	2.0040	2.0040	2.0040	2.0040	2.0040	2.0040	2.0040	2.0040	2.0040	2.0040
Is mean revision significant?	NO	NO	YES	YES	YES	YES	YES	NO	YES	YES	YES	YES	NO	NO	NO
Correlation	0.8909	0.9806	0.7760	0.9823	0.9378	0.9224	0.9330	0.8492	0.9108	0.9437	0.8616	0.9267	0.9751	0.9183	0.7611
Min Revision	-1.9446	-0.9322	-5.7399	-1.5887	0.4930	-0.3884	-4.8828	-5.9389	-0.6869	-0.9962	-2.1055	-4.0633	-1.4562	-2.8558	-1.9194
Max Revision	2.9689	0.9547	2.5901	2.7761	2.5561	2.1328	3.3808	6.0390	1.6545	2.1906	1.7067	1.1017	1.6390	1.7889	1.4427
Range	4.9134	1.8869	8.3301	4.3648	2.0630	2.5213	8.2636	11.9779	2.3414	3.1868	3.8122	5.1650	3.0952	4.6447	3.3621
% Later > Earlier	42.86	48.21	89.29	85.71	100.00	82.14	25.00	46.43	83.93	85.71	26.79	28.57	44.64	44.64	46.43
% Sign(Later) = Sign(Earlier)	82.14	87.50	75.00	89.29	87.50	83.93	94.64	71.43	89.29	82.14	80.36	89.29	89.29	83.93	80.36
Variance of Later estimate	1.1534	4.8210	1.6253	14.4030	1.5059	0.9232	9.6374	10.0368	1.8339	4.4583	3.4134	9.3333	4.8237	4.5204	1.6441
Variance of Earlier estimate	5.1138	3.1864	3.2523	15.5073	2.2471	2.0853	14.8510	16.5747	1.3672	3.4811	3.5622	4.8450	6.3140	5.7986	2.5284
UM %	0.4880	0.3567	42.8693	50.2818	87.1267	54.0836	15.5346	10.2944	49.2151	54.1991	35.2730	33.8970	0.7033	0.7075	9.9381
UR %	87.3044	42.0344	28.9191	3.9896	5.1560	31.8305	35.7657	36.3513	0.6601	1.4582	5.8489	15.3054	36.4959	22.5010	31.7826
UD %	12.2077	57.6089	28.2116	45.7286	7.7172	14.0859	48.6997	53.3543	50.1247	44.3427	58.8781	50.7977	62.8008	76.7916	58.2793

ANNEX

A1. Summary indices of revisions

Figure 4: Summary indices of revisions to the first published estimates. Mean revision

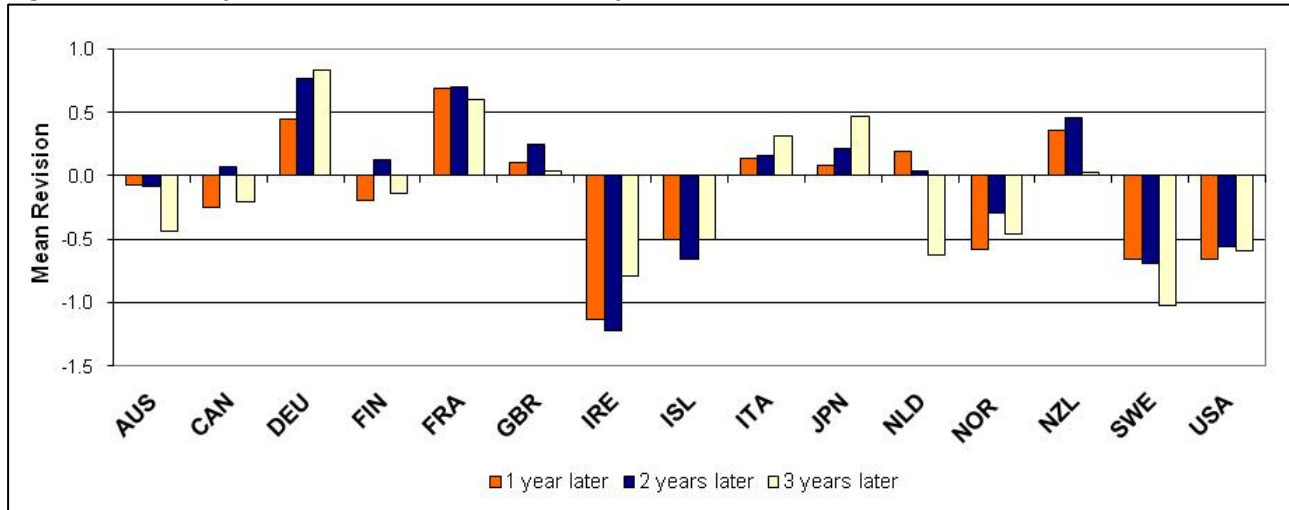


Figure 5: Summary indices of revisions to the first published estimates. Mean absolute revision

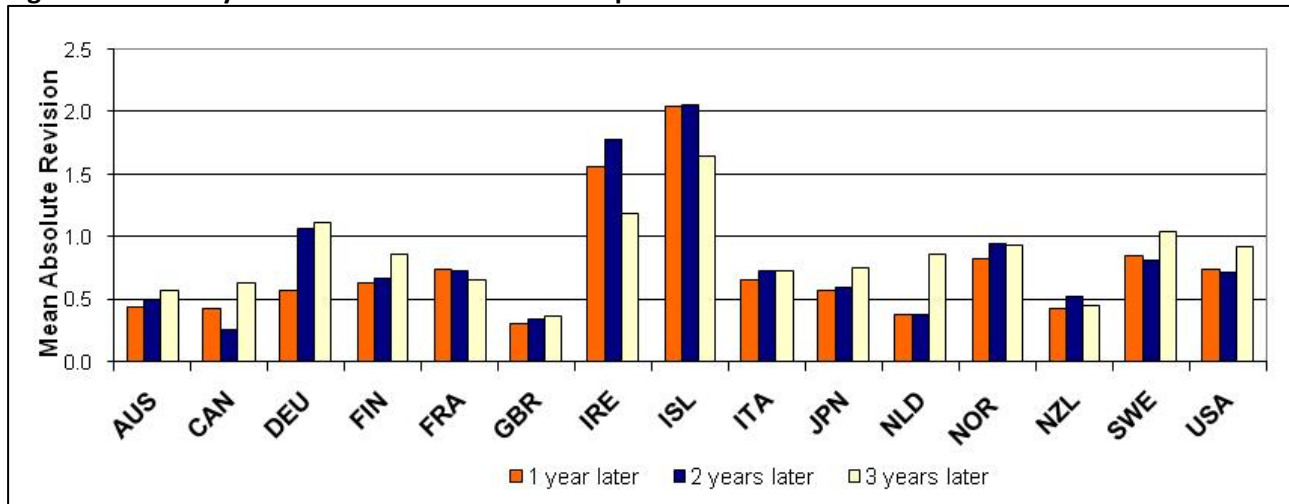


Figure 6: Summary indices of revisions to the first published estimates. Mean squared revision

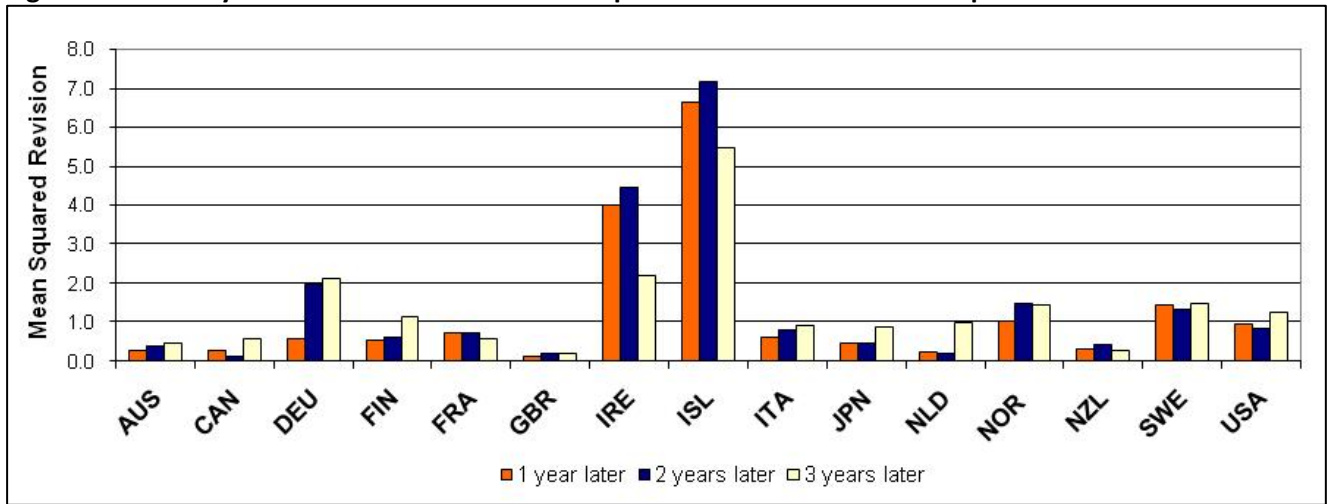


Figure 7: Summary indices of revisions to the first published estimates. Relative mean absolute revision

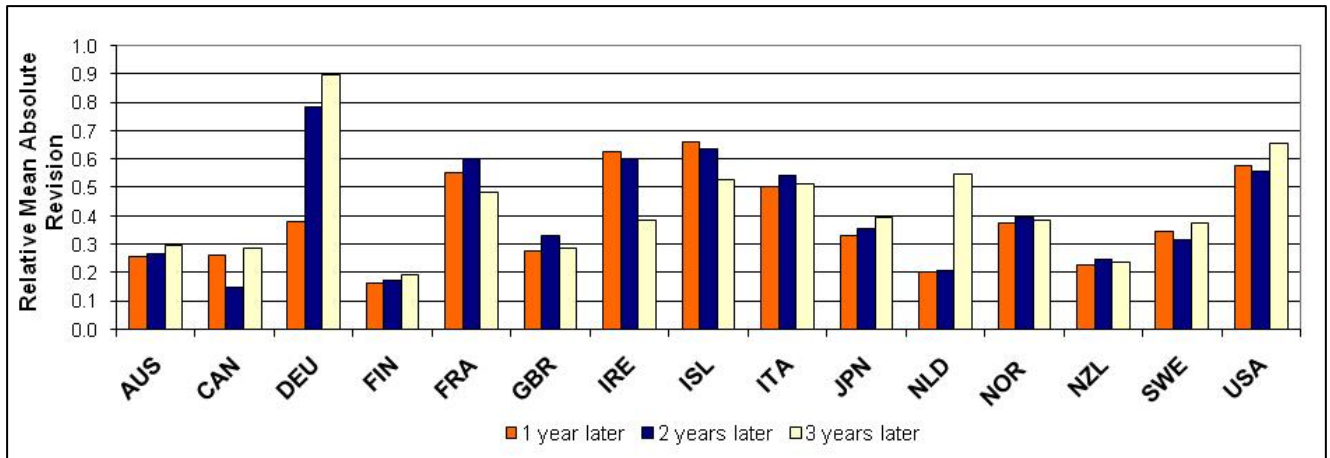


Figure 8: Summary indices of revisions to the first published estimates. % of sign(E)=sign(L)

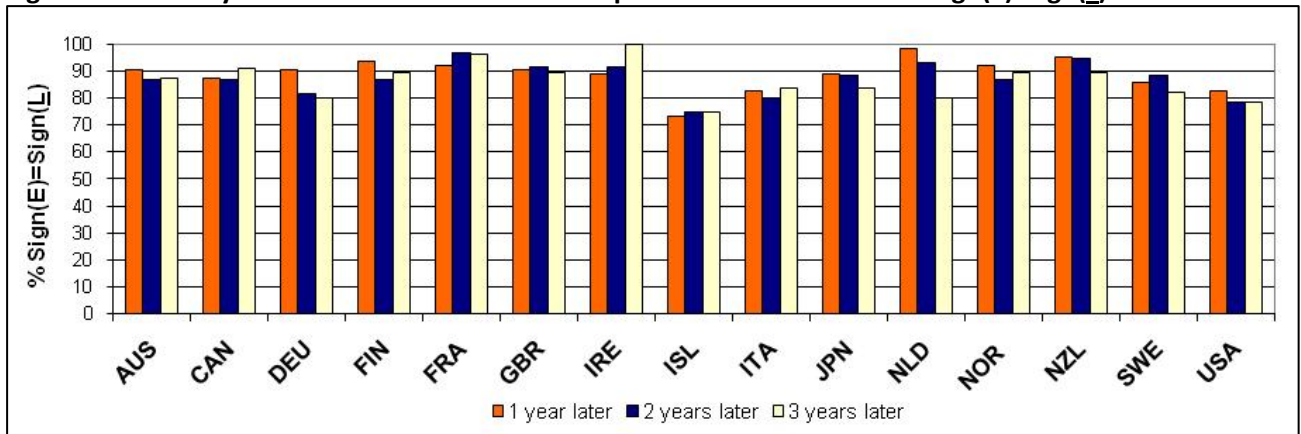


Figure 9: Summary indices of revisions to the first published estimates. % of $L > E$

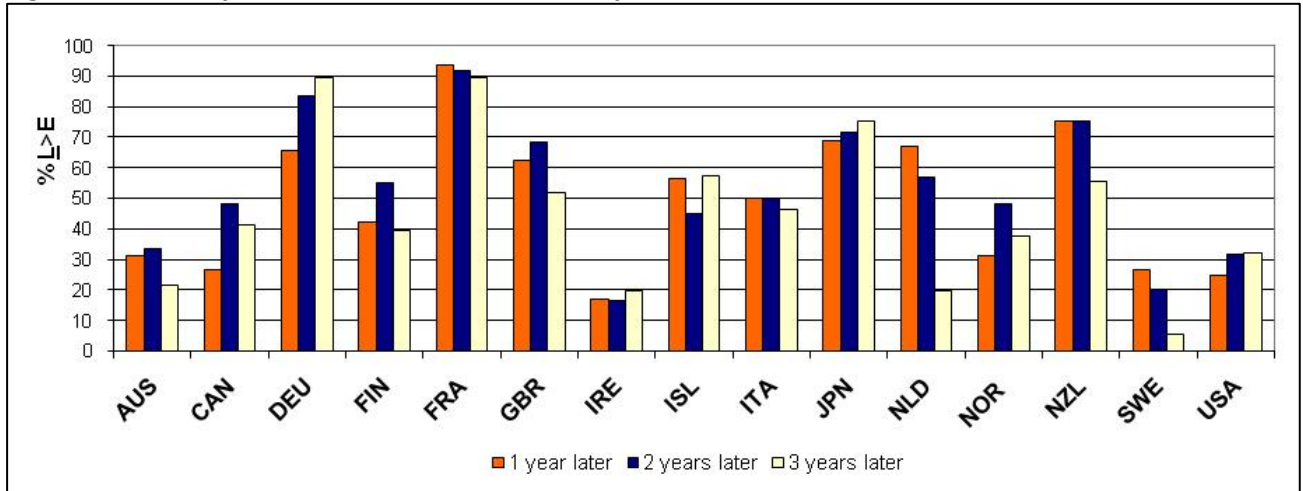


Figure 10: Summary indices of revisions of subsequent estimates. Mean absolute revision

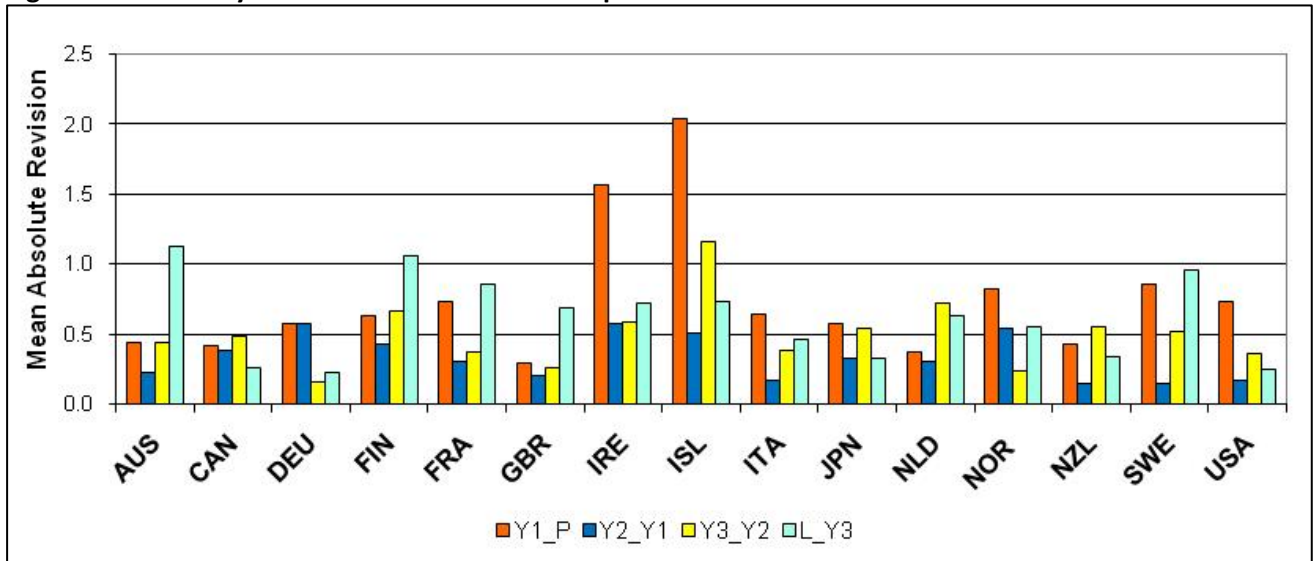


Table 9: Significance of the mean revision to the first published estimates*

To the first estimates	1 year later	2 years later	3 years later	Latest
AUS	NO	NO	YES	NO
CAN	YES	NO	NO	NO
DEU	YES	YES	YES	YES
FIN	NO	NO	NO	YES
FRA	YES	YES	YES	YES
GBR	NO	YES	NO	YES
IRE	YES	YES	YES	YES
ISL	NO	NO	NO	NO
ITA	NO	NO	NO	YES
JPN	NO	NO	YES	YES
NLD	YES	NO	YES	YES
NOR	YES	NO	YES	YES
NZL	YES	YES	NO	NO
SWE	YES	YES	YES	NO
USA	YES	YES	YES	NO

* t-test, HAC estimated variance, 5% significance.

Table 10: Comparison of successive revisions. Significance of the mean revision*

Comparison of successive revisions	Y1_P	Y2_Y1	Y3_Y2	L_Y3
AUS	NO	NO	YES	NO
CAN	YES	YES	NO	YES
DEU	YES	YES	NO	YES
FIN	NO	YES	NO	YES
FRA	YES	NO	NO	YES
GBR	NO	YES	YES	YES
IRE	YES	NO	YES	NO
ISL	NO	NO	YES	NO
ITA	NO	NO	NO	YES
JPN	NO	NO	NO	YES
NLD	YES	NO	YES	NO
NOR	YES	YES	NO	YES
NZL	YES	NO	YES	NO
SWE	YES	NO	YES	YES
USA	YES	YES	NO	YES

* t-test, HAC estimated variance, 5% significance.

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