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Annual analysis of revisions to money and credit aggregates and effective interest rates data (2011-13)

Barney Greenish, Dennis Jeevarajasingham and Jas Sarai

Tel: +44 (0) 20 7601 5361
Email: srdd_ms@bankofengland.co.uk

This article is the annual update of the analysis of revisions to monthly money and credit data and effective interest rates data produced by the Bank of England's Statistics and Regulatory Data Division (SRDD). Based on measures of revision size and bias, the results show that revisions can be considered immaterial for most series tested. This is the same broad conclusion as was reached in the 2015 analysis of 2010-12 data.

The Bank of England's Statistics and Regulatory Data Division has presented analysis of revisions to monthly money and credit data and effective interest rates data on an annual basis since 2009. Revisions are examined on a rolling three-year window of published data after two years have elapsed. This article updates the analysis for 2011-13 data, covering broadly the same series as considered last year. All M4 lending series investigated in this analysis refer to those series which were relabelled from M4Lx to M4L from May 2015.[1]

Key points

For money and credit data, the results are similar to last year's analysis for 2010-12 data, where revisions to series were found to be largely immaterial.[2] The one-off methodological change highlighted in last year's review continues to have a minor impact on some series over the period. This related to M4 lending and its other financial corporations (OFC) components.[3] For effective rates data the results are similar to last year's analysis, where revisions were found to be immaterial.

Revision size, bias and materiality

As in previous analyses, this article evaluates revisions according to measures of their size, tests for bias in revisions and measures of materiality. Methodology and results for this analysis are presented in full in Annex A and Annex B. Definitions for the series investigated can be found in Annex C.

For money and credit series, both seasonally adjusted and non seasonally adjusted data are considered. Mean revisions and mean absolute revisions are largely unchanged overall (Annex B, Table 1). However, mean absolute revisions have fallen slightly for more than half of the seasonally adjusted series considered, compared to last year. For effective interest rates data, revisions are slightly larger than those observed in the 2015 analysis for most series, although as in 2015 these can be considered immaterial (Annex B, Table 2).

Bias was found in four of the money and credit series (Annex B, Table 3) and one effective rates series (Annex B, Table 4). For these series, however, mean revisions were small.

Even in the absence of bias, revisions could still be considered to be material. However, this was not found to be the case (Annex B, Tables 5 and 6).

[1] All M4 lending series investigated in this analysis refer to those series which were relabelled from M4Lx to M4L from May 2015. For further details, see 'Changes to the treatment of loan transfers and lending to housing associations' by Zeeshan Akhtar and Alistair Strathern, Bank of England *Bankstats (Monetary & Financial Statistics),* April 2015, available at www.bankofengland.co.uk/statistics/Documents/ms/articles/art1apr15.pdf.

[2] See 'Annual analysis of revisions to monetary aggregates and effective interest rates data (2010-12)' by Timothy Boobier, Louise Johnston and Gayle Sansum, Bank of England *Bankstats (Monetary & Financial Statistics)*, June 2015, available at www.bankofengland.co.uk/statistics/Documents/articles/2015/1may.pdf.

[3] For further details on this change, see 'Estimations of securities transactions: a change in the methodology and its impact on M4Lx', by Tim McDonald, Bank of England *Bankstats (Monetary & Financial Statistics),* February 2012, available at www.bankofengland.co.uk/statistics/Documents/ms/articles/art1feb12.pdf.

Illustrative examples

This section considers in more detail selected examples of series that demonstrate the largest revisions for the series considered in this analysis.

Chart A depicts revisions to the one-month growth rate in M4 lending to OFCs, non seasonally adjusted. Among the non seasonally adjusted data, this series had the highest mean absolute revision (0.42 percentage points), although no evidence of bias was detected for this series.

Revisions are generally larger before February 2012. This reflects the fact that methodological changes to the estimation of this series were implemented for February 2012 data and this affected the estimation of data before this point. These changes consisted of improvements in the estimation of the effects of price movements in OFC securities held by monetary financial institutions (MFIs), specifically to exclude MFIs' holdings of bonds issued by their own securitisation special purpose vehicles. [4] Therefore, the size and materiality of revisions to this series should be seen as reflecting a one-off change in the measure's construction; as a result the mean absolute revision for this series has decreased since last year's analysis for 2010-12 data by 0.24pp to 0.42pp. This change is also the key driver of the revisions to the one-month growth rate of all M4 lending series (which show similar results in terms of materiality).

Chart B shows initial and revised estimates for seasonally adjusted M4 excluding intermediate other financial corporations (IOFCs). In this case, the materiality of revisions can be attributed to a change in the seasonal adjustment methodology implemented in November 2013. This involved a change from temporary adjustment methods to standard methods for the OFC component of M4, which drove the materiality of revisions.[5] Moreover, combined with the change in estimation of MFIs' holdings of OFC securities, this helps explain the magnitude of the revisions to seasonally adjusted M4 Lending and its OFC component.

For effective interest rates, the series with the largest ratio of mean square revision to variance of the underlying data (one measure of materiality used by the Bank) was time deposits from OFCs (4.68pp, Annex B, Table 6). As discussed in last year's analysis, revisions to these series were due to a methodological change to exclude the reporting of effective rates for intra-group business.[6] This is greater than the 2015 figure (1.96pp) due to smaller variance of the underlying (revised) data; the variance of the revisions is unchanged from last year. Revisions to other rates series were immaterial.

Chart A: Estimates of M4 lending to OFCs, one-month growth rates, non seasonally adjusted

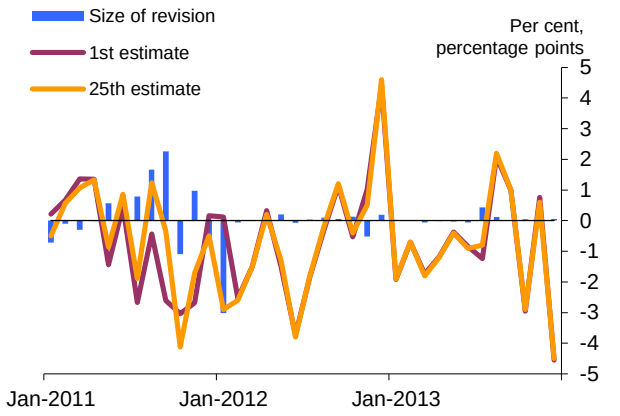
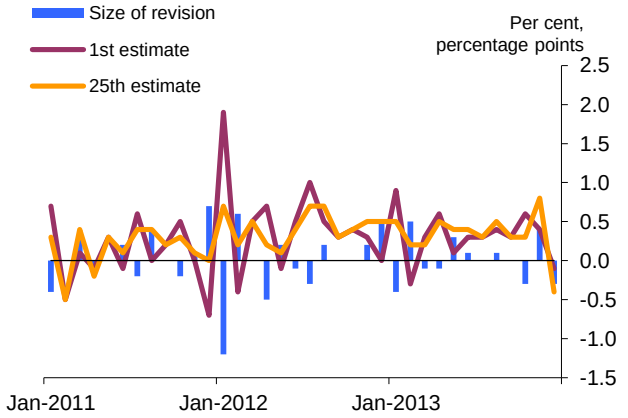


Chart B: Estimates of M4 excluding IOFCs, one-month growth rates, seasonally adjusted



[4] For further details, see footnote 3.
[5] For further details, see 'Modifications to the seasonally adjusted measures of M4 and M4 lending excluding intermediate OFCs', by Rajveer Berar and Ross Meader, Bank of England *Bankstats (Monetary & Financial Statistics)*, October 2013, available at www.bankofengland.co.uk/statistics/Documents/ms/articles/art1oct13.pdf.

[6] For further details, see 'Developments in effective and quoted rates statistics' by Kiman Bassi, Bank of England *Bankstats (Monetary & Financial Statistics),* March 2011, available at: www.bankofengland.co.uk/statistics/Documents/ms/articles/art3mar11.pdf.

Annex A: Background

The Bank's *Statistical Code of Practice* commits SRDD to report regularly on data quality, including revisions.[7] Alongside this commitment, SRDD has published a *Data Quality Framework* describing its approach to data quality issues, which features quantitative indicators of revisions.[8]

Lyon and Sansum (2009) presented the results of the first annual analysis under the *Data Quality Framework*, covering revisions to 2004-06 data on monthly money and credit data and monthly effective interest rate data.[9] This analysis has been updated on an annual basis since then. This article updates the analysis for 2011-13 data, covering broadly the same series as last year.[10] Definitions for the analysed data series can be found in Annex C.

Revisions and data quality

Revisions reflect the reliability of the first published estimates of data series as indicators of later, or 'settled', estimates for the period in question. Given this, information on revisions represents one aspect of data quality, complementing other aspects, such as timeliness and consistency.

Revisions may reflect corrections to earlier information, or they may be the consequence of improved information superseding earlier estimates.

In particular, revisions to seasonally adjusted data can arise as a consequence of revisions to the underlying unadjusted data, the addition of the latest observation to the series and changes to the seasonal adjustment process (including the re-estimation of seasonal and calendar factors). The annual assessment of seasonal adjustment settings (e.g. the parameters of the X-13ARIMA-SEATS model) can be another source of revision.[11] As a result, revisions to seasonally adjusted data might naturally be expected to be initially larger, and to settle down later, than revisions to the non seasonally adjusted data. In this respect, some revisions are necessary and desirable to maintain the quality of seasonal adjustment and ensure that the seasonally adjusted data are free from residual seasonality and calendar effects.

Definitions and method

For an observation (data point) for a given reporting period, the revision is defined as the difference between the first estimate for the period and the estimate published 24 months later, with a positive sign meaning the later estimate is greater than the first estimate. Revisions for money and credit data series are calculated with respect to their one-month growth rates.[12] However, for mortgage approvals, they are calculated in terms of new monthly approvals for house purchase measured by number (000's) and total of all mortgage approvals by value (£mn); for net finance raised by private non-financial corporations (PNFCs) by value (£mn); and for effective interest rates, they are defined in terms of their actual levels (%).

The *Data Quality Framework* recommends using a standard sample of revisions covering three calendar years in the case of monthly data, i.e. 36 observations, and therefore requires a five-year span of available data (i.e. 36 + 24 months). The results presented in this analysis relate to revisions to the first estimates produced for the reporting periods from January 2011 to December 2013, using information on revisions to estimates published up to December 2015 data.

[7] See the Bank of England's 'Statistical Code of Practice', June 2013, available at www.bankofengland.co.uk/statistics/Documents/about/code.pdf.
[8] See the Bank of England's 'Data Quality Framework', March 2014, available at www.bankofengland.co.uk/statistics/Pages/about/dqf.aspx.
[9] See 'Analysis of revisions to monetary and effective interest rates data' by Michael Lyon and Gayle Sansum, Bank of England *Bankstats (Monetary & Financial Statistics)*, March 2009, available at: www.bankofengland.co.uk/statistics/Documents/ms/articles/art1mar09.pdf.
[10] The headline M4 excluding intermediate OFCs series and M4 lending excluding intermediate OFCs series are included in this year's revisions analysis for the first time.
M4 lending series have changed from the series used in last year's article due to the previous M4 Lending (historic measure) no longer being published. For further details, see 'Changes to the treatment of loan transfers and lending to housing associations' by Zeeshan Akhtar and Alistair Strathern, Bank of England *Bankstats (Monetary & Financial Statistics),* April 2015, available at: www.bankofengland.co.uk/statistics/Documents/ms/articles/art1apr15.pdf.
The lending to individuals (unsecured) series, which measure both MFI and other specialist lenders' lending to individuals, used in last year's article, have been changed to lending to individuals (consumer credit), which measures just MFIs' lending to individuals (consumer credit), in this year's analysis.
See Annex C for the definition of all series used.

[11] For further details, see 'Seasonal adjustment: 2016 update' by Timothy Boobier, Bank of England *Bankstats (Monetary & Financial Statistics)*, May 2016, available at www.bankofengland.co.uk/statistics/Documents/articles/2016/12may.pdf.
[12] Growth rates of the monthly aggregates are as defined in the explanatory notes: 'Changes, flows, growth rates', at www.bankofengland.co.uk/statistics/Pages/iadb/notesiadb/Changes_flows_growth_rates.aspx.

Annex B: Results

Revision size

Table 1 shows mean revisions, and means of revisions in absolute size, for the monthly money and credit data. The latter can be interpreted as a measure of the average size of revision irrespective of sign. This table covers both non seasonally adjusted and seasonally adjusted data. [13]

Table 2 shows the same information for effective interest rates. These data are not seasonally adjusted data.

In the following tables, net finance raised by PNFCs corresponds to funds raised by PNFCs from monetary financial institutions and capital markets. There are no corresponding stocks series for this. Although it would be an inexact match to the flow definition, the mean total stock of monetary financial institutions' (MFI) lending to PNFCs could be used for an indicative order of magnitude scaling. On this basis, the mean revision and mean absolute revision to the one month growth rate would be of the order of 0.03% and 0.16% of this stock, respectively, for seasonally adjusted data.

[13] Note that this article reports on revisions to monthly data published at a monthly frequency, and does not readily extend to revisions of annual data, such as 12-month growth rates. Annual growth rates are determined as a compound of monthly rates so that revisions to such data will reflect different vintages of revised monthly data. Most revisions tend to occur within the first few months following initial release, so that revisions to annual growth rates will typically be mostly influenced by those to recent monthly data only.

Table 1: Revisions to money and credit aggregates, non seasonally adjusted and seasonally adjusted data
(one-month growth rate; or as stated)[a]

	Non seasonally adjusted data		Seasonally adjusted data	
Series	**Mean revision**	**Mean absolute revision**	**Mean revision**	**Mean absolute revision**
Notes and coin	0.00	0.01	-0.03	0.18
Household Divisia money [b]	n.a.	n.a.	-0.06	0.15
M4	-0.02	0.07	-0.01	0.21
M4, excluding intermediate OFCs [c]	0.00	0.08	0.02	0.25
M4, retail	-0.01	0.03	0.01	0.09
M4, wholesale	-0.04	0.17	-0.10	0.47
M4, households	0.01	0.03	0.02	0.05
M4, PNFCs	-0.01	0.13	-0.05	0.44
M4, OFCs	-0.06	0.18	-0.05	0.51
M4 lending [d]	-0.03	0.08	0.02	0.18
M4 lending excluding intermediate OFCs [c]	0.04	0.19	0.04	0.18
M4 lending to households [d]	0.02	0.03	0.02	0.03
M4 lending to PNFCs [d]	0.05	0.11	0.04	0.18
M4 lending to OFCs [d]	0.03	0.42	0.04	0.51
Lending to individuals (secured)	0.02	0.03	0.02	0.03
Lending to individuals (consumer credit) [e]	0.09	0.22	0.11	0.19
Total value of all mortgage approvals, £mn	25 (0.2%)	26 (0.2%)	36 (0.3%)	182 (1.4%)
Number of mortgage approvals for house purchase, 000's	0.1 (0.1%)	0.1 (0.1%)	0.2 (0.3%)	0.7 (1.4%)
Net finance raised by PNFCs, £mn [f]	n.a.	n.a.	137	679

Definitions: see Annex C.
(a) Revisions calculated after two years to first estimates for the period 2011 to 2013. Net finance raised by PNFCs and total value of all mortgage approvals are reported as monthly flows, in £mn. Number of mortgage approvals for house purchase by number is reported in 000's. Figures in parentheses for certain series represent revisions expressed as a percentage of the mean of the revised published series over the period.
(b) Estimates for Household Divisia money were published as seasonally adjusted data only for the period covered.
(c) The headline M4 excluding intermediate OFCs series and M4 lending excluding intermediate OFCs series are included in this year's revisions analysis for the first time as the one-month growth rates for these measures were published from October 2010.
(d) M4 lending series have been updated to use the current series, whereas last year's analysis reviewed the series now named M4L (historical measure), which has been end-dated.
(e) The lending to individuals (unsecured) series, which measure both MFI and other specialist lenders' lending to individuals, used in last year's article, have been changed to lending to individuals (consumer credit), which measures just MFIs' lending to individuals (consumer credit), in this year's analysis.
(f) Estimates for net finance raised by PNFCs were published as seasonally adjusted data only for the period covered.

Summary of Table 1

The broad results from Table 1 with respect to non seasonally adjusted data are that:

- The largest mean revision to growth rates was for lending to individuals (consumer credit) at 0.09 percentage points (pp). For all other growth rate series, mean revisions are no more than 0.06pp in either direction.

- Mean revisions to the approvals series considered (total value of all mortgage approvals and number of mortgage approvals for house purchase) were at or under ±0.2% of the originally reported figures. This was also the case for mean absolute revisions.

- The largest mean absolute revision to growth rates occurred with respect to M4 lending to OFCs (0.42pp). This has fallen from 0.66pp last year for the same series.

Overall, these results are similar to those found in the 2015 analysis.

With respect to the seasonally adjusted data:

- The largest mean revision to growth rate series is for lending to individuals (consumer credit) (0.11pp). For all other growth rate series, mean revisions are no more than 0.10pp in either direction.

- The largest mean absolute revisions are 0.51pp for both M4 OFCs and M4 lending to OFCs.

- Mean absolute revisions have fallen slightly for more than half of the series tested, compared to last year.

Similarly to non seasonally adjusted data, the current results for seasonally adjusted series are broadly the same as last year's results.

Table 2: Revisions to effective interest rates, by product and sector (annualised, percentage points), NSA[(a)]

Series	Mean revision	Mean absolute revision
Rates on outstanding business		
Interest bearing sight deposits, households	0.00	0.01
Time deposits, households	0.00	0.00
Loans secured on dwellings, households	0.01	0.01
Credit card loans, households	0.21	0.24
Other loans, households	0.06	0.09
Overdrafts, households	0.04	0.15
Interest bearing sight deposits, PNFCs	0.01	0.01
Time deposits, PNFCs	0.00	0.01
Overdrafts, PNFCs	0.01	0.06
Other loans, PNFCs	0.02	0.03
Interest bearing sight deposits, OFCs	0.02	0.02
Time deposits, OFCs	-0.20	0.24
Other loans, OFCs	0.07	0.09
Rates on new business		
Time deposits, households	-0.01	0.02
Loans secured on dwellings, households	0.00	0.01
Other loans, households	0.44	0.45
Time deposits, PNFCs	0.00	0.01
Other loans, PNFCs	0.09	0.11

Definitions: see Annex C.
(a) Revisions calculated after two years to first estimates for the period January 2011 to December 2013.

Summary of Table 2

The results from Table 2 show revisions to effective interest rates data are slightly larger than those in last year's report, specifically:

- The largest mean revision and mean absolute revision occurred with respect to 'Other loans, households, new business' (0.44pp and 0.45pp, respectively), largely reflecting revisions to 2013 data due to system improvements and changes in reporting practices by two institutions.
- Mean and mean absolute revisions for 'Credit card loans, households' (0.21pp and 0.24pp) were mainly due to reporting improvements by one institution.
- Mean and mean absolute revisions for 'Time deposits, OFCs' (-0.20pp and 0.24pp, respectively) reflect a methodological change on Form ER whereby intra-group business was excluded, causing downward revisions.[14] This was identified in last year's report and also affected the series 'Other loans, OFCs'.
- All other mean revisions and mean absolute revisions were no more than 0.15pp.

Bias of revisions

When interpreting data releases, users may want to assess whether there is a persistent direction of revisions, and hence whether the early estimates are biased upwards or downwards. This can be investigated by applying statistical tests to establish, at a certain level of significance, whether the mean revision is different from zero. If that is the case, it may be concluded that original estimates are subject to a systematic bias over the period in question.

Tables 3 and 4 show outcomes of the application of a t-test and a Newey-West test both based on a 95% confidence interval for each revisions series, and summary conclusions on the presence or absence of bias in each case.

Table 3 relates to the money and credit aggregates, covering both non seasonally adjusted and seasonally adjusted data; and Table 4 relates to effective interest rates.

[14] For further details see 'Developments in effective and quoted rates statistics' by Kiman Bassi, Bank of England *Bankstats (Monetary & Financial Statistics),* March 2011, available at: www.bankofengland.co.uk/statistics/Documents/ms/articles/art3mar11.pdf.

Table 3: Evidence for bias in money and credit aggregates, non seasonally adjusted and seasonally adjusted data (based on one-month growth rates)[(a)]

	Non seasonally adjusted data			Seasonally adjusted data		
Series	**Evidence for bias: t-test[(b)]**	**Evidence for bias: Newey-West test**	**Conclusion on bias**	**Evidence for bias: t-test[(b)]**	**Evidence for bias: Newey-West test**	**Conclusion on bias**
Notes and coin	No	No	Unbiased	No	No	Unbiased
Household Divisia money [(c)]	n.a.	n.a.	n.a.	No*	No	Unbiased
M4	No	No	Unbiased	No*	No	Unbiased
M4, excluding intermediate OFCs [(d)]	No	No	Unbiased	No*	No	Unbiased
M4, retail	No*	No	Unbiased	No*	No	Unbiased
M4, wholesale	No	No	Unbiased	No	No	Unbiased
M4, households	No	No	Unbiased	No	No	Unbiased
M4, PNFCs	No	No	Unbiased	No*	No	Unbiased
M4, OFCs	No	No	Unbiased	No*	No	Unbiased
M4 lending [(e)]	No*	No	Unbiased	No*	No	Unbiased
M4 lending excluding intermediate OFCs [(d)]	No	No	Unbiased	No	No	Unbiased
M4 lending to households [(e)]	No*	Yes	Inconclusive	No	No	Unbiased
M4 lending to PNFCs [(e)]	Yes	Yes	Biased: upwards revisions	No*	No	Unbiased
M4 lending to OFCs [(e)]	No*	No	Unbiased	No	No	Unbiased
Lending to individuals (secured)	Yes*	Yes	Biased: upwards revisions	Yes*	Yes	Biased: upwards revisions
Lending to individuals (consumer credit) [(f)]	No	No	Unbiased	No*	Yes	Inconclusive
Total value of all mortgage approvals, £mn	No*	Yes	Inconclusive	No*	No	Unbiased
Number of mortgage approvals for house purchase, 000's	Yes*	Yes	Biased: upwards revisions	No*	No	Unbiased
Net finance raised by PNFCs, £mn [(g)]	n.a.	n.a.	n.a.	No	No	Unbiased

Definitions: see Annex C.
(a) Tests are assessed using a 95% confidence interval. Revisions calculated after two years to first estimates for the period 2011 to 2013. Net finance raised by PNFCs and total value of all mortgage approvals by value are reported as monthly flows, in £mn. Number of mortgage approvals for house purchase by number is reported in 000's.
(b) Evidence of bias is judged by the t-test when there is no significant evidence of first order autocorrelation of revisions according to a chi-squared test. Where autocorrelation is significant, the reported outcome represents the result of the adjusted t-test and is indicated as (*).
(c) Estimates for Household Divisia money were published as seasonally adjusted data only for the period covered.
(d) The headline M4 excluding intermediate OFCs series and M4 lending excluding intermediate OFCs series are included in this year's revisions analysis for the first time as the one-month growth rates for these measures were published from October 2010.
(e) M4 lending series have been updated to use the current series, whereas last year's analysis reviewed the series now named M4L (historical measure), which has been end-dated.
(f) The lending to individuals (unsecured) series, which measure both MFI and other specialist lenders' lending to individuals, used in last year's article, have been changed to lending to individuals (consumer credit), which measures just MFIs' lending to individuals (consumer credit), in this year's analysis.
(g) Estimates for net finance raised by PNFCs were published as seasonally adjusted data only for the period covered.

Summary of Table 3

For the non seasonally adjusted money and credit aggregates data, the key features are as follows:

- With the exception of M4 lending to PNFCs, lending to individuals (secured), and number of mortgage approvals there is no significant evidence from the t-test and Newey-West test statistics for statistically significant bias to the money and credit aggregates data.
- M4 lending to PNFCs, lending to individuals (secured), and number of mortgage approvals data were found to have bias. However, the mean revision are 0.05pp, 0.02pp and 0.10pp. Therefore any bias can be considered immaterial.
- Tests for bias in M4 lending to households were inconclusive. However, with mean revisions at 0.02pp, any bias may be considered immaterial.

These results suggest there are more series with bias present this year compared to the 2015 analysis, where only notes and coin data had evidence of downward bias.

For the seasonally adjusted data:

- Lending to individuals (secured) data were found to have bias. However, the mean revision is 0.02pp, therefore any bias can be considered immaterial.
- Tests for bias were found to be inconclusive for lending to individuals (consumer credit).

With the exception of the above all series were found to be unbiased.

Table 4: Evidence for bias in annualised effective interest rates data, NSA[(a)]

Series	Evidence of bias: t-test[(b)]	Evidence of bias: Newey-West test	Conclusion on bias
Rates on outstanding business			
Interest bearing sight deposits, households	No*	No	Unbiased
Time deposits, households	No*	No	Unbiased
Loans secured on dwellings to households	No*	Yes	Inconclusive
Credit card loans to households	No*	Yes	Inconclusive
Other loans to households	Yes	Yes	Biased: upwards revisions
Overdrafts to households	No*	No	Unbiased
Interest bearing sight deposits, PNFCs	No*	No	Unbiased
Time deposits, PNFCs	No*	No	Unbiased
Overdrafts to PNFCs	No*	No	Unbiased
Other loans to PNFCs	No*	No	Unbiased
Interest bearing sight deposits, OFCs	No*	Yes	Inconclusive
Time deposits, OFCs	No*	Yes	Inconclusive
Other loans to OFCs	No*	No	Unbiased
Rates on new business			
Time deposits, households	No*	No	Unbiased
Loans secured on dwellings to households	No	No	Unbiased
Other loans to households	No*	Yes	Inconclusive
Time deposits, PNFCs	No	No	Unbiased
Other loans to PNFCs	No*	Yes	Inconclusive

Definitions: see Annex C.
(a) Tests are assessed using a 95% confidence interval. Revisions calculated after two years to first estimates for the period January 2011 to December 2013.
(b) Evidence of bias is judged by the t-test when there is no significant evidence of first order autocorrelation of revisions according to a chi-squared test. Where autocorrelation is significant, this is indicated as (*), and the reported outcome represents the adjusted t-test.

Summary of Table 4

With the exception of the outstanding series 'Other loans to households', there is no evidence of systematic bias in effective interest rates series. As in the results from the 2015 analysis, this series was biased upwards. However, the mean revision is 0.06pp and therefore any bias can be considered immaterial.

Tests for bias in the outstanding series 'Loans secured on dwellings to households', 'Credit card loans to households', 'Interest bearing sight deposits, OFCs' and 'Time deposits, OFCs', were inconclusive as the t-test and Newey-West test showed different results. The mean revisions for these series are 0.01pp, 0.21pp, 0.02pp and -0.20pp respectively (Table 2).

In comparison, the 2015 results showed evidence of bias in two series, for the outstanding and new business series 'Other loans to households'; these were found to be biased upwards.

Materiality of revisions

As seen above, it is possible for revisions to a series to exhibit a statistically significant bias which might nonetheless be considered subjectively to be small. Conversely, mean revisions may not be significantly different from zero, but possess a large variance. From the user perspective, a statistically significant but small bias might be regarded as immaterial. We do not offer any formal statistical test to determine whether the overall magnitude of revisions can be classed as 'small' or otherwise: materiality as discussed here amounts to a subjective assessment of the magnitude of the sample revisions.

Table 5 and Charts C and D present a selection of measures designed to enable users to compare the magnitudes of revisions with those of the underlying data for money and credit series. Table 6 shows the same for effective interest rates. Useful measures for considering materiality include the mean square revision (MSR), which combines the variance and squared mean of revisions, and the root mean square revision (RMSR), the square root of this term.[15]

These allow two comparative ratios to be defined:

- Ratio of RMSR to the mean of underlying (revised) data; and
- Ratio of MSR to variance of underlying (revised) data (a 'noise to signal' ratio).

These ratios provide a summary comparison between potential sources of uncertainty - i.e. both the average revision and the variability of the revisions - when interpreting a first estimate of a data point, and the variability of the underlying series. The way in which individual users interpret these ratios will depend upon their specific uses of the data. But the basic principle is that the smaller these ratios the greater the confidence the user can have in the inference that revised estimates do not change the user's understanding of the data based on original estimates.

For example, in our analysis an MSR to variance ratio that is smaller than one indicates that revisions have been less volatile than the growth profile shown in the underlying series. Therefore, revisions have not led to large changes in growth rates. As the MSR is composed of the squared mean and the variance of the revisions, the squared mean acts as a penalty factor in the calculation: a higher mean, i.e. more bias, requires lower variance to keep the MSR to variance ratio under one.

The converse proposition is less conclusive, since high values for these ratios could arise from relatively large revisions, or alternatively, in situations in which the underlying data exhibit low growth rates or low variance.

[15] Further information on definitions and advice on suitable measures of revisions can be found at www.oecd.org/std/oecdeurostatguidelinesonrevisionspolicyandanalysis.htm.

Table 5: Measures of root mean square revision and mean square revision for money and credit aggregates, non seasonally adjusted and seasonally adjusted data[(a)]

	Non seasonally adjusted data			Seasonally adjusted data		
Series	**RMSR (pp, or as stated)**	**RMSR, ratio to mean revised data**	**MSR, ratio to variance of revised data**	**RMSR (pp, or as stated)**	**RMSR, ratio to mean revised data**	**MSR, ratio to variance of revised data**
Notes and coin	0.02	0.04	0.00	0.34	0.89	1.54
Household Divisia money[(b)]	n.a.	n.a.	n.a.	0.21	0.50	0.21
M4	0.16	-1.71	0.07	0.33	-4.39	0.27
M4, excluding intermediate OFCs[(c)]	0.14	0.48	0.06	0.36	1.17	1.66
M4, retail	0.04	0.10	0.00	0.11	0.29	0.23
M4, wholesale	0.37	-0.44	0.05	0.64	-0.76	0.20
M4, households	0.04	0.12	0.01	0.07	0.21	0.17
M4, PNFCs	0.17	0.40	0.01	0.52	1.38	0.35
M4, OFCs	0.41	-0.47	0.04	0.84	-1.03	0.22
M4 lending [(d)]	0.20	-1.20	0.16	0.29	-1.39	0.26
M4 lending excluding intermediate OFCs [(c)]	0.33	7.31	1.57	0.24	5.78	1.03
M4 lending to households [(d)]	0.03	0.39	0.14	0.05	0.66	0.86
M4 lending to PNFCs [(d)]	0.15	-0.87	0.06	0.25	-1.39	0.40
M4 lending to OFCs [(d)]	0.79	-1.18	0.18	0.83	-1.23	0.20
Lending to individuals (secured)	0.03	0.43	0.34	0.03	0.44	0.69
Lending to individuals (consumer credit) [(e)]	0.35	-4.06	0.16	0.28	-4.13	0.32
Total value of all mortgage approvals, £mn	55	0.00	0.00	235	0.02	0.02
Number of mortgage approvals for house purchase, 000's	0.10	0.00	0.00	1.1	0.02	0.02
Net finance raised by PNFCs, £mn [(f)]	n.a.	n.a.	n.a.	962	-2.69	0.22

Definitions: see Annex C.
(a) Revisions calculated after two years to first estimates for the period 2011 to 2013. Net finance raised by PNFCs and total value of all mortgage approvals are reported as monthly flows, in £mn. Number of mortgage approvals for house purchase is reported in 000's.
(b) Estimates for Household Divisia money were published as seasonally adjusted data only for the period covered.
(c) The headline M4 excluding intermediate OFCs series and M4 lending excluding intermediate OFCs series are included in this year's revisions analysis for the first time as the one-month growth rates for these measures were published from October 2010.
(d) M4 lending series have been updated to use the current series, whereas last year's analysis reviewed the series now named M4L (historical measure), which has been end-dated.
(e) The lending to individuals (unsecured) series, which measure both MFI and other specialist lenders' lending to individuals, used in last year's article, have been changed to lending to individuals (consumer credit), which measures just MFIs' lending to individuals (consumer credit), in this year's analysis.
(f) Estimates for net finance raised by PNFCs were published as seasonally adjusted data only for the period covered.

Summary of Table 5

Key results for the non seasonally adjusted series:

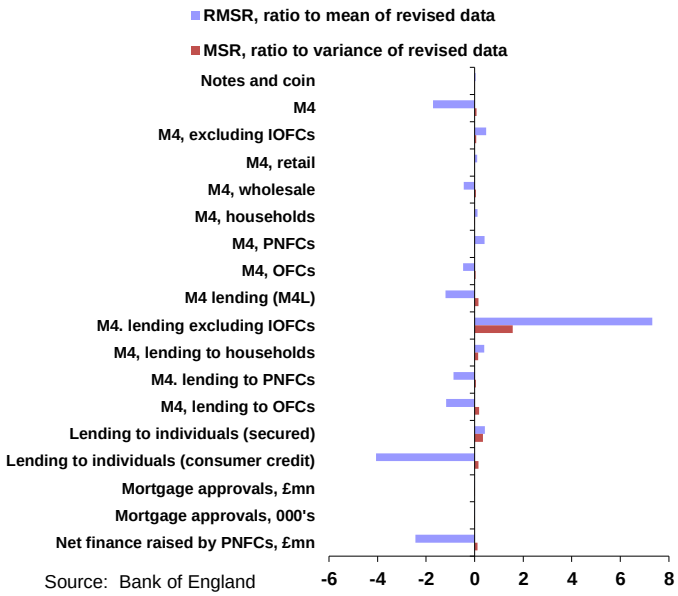
- For all the one-month growth rates, the RMSRs are no more than 0.41pp, apart from for M4 lending to OFCs, where it is 0.79pp.
- The ratio of RMSR to the mean of the underlying data is greater than one (in absolute terms) for six series. M4 lending excluding IOFCs shows the highest absolute ratio (7.31) mainly due to the underlying data exhibiting low growth rates.
- In the case of the ratio of the MSR to the variance of the underlying data, all series have ratios below one except M4 Lending excluding IOFCs.

For all seasonally adjusted series, the RMSR is greater than or equal to the RMSR for the non seasonally adjusted data except M4 lending excluding IOFCs and lending to individuals (consumer credit). Other key results include the following:

- The largest RMSR among the growth rates occurs with respect to M4 OFCs (0.84pp).
- The largest ratio of RMSR to the mean of the underlying data occurs for M4 lending excluding IOFCs (5.78).
- This RMSR to mean ratio is greater than one for ten series. However, the RMSR to variance ratio is less than one for all but two of these series highlighting that these revisions did not lead to a large change in growth rates.
- The MSR to variance ratio is largest for M4 excluding IOFCs (1.66).

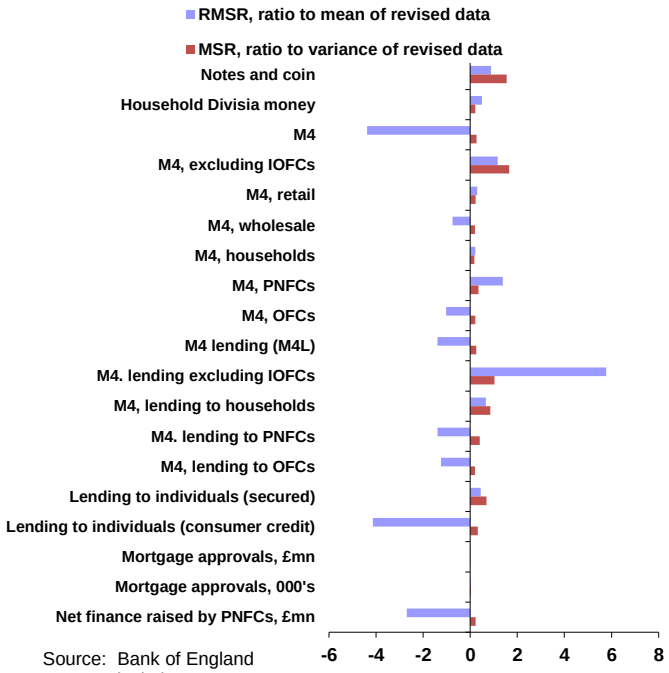
MSR to variance ratios are broadly unchanged when compared to the period considered in last year's review.

Chart C: Revisions to money and credit aggregates, non seasonally adjusted data, mean and RMS revisions as ratios to revised data



Source: Bank of England calculations.

Chart D: Revisions to money and credit aggregates, seasonally adjusted data, mean and RMS revisions as ratios to revised data



Source: Bank of England calculations.

Table 6: Measures of root mean square revision and mean square revision, effective interest rates, NSA[(a)]

Series	RMSR (pp)	RMSR, ratio to mean revised data	MSR, ratio to variance of revised data
Rates on outstanding business			
Interest bearing sight deposits, households	0.01	0.01	0.01
Time deposits, households	0.00	0.00	0.00
Loans secured on dwellings to households	0.02	0.00	0.08
Credit card loans to households	0.39	0.02	1.53
Other loans to households	0.12	0.02	1.12
Overdrafts to households	0.44	0.05	0.27
Interest bearing sight deposits, PNFCs	0.02	0.04	0.27
Time deposits, PNFCs	0.01	0.01	0.00
Overdrafts to PNFCs	0.09	0.03	0.25
Other loans to PNFCs	0.05	0.02	0.29
Interest bearing sight deposits, OFCs	0.03	0.04	0.22
Time deposits, OFCs	0.40	0.36	4.68
Other loans to OFCs	0.16	0.09	1.50
Rates on new business			
Time deposits, households	0.04	0.01	0.00
Loans secured on dwellings to households	0.01	0.00	0.00
Other loans to households	0.67	0.09	1.00
Time deposits, PNFCs	0.02	0.03	0.02
Other loans to PNFCs	0.15	0.06	1.05

Definitions: see Annex C.
(a) Revisions calculated after two years to first estimates for the period January 2011 to December 2013.

Summary of Table 6

The 2016 results show:

- The largest RMSR occurs with respect to 'Other loans to households, new business' (0.67pp). The series 'Overdrafts to households' has a RMSR of 0.44pp whilst the series 'Time deposits, OFCs' has a RMSR of 0.40pp and the series 'Credit card loans to households' has a RMSR of 0.39pp. All other RMSRs are no more than 0.16pp. In comparison, the largest RMSR in the 2015 data was 0.43pp for the series 'Overdrafts to households'.

- All of the ratios of RMSR to the mean of the revised data are 0.09 or below, with the exception of 'Time deposits, OFCs' (0.36). These are broadly in line with the 2015 results.

- The series 'Time deposits, OFCs' has the largest ratio of the MSR to the variance of the revised data (4.68). This is greater than the 2015 figure due to smaller variance of the underlying revised data. The variance of the revisions is broadly unchanged from last year. This series was affected by a methodological change for January 2011 data onwards, therefore the revisions do not reflect initial systematic overestimation of the series.[16] This methodological change also affected 'Other loans to OFCs' (1.50).

- The series 'Other loans to households' was found to have evidence of bias (Table 4), and has a MSR to variance of 1.12. This is larger than the 2015 figure due to smaller variance of the underlying revised data; the variance of the revisions is broadly unchanged from last year.

- The series 'Credit card loans to households' has a MSR to variance of 1.53. This is larger than the 2015 figure (0.09) due to reporting improvements by one institution to 2013 data.

- Other series showing larger MSR to variance ratios are 'Other loans to PNFCs, new business' (1.05), and 'Other loans to households, new business' (1.00). The latter series was affected by system improvements and changes in reporting practices by two institutions.

[16] For further details see 'Developments in effective and quoted rates statistics' by Kiman Bassi, Bank of England *Bankstats (Monetary & Financial Statistics),* March 2011, available at: www.bankofengland.co.uk/statistics/Documents/ms/articles/art3mar11.pdf.

Annex C: Definitions

Money and credit series

Notes and coin – LPMVQVT (NSA), LPMVQUT (SA): Monthly 1 month growth rate of total sterling notes and coin in circulation outside the Bank of England (in percent).

Household Divisia money – LPMB6F7 (SA only): Monthly 1 month growth rate of monetary financial institutions' sterling divisia for household sector (in percent).

M4 – LPMVQKY (NSA), LPMVQJS (SA): Monthly 1 month growth rate of M4 (monetary financial institutions' sterling M4 liabilities to private sector) (in percent).

M4, excluding IOFCs – RPMB3D4 (NSA), RPMB68P (SA): Monthly 1 month growth rate of monetary financial institutions' sterling M4 liabilities to Private sector excluding intermediate OFCs (in percent).

M4, retail – LPMVQXX (NSA), LPMVQWW (SA): Monthly 1 month growth rate of monetary financial institutions' sterling retail M4 liabilities to private sector (in percent).

M4, wholesale – LPMVRKC (NSA), LPMVRGU (SA): Monthly 1 month growth rate of monetary financial institutions' sterling wholesale M4 liabilities to private sector (in percent).

M4, households – LPMVVIL (NSA), LPMVVHT (SA): Monthly 1 month growth rate of monetary financial institutions' sterling M4 liabilities to household sector (in percent).

M4, PNFCs – LPMVVIF (NSA), LPMVVHN (SA): Monthly 1 month growth rate of monetary financial institutions' sterling M4 liabilities to private non-financial corporations (in percent).

M4, OFCs – LPMVVHZ (NSA), LPMVVHH (SA): Monthly 1 month growth rate of monetary financial institutions' sterling M4 liabilities to other financial corporations (in percent).

M4 lending (M4L) – LPMBF38 (NSA), LPMVWVM (SA): Monthly 1 month growth rate of monetary financial institutions' sterling net lending to private sector (in percent).

M4, lending excluding IOFCs – RPMB3D5 (NSA), RPMB66P (SA): Monthly 1 month growth rate of monetary financial institutions' sterling net lending to Private sector excluding intermediate OFCs (in percent).

M4L to households – LPMB3Z7 (NSA), LPMVWNM (SA): Monthly 1 month growth rate of monetary financial institutions' sterling net lending to household sector (in percent).

M4L to PNFCs – LPMB3Z6 (NSA), LPMVWNR (SA): Monthly 1 month growth rate of monetary financial institutions' sterling net lending (historical measure) to private non-financial corporations (in percent).

M4L to OFCs – LPMB3Z5 (NSA), LPMVWNM (SA): Monthly 1 month growth rate of monetary financial institutions' sterling net lending (historical measure) to other financial corporations (in percent).

Lending to individuals (secured) – LPMVTYD (NSA), LPMVTYF (SA): Monthly 1 month growth rate of total sterling net secured lending to individuals (in percent).

Lending to individuals (consumer credit) – LPMB3UJ (NSA), LPMVWAU (SA): Monthly 1 month growth rate of of monetary financial institutions' sterling net consumer credit (excluding credit card) excluding securitisations to individuals (in percent).

Total value of all mortgage approvals, £mn – LPMVTVN (NSA), LPMVTVQ (SA): Monthly value of total sterling approvals for secured lending to individuals (in sterling millions).

Number of mortgage approvals for house purchase, 000's – LPMVTVU (NSA), LPMVTVX (SA): Monthly number of total sterling approvals for house purchase to individuals.

Net finance raised by PNFCs, £mn – LPMVYVV (SA only): Monthly amount of private non-financial corporations' sterling and all foreign currency funds raised from UK MFIs and capital markets (in sterling millions).

Effective interest rates series (outstanding business)

Please note that series codes changed from January 2016 data as part of changes from the ER Rolling Review. For further details, please see the

article "Developments in Effective Rates statistics" in the *Bankstats* December 2015 edition.

Interest bearing sight deposits, households – CFMHSCV: Monthly average of UK resident monetary financial institutions' (excl. Central Bank) sterling weighted average interest rate, interest bearing sight deposits from households (in percent).

Time deposits, households – CFMHSCW: Monthly average of UK resident monetary financial institutions' (excl. Central Bank) sterling weighted average interest rate, time deposits from households (in percent).

Loans secured on dwellings to households – CFMHSDE: Monthly average of UK resident monetary financial institutions' (excl. Central Bank) sterling weighted average interest rate, loans secured on dwellings to households (in percent).

Credit card loans to households – CFMHSDG: Monthly average of UK resident monetary financial institutions' (excl. Central Bank) sterling weighted average interest rate, credit card loans to households (in percent).

Other loans to households – CFMHSDI: Monthly average of UK resident monetary financial institutions' (excl. Central Bank) sterling weighted average interest rate, other loans to households (in percent).

Overdrafts to households – CFMHSDH: Monthly average of UK resident monetary financial institutions' (excl. Central Bank) sterling weighted average interest rate, overdrafts to households (in percent).

Interest bearing sight deposits, PNFCs – CFMHSCT: Monthly average of UK resident monetary financial institutions' (excl. Central Bank) sterling weighted average interest rate, interest bearing sight deposits from private non-financial corporations (in percent).

Time deposits, PNFCs – CFMHSCU: Monthly average of UK resident monetary financial institutions' (excl. Central Bank) sterling weighted average interest rate, time deposits from private non-financial corporations (in percent).

Overdrafts to PNFCs – CFMHSDB: Monthly average of UK resident monetary financial institutions' (excl. Central Bank) sterling weighted average interest rate, overdrafts to private non-financial corporations (in percent).

Other loans to PNFCs – CFMHSDC: Monthly average of UK resident monetary financial institutions' (excl. Central Bank) sterling weighted average interest rate, other loans to private non-financial corporations (in percent).

Interest bearing sight deposits, OFCs – CFMHSCR: Monthly average of UK resident monetary financial institutions' (excl. Central Bank) sterling weighted average interest rate, interest bearing sight deposits from other financial corporations (in percent).

Time deposits, OFCs – CFMHSCS: Monthly average of UK resident monetary financial institutions' (excl. Central Bank) sterling weighted average interest rate, time deposits from other financial corporations (in percent).

Other loans to OFCs – CFMHSDA: Monthly average of UK resident monetary financial institutions' (excl. Central Bank) sterling weighted average interest rate, other loans to other financial corporations (in percent).

Effective interest rates series (new business)

Time deposits, households – CFMBJ74: Monthly average of UK resident monetary financial institutions' (excl. Central Bank) sterling weighted average interest rate - new time deposits from households (in percent).

Loans secured on dwellings to households – CFMBJ95: Monthly average of UK resident monetary financial institutions' (excl. Central Bank) sterling weighted average interest rate, loans secured on dwellings, new advances to households (in percent).

Other loans to households – CFMBJ93: Monthly average of UK resident monetary financial institutions' (excl. Central Bank) sterling weighted average interest rate - other loans, new advances to households (in percent).

Time deposits, PNFCs – CFMBJ72: Monthly average of UK resident monetary financial institutions' (excl. Central Bank) sterling weighted average interest rate - new time deposits from private non-financial corporations (in percent).

Other loans to PNFCs – CFMBJ82: Monthly average of UK resident monetary financial institutions' (excl. Central Bank) sterling weighted average interest rate - other loans, new advances to private non-financial corporations (in percent).