A MONEY AND CREDIT REAL-TIME DATABASE FOR CANADA

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1. Introduction

Money and credit data, such as time-series data on short- and long-term business credit, total residential mortgage credit, and measures of the money supply, are part of the broad information set considered by central banks in their monetary policy decision-making and in assessing financial stability risk.[2] Various studies have concluded that these data contain information that is useful for predicting output and inflation in Canada.3 There is also evidence that credit data, in particular, are useful for predicting financial stress (Borio and Lowe 2002; Misina and Tkacz 2008).

Time-series data are regularly updated and revised, however, as new information becomes available. As a result, the version of a time series that is used in economic studies may differ from that used by policy-makers. Conclusions about the usefulness of the information contained in the financial variables therefore depends on whether real-time data (i.e., the data in the form in which they were available to analysts and researchers at various times in the past) were employed. The importance of this issue has been demonstrated in various economic studies. Amato and Swanson (2001), for example, show that the assessment of the information content of monetary aggregates can change when real-time data are used (aggregates that seem useful with revised data do not perform well with real-time data). Orphanides and van Norden (2005) make the same observation in the case of measures of the output gap.[4] To date, no published study using Canadian money and credit data has factored in revisions, since no real-time version of these data was available. The database described in this article was designed to fill this gap.
This article reports on some Bank of Canada research into possible patterns and biases in the revisions to the data that have been compiled in the database. It begins with a description of the contents of the database and reviews the sources of the revisions. It then examines biases and patterns in data revisions and concludes with a summary of our main findings. In future work, it would be interesting to use this new database to revisit the conclusions of previous studies about the information content of Canadian money

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[2] Recent theoretical advances, such as the development of models with financial-accelerator mechanisms (see Bernanke, Gertler, and Gilchrist 1998; Iacoviello 2005; and Christensen and Dib 2006), have rekindled interest in credit developments. Meanwhile, recent studies with real-time data (e.g., Orphanides and van Norden 2005) have shown that indicators widely used by central banks—in particular, measures of the output gap—include little or no useful information about future inflation. This finding has stimulated research on alternative indicators, such as money and credit aggregates.

[3] See, for example, Hostland, Poloz, and Storer (1988); Milton (1988); Muller (1992); Longworth (2003); Chan, Djoudad, and Loi (2005); and Dufour and Tessier (2006).

[4] See Croushore (2006) for a good discussion about forecasting models and real-time data.

and credit aggregates. The database could also be used to study the impact of data uncertainty on policy decisions

2. Contents of the Database

The Canadian money and credit real-time database is a collection of monthly data representing selected vintages of various money and credit series. A vintage is the latest estimate of a given series at a particular time (i.e., the full history of total business credit as it was reported in January 1993 is one vintage; that reported in February 2007 is another). In this article, we focus on the following series: gross M1+, gross M2++, short-term business credit, long-term business credit, total business credit, total household credit, total residential mortgage credit, and total consumer credit. We chose these series because they tend to be the ones emphasized by Bank of Canada economists in their analyses. These series, as well as others that will be updated regularly in the real-time database, are defined in Appendix A.5 They are constructed largely on the basis of information received from banks and other financial institutions, although some are also created using information supplied by Statistics Canada.
Both print and electronic sources were used to construct the database. Print sources include two Bank of Canada publications: the *Weekly Financial Statistics* (WFS) and the *Bank of Canada Banking and Financial Statistics* (BFS). The Bank of Canada has been electronically archiving vintages of money and credit aggregates since June 2001.

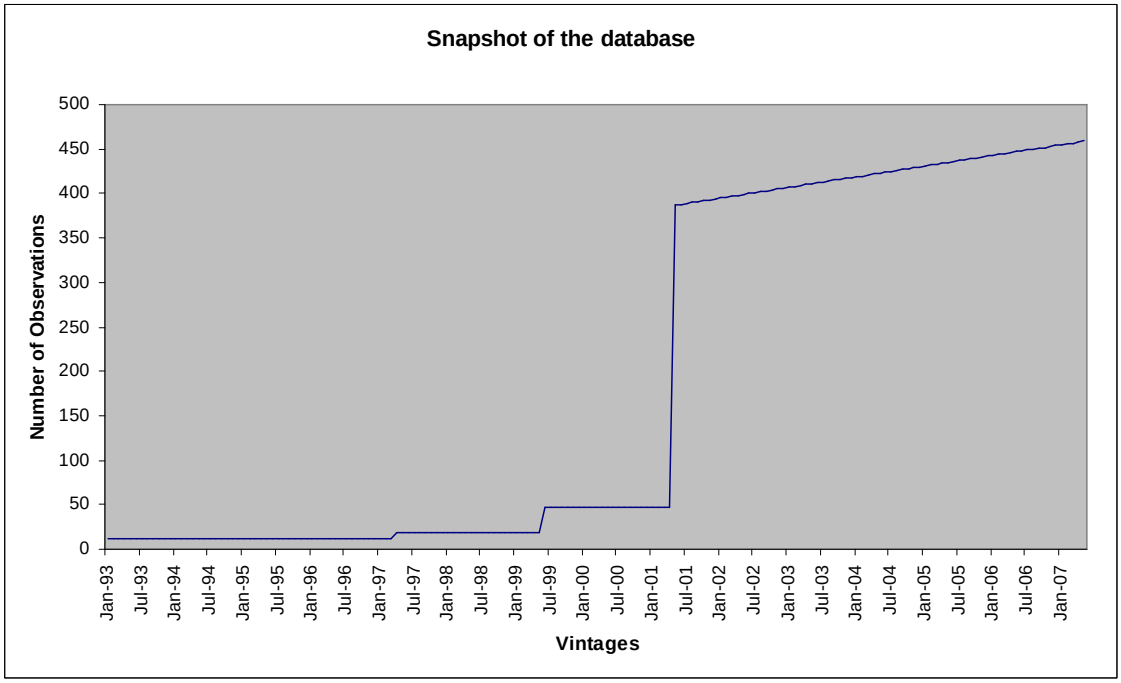
For most of our money and credit data, the earliest vintages date from January 1993. There are two exceptions: gross M1+ and gross M2++. Since these monetary aggregates were created in January 1999, vintages of these series are only available from that date.
Chart 1 displays the number of observations available in each vintage of a typical variable (total business credit). Complete sample vintages are available since June 2001, which is when the Bank began electronically archiving vintages. The first observation in each of these complete sample vintages is January 1969, for all series except gross M1+ and gross M2++.[6] Thus, Chart 1 shows 388 observations (January 1969 to June 2001) for the June 2001 vintage; one observation is added for each subsequent month until there are 459 observations for the most recent vintage. Prior to June 2001, when print versions were used, there are fewer observations in the various vintages, with the fewest (12) being recorded from January 1993 to March 1997.[7]

[5] The database also includes gross M1 and net versions of M2+ and M2++. In early 2007, the Bank stopped producing these data based on research by Chan, Djoudad, and Loi (2005). Thus, no new vintages of these series will be added to the database.

[6] The first observations for these series were in January 1975 and February 1968, respectively.

[7] The first few vintages in total household credit, total residential credit, and total consumer credit have 11 observations.

Chart 1



Many vintages were created in the third or fourth week of the month, which corresponds with the first release dates (for instance, total business credit for December is typically published in the third or fourth week of January). An exception is the period during which the BFS was used to build the data (July 1999 to May 2001). Since the *Banking and Financial Statistics* was published two or three weeks after the first release, these vintages may have included more revisions; this is a limitation of the database.[8] Because revisions during those two to three weeks tend to be small, however, we expect the BFS-based vintages to be very close (often identical) to the first-release vintages.

Although each observation in a particular vintage can be expressed either in levels or in growth rates, we use (annualized) month-over-month growth rates in this article. One reason for focusing on growth rates instead of levels is that definitional changes imply that there can be breaks in the data when they are assessed in levels. These breaks would not be reflected in the growth rates because they are calculated within a given vintage.

Most of our real-time data exist only in seasonally adjusted form. The sole exception is long-term business credit, which is not seasonally adjusted, because no stable seasonal factors could be estimated for that series.

[8] There was a trade-off to be faced for that period between longer but slightly desynchronized BFS-based vintages and synchronized but much smaller WFS-based vintages.

3. Sources of Revision

Revisions to money and credit data are derived from four major sources: continuity adjustments, adjustments to non-bank data, seasonal adjustments, and new instruments.[9] We discuss each of these sources in turn and briefly summarize their effects on the vintages.

3.1. Continuity adjustments

Continuity adjustments are required in the monetary aggregates whenever changes in the financial industry, such as mergers and acquisitions, generate structural breaks in the data. Without continuity adjustments, the data would show significant breaks, making them useless for most econometric work. The Bank adjusts its monetary aggregates each time one of the following four events takes place (Kottaras 2003):

- the acquisition of a trust company by a bank
- the acquisition of an entity in a sector (e.g., investment dealers) that was not previously included in the monetary aggregates
- the formation of a bank from a trust company or companies
- the acquisition of a bank by a trust company.

These discontinuities are documented in the annual *Notes to the Bank of Canada Banking and Financial Statistics* (Tables C1–C2 and D1). All continuity adjustments are made prior to seasonal adjustments.
Mergers and acquisitions do not always lead to a level change, since most of the aggregates in the real-time database include non-bank data. As a result, continuity adjustments are not always necessary.

3.2. Adjustments to non-bank data

Non-bank data, most of which are compiled by Statistics Canada, are subject to revisions from two sources. First, since Statistics Canada provides quarterly data two months after the end of a quarter, the Bank of Canada must use estimates based on interpolation and extrapolation techniques and judgment, making the data subject to revisions. Second, Statistics Canada revises the data for the previous quarters when it releases the data for the current quarter.
An example will illustrate the process. In late February 2007, the Bank of Canada received non-bank data from Statistics Canada for Q4 of 2006, as well as revisions to Q1, Q2, and Q3 of 2006. The Bank had provided initial estimates of the monthly data in Q4 of 2006. In March 2007, the Bank published revised data for the period January–December 2006. All of our real-time series are subject to this type of revision. Given the lags in receiving the quarterly Statistics Canada data, we may see large revisions in March, June, September, and December vintages of each year see Chart 2).
Due to differences in survey coverage and initial response rate of the non-bank and the chartered-bank data , the non-bank data are more subject to revisions especially in initial response periods. This is not the case in the chartered banks data where the coverage is much larger and penalties for errors in data are in place.

3.3. Seasonal adjustments

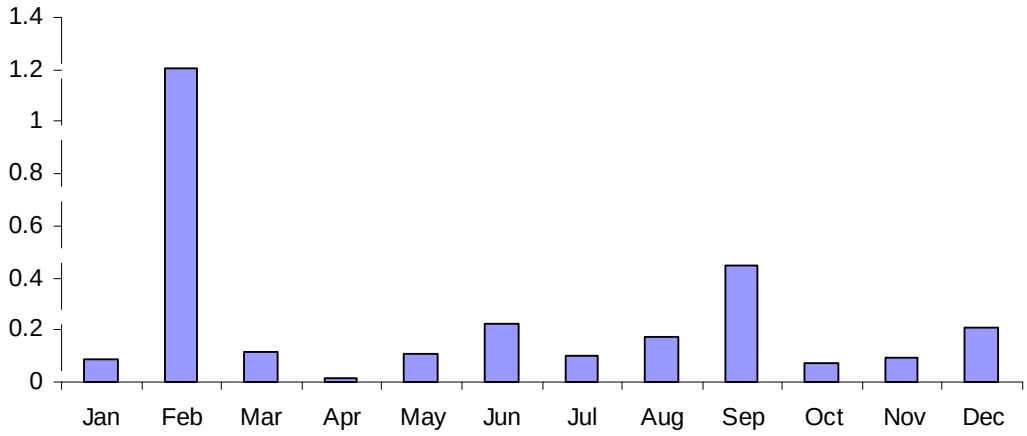
At the beginning of each year, new factors representing seasonal patterns are applied to the series. These seasonal factors are also adjusted to reflect revisions made to the data during the previous year. Thus, in addition to the original revisions to the unadjusted data, other revisions result from changes in the seasonal factors. The new seasonally adjusted data are published annually in February. Our investigation shows that some data, such as credit card loans, non-bank liquid assets, chartered bank deposits, and commercial paper issued by non-financial institutions, are more prone to seasonality and, hence, have

[9] Data are sometimes revised by financial institutions because of reporting errors or misclassifications. Given the many quality checks that are built in at different steps of reporting, these types of revisions are small when compared with other types.

larger seasonal factors. We expect that the corresponding aggregate real-time series, i.e., total consumer credit, short-term business credit, gross M1+, and gross M2++, will show relatively large and frequent revisions because of seasonal adjustments.
Chart 2 shows absolute mean revisions to gross M2++ in each month over the sample period.[10, 11] Average revisions in the February vintage are significantly higher than those of the other months, reflecting revisions resulting from seasonal adjustments.

Chart 2

Mean absolute revisions to Gross M2++ by month, 1999-2007 vintages



It should be mentioned that the seasonal adjustment procedures are run once a year, and the relatively significant spike in the February revisions could be the result of this procedure. It is possible that with running quarterly seasonal adjustment the results could have been different and revisions may have been spread across the study period in a smoother pattern.

3.2. New instruments

Some of the series, especially total business credit and long-term business credit, are subject to revisions because new types of financial instrument are included in the calculations. Flow-through shares, for example, have been traded in the market since they were created; only recently, however, has the Bank decided to include this instrument in the data for long-term business credit, thus expanding the coverage

[10] Absolute mean revisions are defined in the section on methodology.
[11] The results obtained from other aggregates support our discussions on sources of revisions. Because of space limitations, however, we have decided to present only gross M2++ in this article.

of total business credit.[12] Since the new instruments have been included to improve the information content of the series, any bias in long-term business credit data may not necessarily point to a shortcoming in the revisions process.

4. Biases and Patterns in Data Revisions

Our methodology is designed to detect possible biases in the revisions to the data and to determine whether there are patterns in the revisions. We expanded our investigation of possible biases by using two definitions of data revisions. We also studied the size of the revisions in real-time data.

4.1. Methodology

Revision to observation *i* in vintage *j*, compared with vintage *k* for *j* > *k*, is defined as $R_i^{j,k} = x_i^j - x_i^k$, where *x* is the month-over-month annualized growth rate of each observation. For instance, *j* could be the December 2006 vintage of total business credit, *i* the March 2006 observation of this series, and *k* the November 2006 vintage of the same data point. A positive number for R_i^{jk} indicates upward revision. The mean revision in each vintage is calculated as the sum of all revisions divided by the number of observations in that vintage:

$$\overline{R}^{j,k} = \left(\frac{1}{n_k}\right)\sum_{i=1}^{n_k} R_i^{j,k} \qquad (1)$$

Mean absolute revisions are calculated as the sum of the absolute values of the revisions divided by the number of observations in the vintage:

$$\overline{|R|}^{j,k} = \left(\frac{1}{n_k}\right)\sum_{i=1}^{n_k} |\, R_i^{j,k} \,| \qquad (2)$$

Equation (1) indicates whether the revisions were biased up or down. When they have a zero mean, they are considered to be unbiased. Equation (2) shows by how much, on average and in absolute terms, data were revised. In gauging the size of revisions, the concept of mean absolute revision in equation (2) is more valuable than that of mean revision in equation (1) because it avoids the offsetting effects of negative and positive revisions.

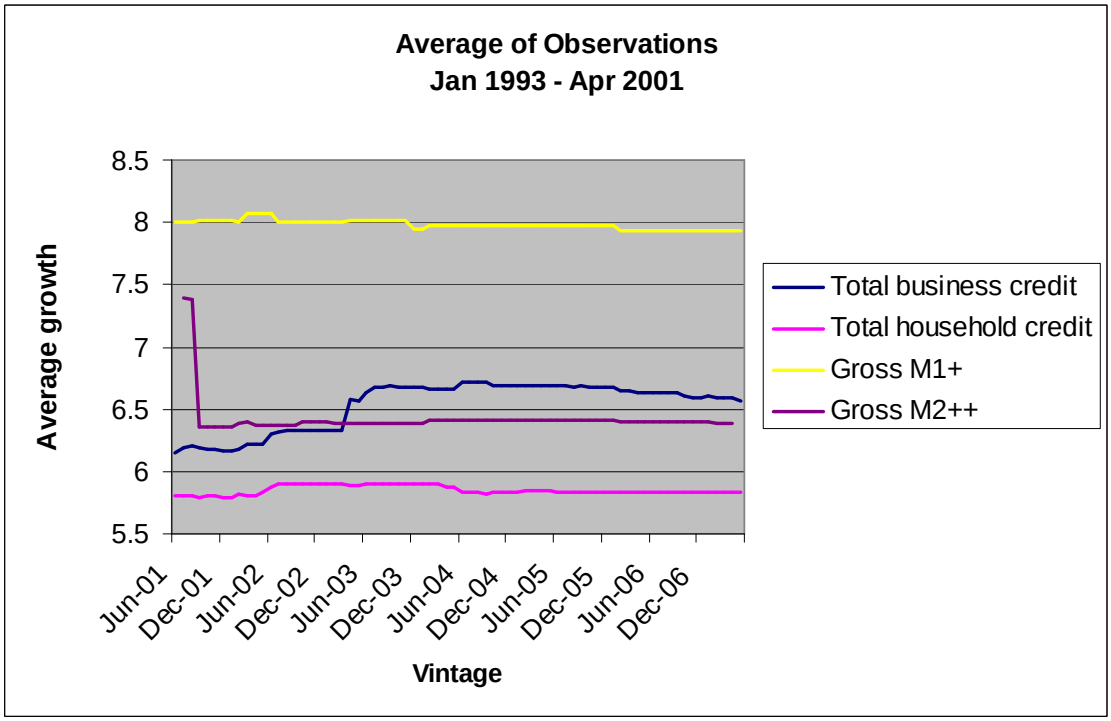
Data tend to fluctuate and to be more volatile over shorter periods, but more stable over longer horizons. For this reason, we speculate that short-run revisions may not provide a realistic picture of patterns in revisions. We therefore study long-run revisions to capture any revisions stemming from occurrences in the more distant past.

To help us determine patterns in data revisions, we first look at them for periods of up to 12 months (the maximum size of some of our vintages). Such revisions can also be interpreted as annual revisions, which are particularly important, considering that researchers at the Bank often use year-over-year data (especially for broad-money growth) to conduct their economic analyses.

[12] Flow-through shares facilitate the ability of exploration companies to raise equity capital, even in the absence of revenue-producing assets. Companies are able to raise this money by flowing through to their investors the tax deductions associated with their exploration expenses.

To determine long-run patterns in the revisions, we compare data in their initial form at first release with the final data. We define "final" in two ways. Although the process of data revisions is ongoing and, in one sense, data are never final, at some point, revisions are fewer, and less pronounced. This is illustrated in Chart 3, which covers the period from January 1993 to April 2001, beginning with the June 2001 vintage, and shows that, for the average growth rates for this fixed period, revisions become less frequent and less pronounced after about three years. We thus assume that the data are almost final three years after they were first released. As a robustness check, we also take the most recent vintage as final, which is our second definition. Further details are provided in the section on mean absolute revisions.

Chart 3[13]



In the following sections, we use equation (1) to study biases in revisions and equation (2) to study the magnitude of revisions.

4.2. Biases in revisions

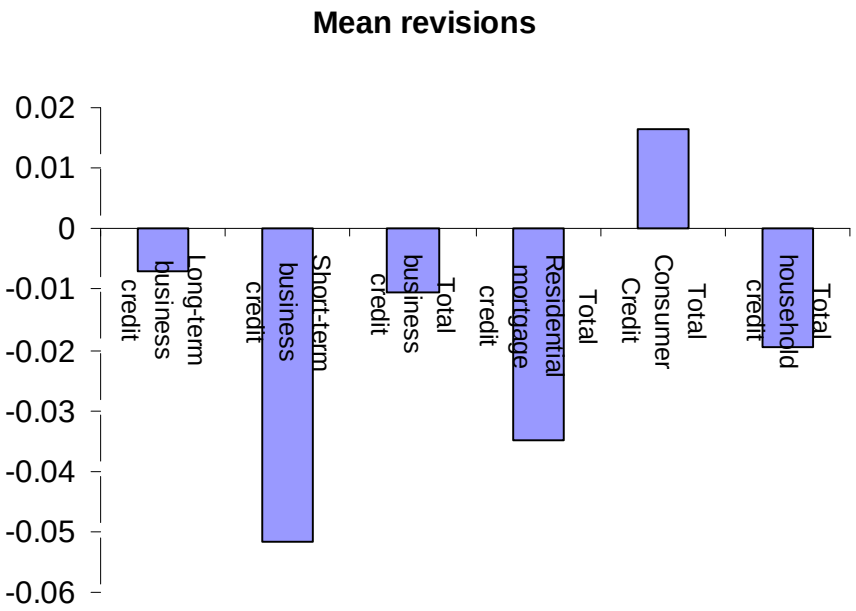
4.2.1 Bias in monthly (short-run) revisions

The mean revisions to monthly annualized growth rates for all of our credit aggregates are shown in Chart 4.[14] To ensure that the statistics we have calculated are comparable, only the final 12 data points in each

[13] We found an outlier corresponding to the October 2001 vintage of gross M2++. Our investigation shows that, as of that date, data for money market mutual funds and non-money mutual funds were revised back to March 1990, reflecting a new data source. We chose to keep this outlier in the sample despite the minor skewness it creates in the statistics.

vintage are considered (remember from Chart 1 that our smallest vintages have 12 data points). Chart 4 indicates that, except for total consumer credit, all variables in our sample have tended to be revised downwards. Short-term business credit shows the highest average monthly revisions. In most cases, these revisions are not significantly different from zero at the 5 per cent level, however, indicating that with this approach we do not find statistically significant evidence of bias in revisions.[15] The only exception is total residential mortgage credit, which shows significant downward revisions. This seems to be a short-run phenomenon, however, because we found that the revisions are not statistically significant when quarterly data are used.

Chart 4



To study whether the pattern of monthly revisions has changed over time, we divided the vintages into two subgroups, 1993–99 and 1999–2007 (Chart 5). Note that the starting date for the second subgroup is 1999, which coincides with the starting date of the first vintages of both gross M1+ and gross M2++ Compared with the other series, both monetary aggregates have low mean revisions. The main difference between the two subgroups is that mean revisions to total consumer credit, total residential mortgage credit, and short-term business credit have decreased for the most recent period. Again, most mean revisions are not statistically significant. Downward revisions to total residential mortgage credit are statistically significant in the first subsample, but not in the second.

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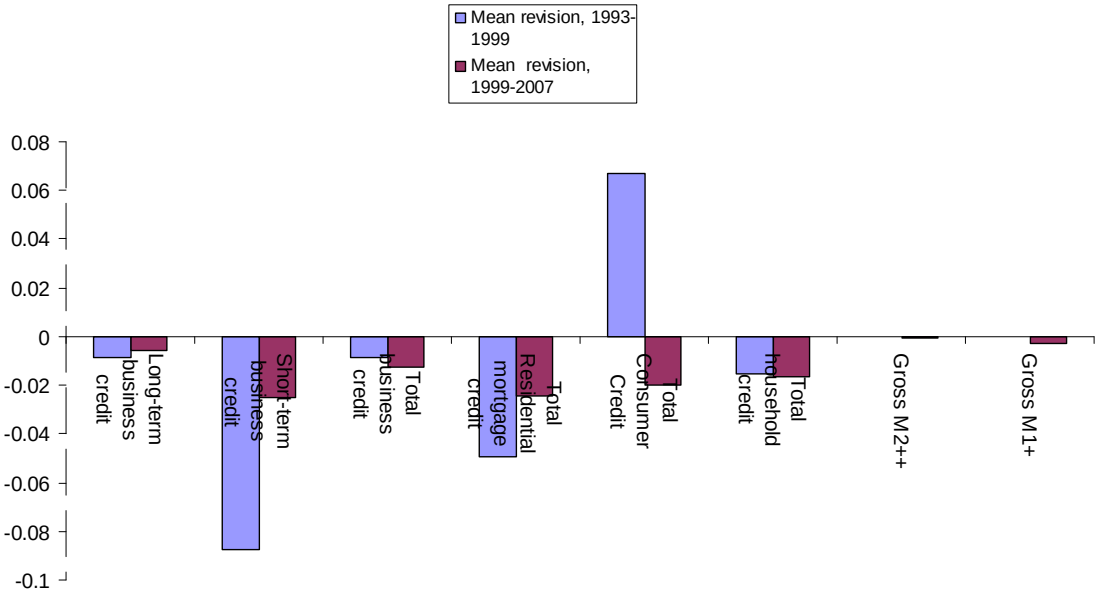
[14] Since 1999 is the first vintage for some of the monetary aggregate series, we do not depict them in this chart.

[15] Standard tests are used to check whether revisions are biased. The null hypothesis is that mean revisions are zero. If we do not reject this hypothesis, it means that revisions are not biased.

Chart 5

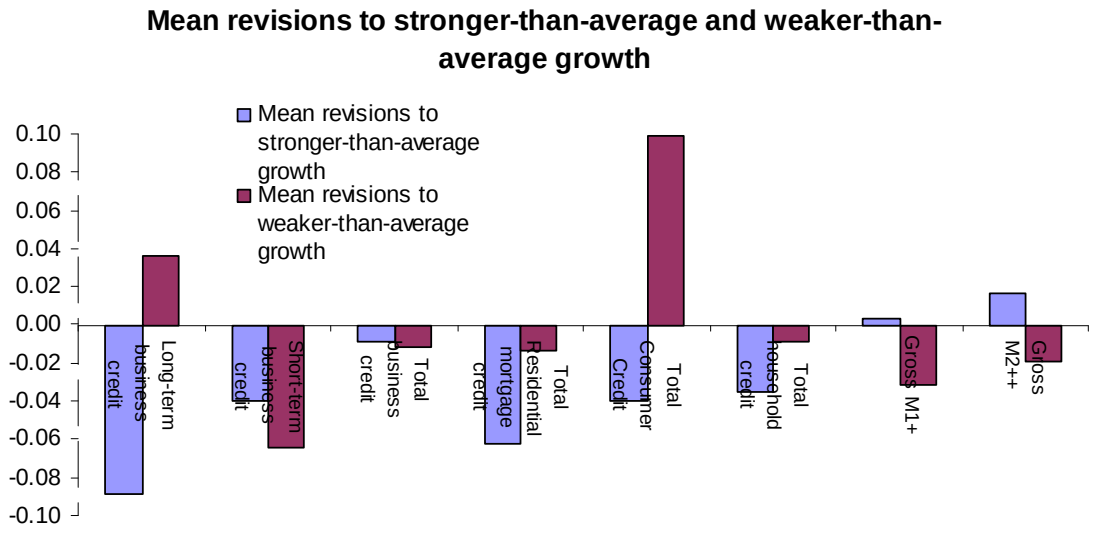
Mean revisions to 1993-1999 and 1999-2007 sub-samples



We would not expect changes to the conclusion that there is no statistically significant systematic bias in mean monthly revisions when revisions to stronger-than-average, or weaker-than-average, growth rates are considered separately. To verify this, we looked at mean revisions to credit aggregates when average growth in a vintage was above the historical average, calculated using data in the most recent vintage, and when it was below average (Chart 6).[16]

[16] The smaller sample (1999–2007) is again used in the case of monetary aggregates. We confirmed that this conclusion is not qualitatively different when the smaller sample is used for all series.

Chart 6



Vintages with stronger-than-average growth tend to be revised downwards for all credit aggregates. Total residential mortgage credit, total household credit, total business credit, and short-term business credit tend to be revised down when data releases reflect both stronger- and weaker-than-average growth.
Formal hypothesis tests cannot reject the null hypothesis that mean revisions are zero to both above- and below-average growth in short-term business credit, total business credit, total consumer credit, and monetary aggregates, even at low levels of significance. On the contrary, revisions to long-term business credit, when growth is above average, are biased down at a 1 per cent level of significance, and are biased up when growth is below average at the 5 per cent level of significance. Similarly, revisions to above-average growth in total residential mortgage credit are biased down at the 1 per cent significance level.

4.2.2 Biases in long-run revisions

In the previous section, we studied the average revisions for the most recent 12 months. It is useful, however, to examine the size of revisions over longer horizons for evidence of trends that are not identifiable in short-run revisions. As noted, the majority of revisions stabilize after about three years, indicating that most of them probably occurred within three years of the data being released. As a robustness check, however, we calculated revisions based on: (i) final revisions, defined as three years after the first release (Scenario A) and (ii) final revisions as they appear in the most recent vintage (Scenario B). The advantage of Scenario B is that it does not impose an arbitrary cut-off date for revisions, but allows them to occur until the last available vintage.[17] The disadvantage of Scenario B is that the length of time between first-released and final data is not constant. In Tables 1 and 2, we compare the monthly revisions with those of Scenario A and Scenario B, as described above.

[17] In Scenario B (as in scenario A), we do not include data for the three years preceding the final vintage. Thus, there is a significant period for potential revisions.

Table 1 Mean Revisions Compared

Aggregates	Short-run (monthly) revisions	Longer-run revisions Scenario A	Longer-run revisions Scenario B
Total business credit	-0.0107	0.78*	0.80*
Short-term business credit	-0.0516	-0.11	-0.66
Long-term business credit	-0.0070	1.24*	1.35*
Gross M1+	-0.0031	0.02	-0.22
Gross M2++	-0.0005	-0.58	-0.57
Total household credit	-0.0195	0.00	-0.12
Total consumer credit	0.0165	0.43	0.42
Total residential mortgage credit	-0.0350**	-0.21	-0.32

Note: As a robustness check, we calculated these statistics using quarterly data. The results are similar to those shown in this table
* Rejects the null hypothesis of no bias at the 1 per cent significance level
** Rejects the null hypothesis of no bias at the 5 per cent significance level

Our results indicate that, in the long run (Scenarios A and B), total business credit and long-term business credit show upward biases; while in the monthly revisions there are no biases (Table 2). We speculate that the long-run biases in revisions to business credit may reflect the impact of financial innovations, which tend to appear in the data only after some delay (see the section on new instruments). Given that the financial innovations tend to be associated with stronger credit growth, they may well produce this upward bias in the long-run revisions.

4.3. Mean Absolute Revisions

The magnitude, or size, of revisions indicates their relative importance. We have defined the size of revisions based on equation (2), which is calculated for short-run (monthly) and long-run revisions of the data on annualized growth rates. Following the methodology used in the previous section, we calculated the size of revisions based on two definitions of final data (i.e., three years after the first release, and the most recent vintage). Again, we call them Scenario A and Scenario B, respectively. Table 3 presents a comparison of the sizes of the revisions for the two scenarios.

Short-term business credit, total consumer credit, and gross M1+ had the largest absolute revisions in both the short and longer run. We speculate that revisions to non-bank data, as well as to their preliminary estimates by the Bank of Canada, are the main sources of the relatively large size of the revisions to these variables.

Note that revisions partly reflect very short-run phenomena. When the data are examined over the long run (i.e., on a lower-frequency basis), revisions are smaller. In Scenario A, for example, mean absolute revisions to annualized quarterly growth rates of gross M1+ are 2.25 per cent, compared with 5.15 per cent when annualized monthly growth rates are considered. The same order of magnitude applies to other series.

Table 2 Mean Absolute Revisions Compared

Aggregates	Short-Run (M(((Monthly) revisions	Longer-run revisions Scenario A	Longer-run revisions Scenario B
Total business credit	0.3964	2.20	2.47
Short-term business credit	0.7756	3.78	4.66
Long-term business credit	0.3060	2.20	2.67
Gross M1+	0.5375	5.15	4.30
Gross M2++	0.2391	2.33	2.20
Total household credit	0.3007	1.85	1.65
Total consumer credit	0.6138	4.21	3.62
Total residential mortgage credit	0.2962	1.68	1.61

5. Conclusion

This database is a valuable source of information for researchers, since it allows them to use real-time data (the data that are available when policy decisions are made) to assess the information content of money and credit aggregates. In this article, we provided a brief introduction to the database and examined whether biases and patterns exist in the revisions to money and credit data.
Based on our analyses of both short-run and long-run data revisions, our main conclusions are:
(i) Revisions to non-bank data, seasonal-adjustment factors, and financial innovations that are factored into the data after a delay appear to be major sources of data revisions.
(ii) In most cases, the process of revising the data tends to settle down within three years or less.
(iii) There is no statistically significant evidence, in most cases, of bias in short-run (monthly) revisions. The only exception is total residential mortgage credit, which tended to be revised downwards in the early part of our sample.
(iv) Some variables, however— in particular, long-term business credit and total business credit—tend to show bias over longer periods. We speculate that this is because there tends to be a delay in factoring the effects of financial innovations into time series. Practitioners should consider this when interpreting long-term business credit growth. It could be misleading, for example, to compare current growth rates with historical averages without making the appropriate adjustments to reflect the likelihood that current growth rates will be revised upwards.
(v) Some data tend to be revised downwards when first-released data are strong (reflecting above-average growth). We have not yet found a good explanation for this.
(vi) Mean absolute revisions are larger for short-term business credit, total consumer credit, and gross M1+.

The work presented in this article stimulated our interest in further investigating the implications of revisions in money and credit data. In particular, we intend to study whether previous conclusions about the information content of money and credit data are robust to the use of real-time data. We would also encourage other researchers to use the new database. In order to conduct a more detailed study of the patterns of revisions we have also built a new database comprising of the components of all monetary and credit aggregates. Further studies using this new data base are underway.

Appendix A
Definitions Canadian Financial Variables

Monetary Aggregates

M1+: Currency outside of banks plus bank and non-bank chequable deposits

M1++: Currency outside of banks plus bank and non-bank chequable deposits, plus bank and non-bank non-chequable deposits

M2+: M2 (currency outside banks plus demand deposits at banks plus non-personal notice deposits plus personal savings deposits in the banks) plus deposits in near-banks plus personal deposits at government saving institutions plus money market mutual funds (MMMFs) plus annuities of life insurance companies

M2++: M2+ plus Canada Savings Bonds plus cumulative net contributions to mutual funds other than Canadian-dollar money market mutual funds (which are already included in M2+)

Credit Aggregates

Short-term business credit: Short-term bank and non-bank loans, securitized short-term bank loans, and commercial paper

Long-term business credit: Leasing and non-residential mortgages, long-term bank and non-bank loans, securitized long-term loans, bonds and debentures, equity and warrants, trust units.

Total business credit: Short-term business credit plus long-term business credit

Total household credit: Total consumer credit plus total residential mortgage credit

Total residential mortgage credit: Bank and non-bank mortgage credit, National Housing Act mortgage-backed securities, and secured mortgages

Total consumer credit: Bank and non-bank consumer credit plus securitized consumer credit

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