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Task Force on Data Presentation and Seasonal Adjustment

Presentation of seasonally adjusted series

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PRESENTATION OF SEASONALLY ADJUSTED SERIES[1]

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Abstract

This paper develops issues related to the presentation and dissemination of seasonally adjusted series to be discussed by the OECD Short-Term Economic Statistics Expert Group (STESEG). Section 1 sets the stage by briefly reviewing the need for seasonal adjustment and its main elements. In section 2 we describe the three main categories of uses of statistical information and the associated dissemination vehicles. In section 3 we describe how to present seasonally adjusted data, and which information on seasonal adjustment should be provided by category of use. Section 4 contains a summary of our recommendations.

1. Introduction

Most sub-annual time series show intra-year variations which recur regularly every year, possibly slowly evolving. In order to gain insight into the current developments measured by a seasonally varying time series, it is necessary to correct it for these recurring intra-year variations. For instance, if a monthly time series decreases every July because of holidays, there is little to be gained by noting that it decreased once more last July as it always does. What is of interest to analysts is whether this last decrease itself was larger or smaller than usual.

Another difficulty with the analysis of seasonal time series is obtaining statistically meaningful comparisons of different periods within the same year; say, for example, comparing the January sales level to that of September. Seasonal variations, irrespective of their causes, are a reflection of the fact that each period within a year has its own basis of comparison that may differ from that of the other periods in the year. Hence, the direct comparison of periods of the same year for seasonal time series is generally not statistically meaningful.

Another important source of intra-year variations in addition to purely seasonal ones stems from calendar effects. For example, the number of Fridays in a month varies from year to year: November 2002 included five Fridays, whereas November 2003 only included four. If it so happens that the activity recorded is more concentrated on Fridays than on other days of the week, the November 2002 value will likely be higher than that of November 2003 simply because of this extra Friday. This particular calendar effect is known as trading-day variations. There are other calendar effects, such as variable holidays like Easter.

There is thus a need for seasonal (and calendar) adjustment. Any time series can be "thought" as composed by several components (seasonal, trend-cycle and irregular), which by definition are

[1] This revised version benefited from comments from various persons, particularly the members of the Task Force on Data Presentation and Seasonal Adjustment of STESEG. The views expressed in this paper are those of the authors, and do not necessarily reflect the views of Statistics Canada.

unobservable since only raw data are known. However, these components can be estimated through appropriate filters. Seasonal adjustment methods are numerous, and vary in sophistication. At the low end, one finds the simple year-over-year change (or percentage change), while at the more sophisticated end there are complete programs such as X-12-Arima[2] and Tramo-Seats.[3] Note that there cannot be a unique method that would be applicable to all series since seasonal adjustment can only be achieved through a model of the seasonal behaviour of the series to be adjusted, whereas each of the best seasonal adjustment methods provides seasonal models that are valid for broad, but limited, classes of time series. For the great majority of series however, only the most sophisticated techniques can produce time series adequately seasonally adjusted for most purposes.

Users of statistical information vary in their needs with respect to presentation, the amount of supporting information required, and the dissemination vehicles used. In the case of the general public, for instance, their needs are generally satisfied with the statistical agency's press release providing the most salient information from a statistical program, presented in a form that does not require from their part any processing other than its assimilation.

With respect to seasonal adjustment, we cannot expect the general public to perform it on their own, nor should we expect that they be interested in, say, the standard error of the trading-day regression that formed part of any particular seasonal adjustment. It is also for the general public that issues related to the presentation of seasonally adjusted data become paramount. As we shall discuss later, for other groups of users the presentation issues are less relevant than the information provided about seasonal adjustment.

In section 2 we identify three broad groups of users for a given piece of statistical information, as well as the limited set of dissemination vehicles associated with each group. In section 3 we describe how to present seasonally adjusted data, and which information on seasonal adjustment should be provided, by category of users. It is likely that this section will overlap with the work of other Task Force members. In section 4 we summarise our recommendations.

2. Categories of use

For any specific piece of statistical information, how it is presented and the amount of supporting information required will vary according to the intended audience. To establish how and what should be presented, it is helpful to distinguish between category of uses. To each category of uses are associated a limited set of dissemination vehicles. Note that this categorization is with respect to usage even though it is described below in terms of audience. Actual users will switch between the three categories according to their needs.

Users of statistical information can be grouped into three broad categories: ***general public, informed users,*** and ***analytic users***. For the first category, the ***general public***, knowledge of the main results of a statistical program is sufficient. The dissemination vehicles generally used to deliver this information are press releases, and the equivalent web pages. In Canada, for example, one vehicle serves both purposes. It is called **The Daily** and is available in various formats: on the main Statistics Canada's web page, and as a downloadable Acrobat file among others.[4]

For the particular case of seasonal adjustment, we cannot expect the general public to perform it on their own, nor to be interested in any of the intermediate statistics arising out of the seasonal adjustment of

[2] See Findley et al. (1998), Ladiray & Quenneville (2001) and U.S. Census Bureau (2002).

[3] See Gomez & Maravall (1996).

[4] Note that with the advent of the Internet and its widespread use across Canada, Statistics Canada' publication model has evolved toward eschewing paper products, to replace them with electronic publications.

a particular series. However, we should expect that they be interested in the meaning of seasonal adjustment. Accordingly, statistical agencies should provide "popular" metadata on seasonal adjustment, i.e. a layperson's explanation of this adjustment. This is discussed further in section 3.3.

The second category consists of ***informed users***. These are users whose needs regarding a particular piece of statistical information are greater than what can be reasonably presented in a press release. They need more detailed results, such as the unemployment rate for a specific subgroup of the population, or they need more information on how the statistical program was carried, or on its reliability. For this category of users, statistical agencies generally provide at least one comprehensive document per statistical program. At Statistics Canada, for the monthly Gross Domestic Product by Industry program for example, we provide a monthly publication,[5] as well as a separate sources and methods document,[6] in various formats (Acrobat file, e-publication[7]).

For informed users, the information required about seasonal adjustment is likely to be which method was used, as well as statistics on the validity of the adjustment for specific series. The statistics to present will be discussed in section 3.3.

The third category consists of ***analytic users***. These users need some of the results of the statistical program to reprocess them for their own uses. For these users, statistical agencies provide externally accessible centralized databases, data files pertinent to their demands in various formats (e.g. Lotus spreadsheets, MS-Access databases, Beyond 20/20 tables), and stand-alone self-contained computer readable products, generally on CD-ROM. Two examples of these stand-alone products available from Statistics Canada are **Labour Force Historical Review** (71F0004XCB) and **Financial Performance Indicators for Canadian Business** (61F0059XCB).

This last group of users, especially those accessing a centralized database, are those who are the most in need of metadata information, i.e. information relevant for the interpretation and analysis of the data extracted. For analytic users, the metadata on seasonal adjustment should be of sufficient extent to enable them to seasonally adjust in a consistent way series from the same statistical program, or from a related one. This principle is discussed further in section 3.3.

One final remark about the above categories of users is that they are inclusive. For example, informed users will also look at the information provided to the general public when looking for the detailed information they need. Also note that this categorization by final use of statistical information should prove useful in other contexts.

3. Relevant seasonal information

In this section we first discuss how to present seasonally adjusted data, then discuss the usefulness of some of the more common transformations applied to seasonally adjusted figures, and finally what information should be provided about seasonal adjustment for each of the three categories of users described in section 2. Some of this discussion may overlap with other work by the Task Force.

3.1 How to present seasonally adjusted data

The presentation of seasonally adjusted data concerns, in the main, members of the general public. Since the most appropriate seasonal adjustment techniques are very sophisticated statistical

[5] Statistics Canada, *Gross Domestic Product by Industry.* Cat. No. 15-001-XIE.

[6] Statistics Canada (2002) *Gross Domestic Product by Industry. Sources and Methods.* Cat. No. 15-547-XIE.

[7] An "e-publication" consists of a self-contained set of web pages that constitute a publication.

transformations, we cannot expect the general public to have the ability to perform these transformations on their own.

Hence, the general public should expect from statistical agencies that the main sub-annual indicators that appear in their press releases be seasonally adjusted appropriately when needed. This is not always the case at Statistics Canada. An example is provided by the quarterly estimates of the Canadian population.[8] Although a demographic indicator, it is more than relevant for calculating per capita economic quantities, such as GDP. Thus our first recommendation is:

Recommendation (1) *When seasonality is present and can be identified, sub-annual indicators should be made available in seasonally adjusted form. The level of detail of indicators to be adjusted should be chosen taking into account user demand and cost-effectiveness criteria. The adjustment should be applied appropriately using the method chosen as a standard by the agency. The method used should be explicitly mentioned.*

Members of the general public cannot be expected to be familiar with all the intricacies of seasonal adjustment. One such subtleties that we have eluded thus far is the distinction between the adjustment for seasonal variations per se, and the other adjustments like those for trading-days and variable holidays such as Easter. Within the statistical community, it is generally understood that "seasonally adjusted" includes all these adjustments unless otherwise specified, not just those for seasonal variations. This definition is also the most widely used by statistical agencies. One exception is found at INSEE, where it is specified that the monthly Index of Industrial Production, for example, is adjusted both for seasonal variations and trading-days: "… l'indice CVS-CJO de la production industrielle …"; see INSEE (2003). Although quite laudable, this is not as user-friendly as simply stating that the series are "seasonally adjusted". Also, by providing some details on what the series are adjusted for, it begs the question as to whether other adjustments, such as moving holidays, are included. Thus our next recommendation is:

Recommendation (2) *When series are adjusted for seasonal variations, including trading-day effects and other regular calendar variation if present, they should be referred to as* ***seasonally adjusted.***

This recommendation raises the issue as to whether a series with no discernible seasonal variations but some identifiable calendar variations, such as trading-days, should be so adjusted and if adjusted, how should it be referred to? Given that trading-day variations will likely be the most important source of regular calendar variations in many non-seasonal series, and that users are often interested in year-over-year comparisons, but that these comparisons could be distorted by the trading-day variations, it is recommended that such series be adjusted for such calendar effects and be referred to as being "seasonally adjusted", consistent with Recommendation (2). Although series of this kind are uncommon, and the recommended treatment is implicit in the previous recommendations, it is worth while to provide a specific recommendation about it.

Recommendation (3) *Series with no identifiable seasonal variations but with identifiable regular calendar variations, such as trading-days, should be so adjusted with the most appropriate techniques, and should be referred to as* ***calendar adjusted.*** *When no seasonal effects are contained in the raw series, the seasonally adjusted results are equal to the calendar adjusted figures. When no calendar effects are present in the raw series, the calendar adjusted results are equal to the raw data.*

[8] See http://www.statcan.ca/Daily/English/030326/d030326c.htm.

Accordingly, for the remainder of this paper, unless otherwise specified, seasonal adjustment includes all calendar adjustments, including those for trading-days, and variable holidays.

Now, should the unadjusted data be presented together with the seasonally adjusted figures in press releases for the general public? The proponents for presenting the two versions generally point out that many users are interested in seeing the actual numbers. Those who do not favour presenting together the adjusted and unadjusted versions assert that there is a possibility for users to be confused about what is the correct information. We actually concur with both points of view. We note however that if centre stage is given to the seasonally adjusted figures, the risk of confusion is greatly reduced.

By the same token, if any of the intermediate components of a seasonally adjusted series is presented (e.g. the series only adjusted for trading-days) in addition to the unadjusted and seasonally adjusted versions, then the risk of confusing the general public is very real. In addition, it is likely that we would then have to provide some explanations about the intricacies of seasonal adjustment with the press releases, increasing the risk of burying the essential information.

Recommendation (4) *When applicable, the focus of press releases concerning the main sub-annual indicators should be on their appropriately seasonally adjusted version. Where there is a user demand, the agency may also disseminate intermediate components of the seasonal adjustment process (e.g. series adjusted for calendar effects) but it should be clearly indicated that the focus is on the seasonally adjusted data.*

In some countries, Canada among them, the **levels** of some seasonally adjusted flow figures are presented at "annual rates", being multiplied by 12 (for monthly series) or 4 (for quarterly series). To our knowledge, there are only two datasets presented in this way in Canada: the sub-annual estimates from the Canadian System of National Accounts, including monthly GDP by industry, prepared by Statistics Canada, and the number of housing starts prepared by another Canadian federal agency, Canada Mortgage and Housing Corporation. All other seasonally adjusted flow series prepared by Statistics Canada are not presented at annual rates. The only other OECD countries following this practice for their sub-annual SNA estimates are Japan, Mexico and the United States.

The only good thing to be said for this practice is that it facilitates the comparison between series of different periodicities (monthly, quarterly and annual). However, given its limited use, it is more of a hindrance when comparing seasonally adjusted figures from different programs within a centralized statistical system such as Statistics Canada. Therefore we recommend that this practice not be followed.

Recommendation (5) *For sub-annual data expressed in levels, seasonally adjusted figures should be presented in their natural form; i.e. seasonally adjusted sub-annual data expressed in levels should not be grossed up and presented in annual terms.*

A somewhat related issue is the question as to whether the sum of the sub-annual seasonally adjusted figures should be forced to agree with the annual totals of the raw series. The answer to this question depends on the significance of these annual totals. Many sub-annual series are benchmarked to annual information that is considered more reliable than their own annual totals.[9] In such cases, the sub-annual raw series become "distributors" of the better annual totals, and hence their seasonally adjusted version should also be viewed under the same light.

[9] See chapter 6 of Bloem, Dippelsman & Mæhle (2001) for a description of various benchmarking methods.

When no benchmark annual totals are available, there is no guarantee that the sum of the raw sub-annual values is in any way better than the sum of the seasonally adjusted sub-annual values. In addition, the benchmarking procedure applied to seasonally adjusted figures preserves the sum of the sub-annual periods, even if the seasonal model is multiplicative. In such instances, benchmarking is not formally correct, although the differences between a formally correct procedure and the current one will generally be of no great importance.

We note that if the annual totals of the raw series do not coincide with those of the seasonally adjusted version, it would only affect the informed users. Any such discrepancies will not be seen by the general public, whereas analytic users will generally be in a position to address the situation in a manner appropriate to their needs. These discrepancies often become a major annoyance for informed users when comparing annual figures derived from sub-annual information with other annual sources, but they do provide an indication of the quality of the seasonal adjustment.

3.2 The analytical transformations

The statistical information reported in press releases is of necessity limited, and concentrates on the meaning of the results of a statistical program. In order to help the public at large assimilate this information, some simple transformations are generally presented such as period-to-period growth rates. In the following, the adequacy of some of the most common such analytical transformations will be discussed.

The most common and useful analytical transformations on seasonally adjusted flow series are the period-to-period growth rates and the period-to-period changes in their levels. If neither of these transformations is present, users will of necessity compute them. Hence our recommendation:

Recommendation (6) *Press releases presenting seasonally adjusted flow series should at the minimum provide the period-to-period change in levels and, where space permits, the period-to-period growth rate for the latest period.*

However, should the period-to-period growth rate be annualized?[10] In Canada, this practice of annualizing the growth rates is followed only for the quarterly estimates of GDP based on the income and expenditure approaches. The monthly growth rates of GDP by industry, the other major sub-annual program that is part of the Canadian System of National Accounts, are not. This practice is also not widespread among the OECD countries. In addition, even among countries presenting annualized growth rates there is a notable difference in the focus given to them. For example, in the United States the Bureau of Economic Analysis emphasizes the annualized quarterly growth rate of GDP in its press releases.[11]

In Canada by contrast, it is the quarterly growth rate itself that is emphasized. In addition, in recent releases of the Canadian quarterly GDP a table such as that shown in Figure 1 is presented.[12] Given that three growth rates are presented for each quarter in Canada, one wonders whether this excess of information for the general public defeats its purpose of shedding light on the statistical results.

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[10] The annualized growth rate for data (x_t) of periodicity p is defined as $(x_t/x_{t-1})^p - 1$. One finds instances where the linear approximation $p(x_t-x_{t-1})/x_{t-1}$ is used. Although it is an acceptable approximation for quick back-of-the-envelope calculations when the period-to-period growth rate is small, the linear approximation should not be used in official releases.

[11] See http://www.bea.gov/bea/newsrel/gdp103a.pdf.

[12] See http://www.statcan.ca/Daily/English/030829/d030829.pdf.

Figure 1

Real gross domestic product, $ chained 1997[1]

	Change	Annualized change	Year-over-year change
		%	
First quarter 2002	1.4	5.8	2.5
Second quarter 2002	0.9	3.8	3.2
Third quarter 2002	0.7	2.7	4.0
Fourth quarter 2002	0.4	1.6	3.5
First quarter 2003	0.6	2.6	2.7
Second quarter 2003	-0.1	-0.3	1.6

[1] *The change is the growth rate from one period to the next. The annualized change is the growth rate compounded annually. The year-over-year change is the growth rate of a given quarter compared with the same quarter in a previous year.*

Considering first the annualized growth rates, one can find two justifications for their use. One justification sometimes advanced is that it provides a forecast for the annual growth rate. The other is that it provides a rate that is interpretable on an annual basis similar, say, to the unemployment rate or an interest rate. Clearly, the first justification as forecasts is to be rejected as it is only applicable to the first period of the year; once the growth rate of the first k periods (r_i, i=1(1)k) in a year are known, a "better" forecast for the whole year is obtained by compounding these first k growth rates with the latest period's growth rate compounded for the remaining periods of the year; i.e. letting r_a denote the forecasted annual growth rate, the better forecast is obtained as:

$$r_a = (1+r_1)(1+r_2) \ldots (1+r_k)(1+r_{k+1})^{p-k}.$$

The second interpretation does however reflect a genuine need on the part of our users. But annualizing has a very negative aspect in that it exaggerates the volatility of the period-to-period growth rates. It is for this reason that annualizing monthly growth rates is very rarely seen, and is not appropriate.[13]

Another transformation that is frequently used and which also provides an annual rate is the year-over-year growth rate. It appears as the third column of Figure 1.[14] It has two drawbacks as an indicator of "annualized" rate. The first is that the year-over-year growth rate provides a better picture of what was occurring six months ago than what is happening currently.[15] The second drawback is that it is subject to "base effects". A base effect occurs when the year-ago data are at a level inconsistent with the current one. For an explanation of the base effect as given to the users of statistical information, see the November 2003 release of the Canadian Consumer Price Index (CPI).[16] Note that despite its drawbacks, the year-over-year

[13] An example for Canada appeared in the Winnipeg Free Press of May 1, 2003: "Gross Domestic Product expanded by 0.2 per cent in [February 2003] after gaining 0.5 per cent in January, [Statistics Canada] said yesterday. (…) The February rate projected to an annual figure would mean growth of 2.4 per cent." This article failed to note that had the January rate been projected to an annual figure, it would have "projected" an annual growth of 6.0 per cent.

[14] The year-over-year growth rate is often used on unadjusted data to provide a quick-and-dirty seasonally adjusted growth rate. It is far from adequate however, as trading-day variations generally make months a year apart not directly comparable.

[15] Technically speaking, the year-over-year growth rate is phase-shifted by about six months. See *inter alia* Rhoades & Elhawary-Rivet (1983) for an explanation.

[16] See http://www.statcan.ca/Daily/English/031119/d031119a.htm.

growth rate is the official measure of growth of the Canadian CPI that is monitored by the Bank of Canada, Canada's central bank, to assess one of the aspects of the inflation situation in the country.

Computing the growth rate over a shorter time span and annualizing the result would provide a more current "annualized" rate than the year-over-year growth rate, with lesser ad-hoc accidental variability than the period-to-period growth rate annualized. A whole sequence of annualized growth rates extending from the annualized period-to-period growth rate to the year-over-year growth rate can be obtained by letting k run from 1 to p in the following formula, where p is the periodicity of the time series:

$$r_t^{(k)} = (x_t/x_{t-k})^{p/k} - 1. \qquad (1)$$

In formula (1), $r_t^{(1)}$ is the annualized period-to-period growth rate, whereas $r_t^{(p)}$ is the year-over-year growth rate. As k increases from 1 to p, the growth rates $r_t^{(k)}$ become less volatile, but their actuality diminishes as they better reflect the actual growth k/2 periods before the current period. This reduction in actuality is called the ***phase.*** There is thus a trade-off to achieve.

One possible trade-off would be to select a time-span such that the phase is about a quarter of a year. For monthly time series this would mean selecting k = 6 months in formula (1), whereas for quarterly series it would mean selecting k = 2 quarters.

Figure 2 compares the monthly growth rates with their annualized version and the actual annual growth rates for Canada's GDP by industry since January 1998. It clearly shows the inappropriateness of annualizing the monthly growth rates. Figure 3 compares the year-over-year growth rates with the actual annual ones and with the ¼-year phased growth rates for the same indicator over the same period. As expected, the ¼-year phased growth rates are more volatile than the year-over-year growth rates, but are quicker to pick-up changes in economic activity. The ¼-year phased growth rates are much less volatile than the annualized monthly growth rates however; note the change in scales between Figure 2 and Figure 3.

Figure 2

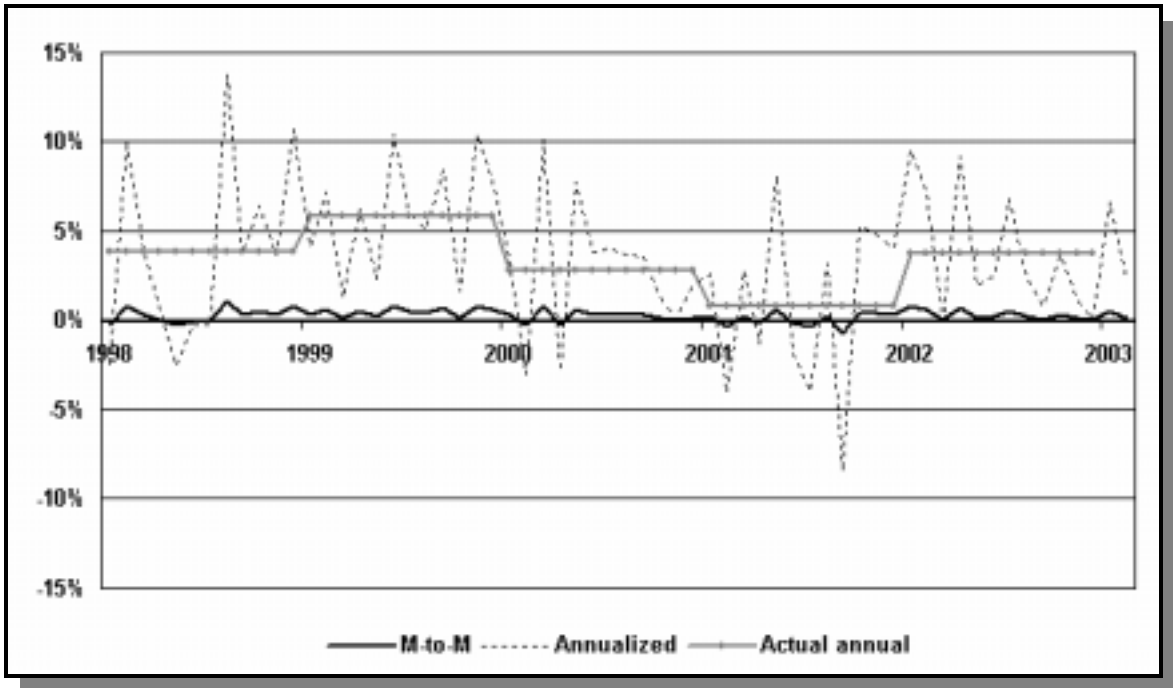


Figure 3

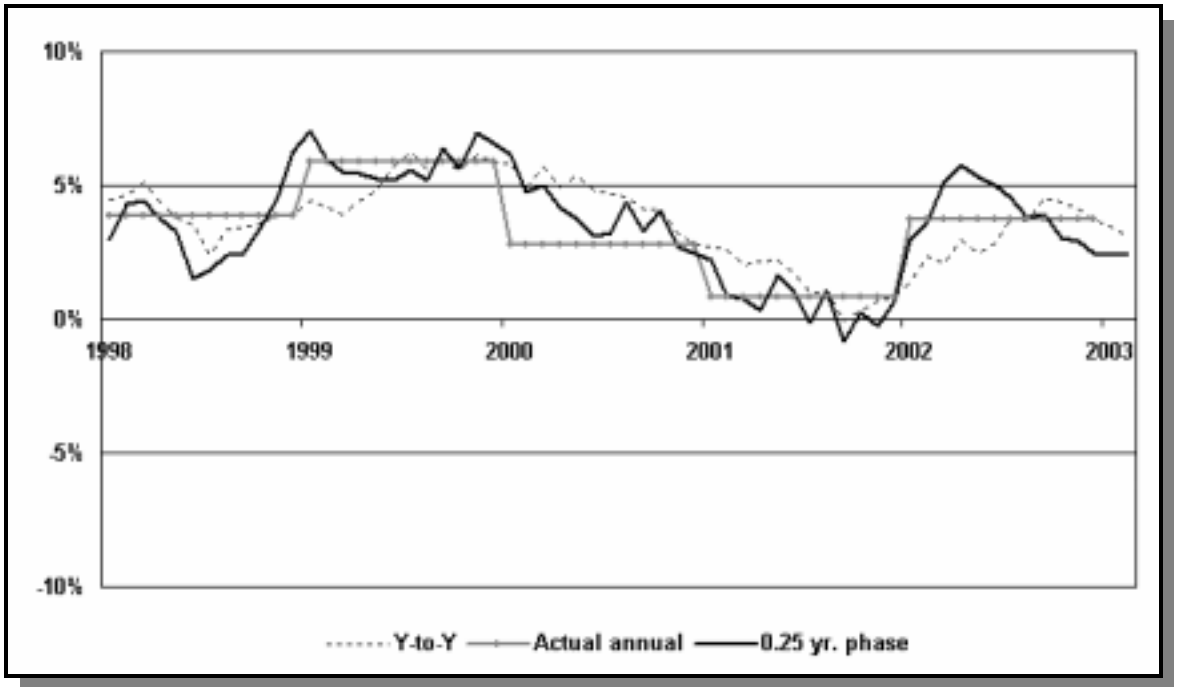


Figure 4 compares the quarterly growth rates with their annualized version and the actual annual growth rates for Canada's GDP derived from the Income and Expenditure Accounts from the first quarter of 1998. Figure 5 shows the year-over-year growth rates with the actual annual ones and with the ¼-year phased growth rates for the same indicator and period. Figure 4 and Figure 5 both show the same behaviour noted in Figure 2 and Figure 3.

Figure 4

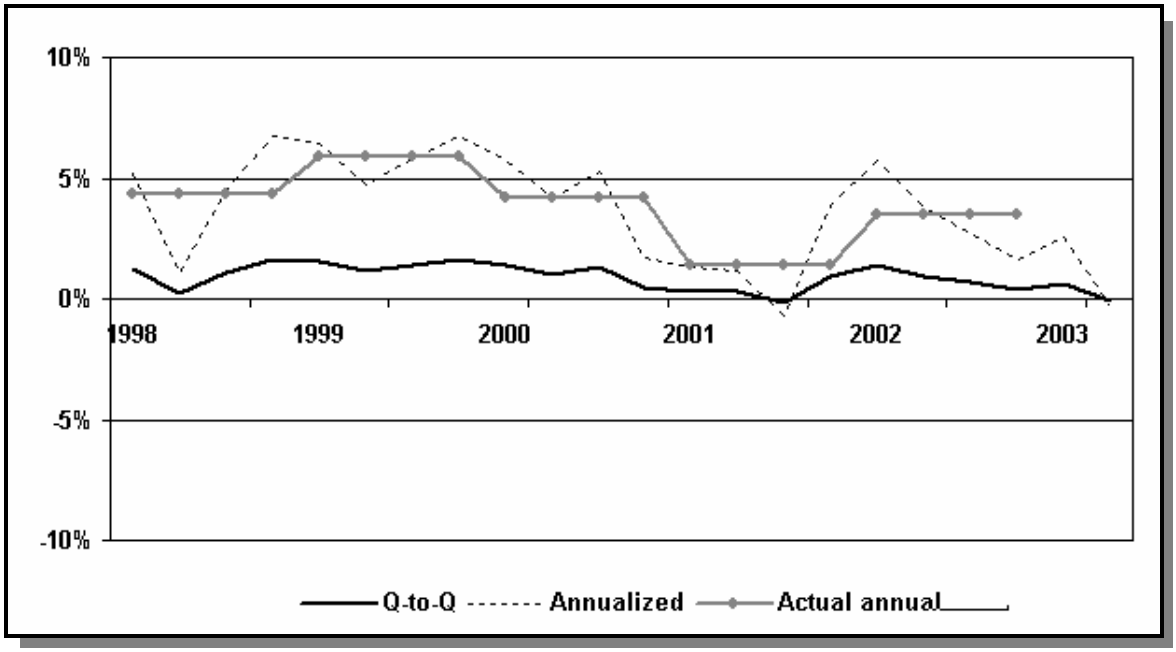
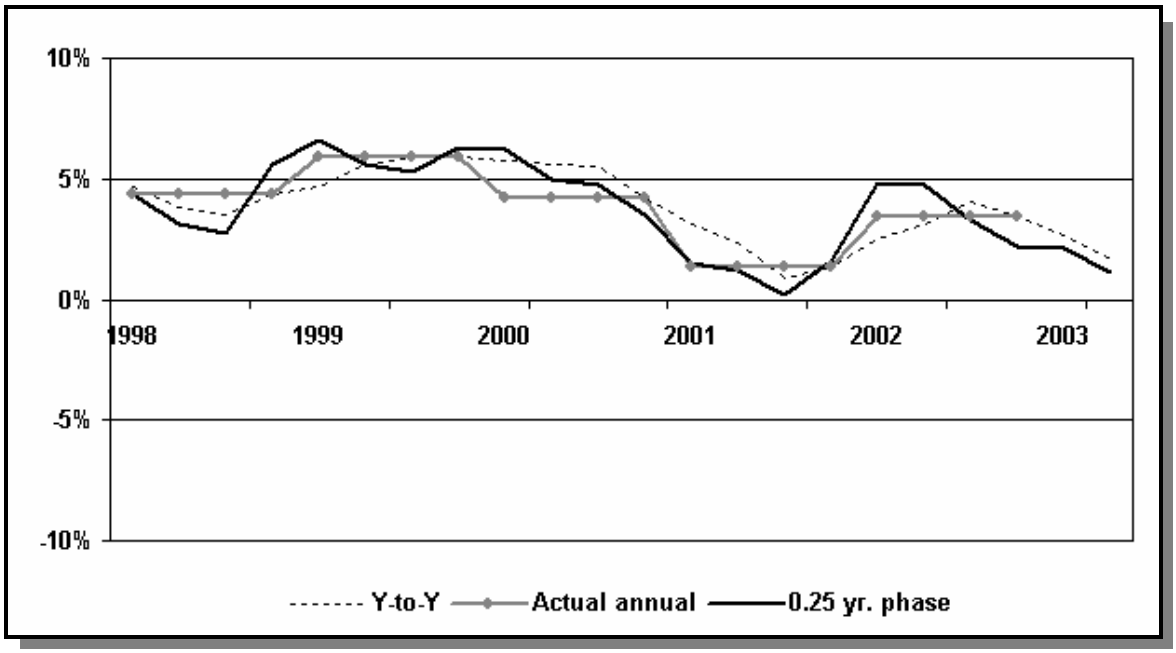


Figure 5



From this short analysis, we can conclude with the following recommendations:

Recommendation 7 *To present quarterly or monthly growth rates at annual rates, annualized period-to-period growth rates should not be used; the year-over-year growth rates are preferable.*

Recommendation 8 *It is recommended that the annualized semi-annual growth rates should be considered instead of the year-over-year ones as they react more quickly to current economic conditions, and as they are much less volatile than the annualized period-to-period growth rates.*

3.3 What to provide about seasonal adjustment

The general public has an interest in understanding what seasonal adjustment is all about. However, given the sophisticated nature of seasonal adjustment methods, we cannot expect the general public to possess the mathematical and statistical background for understanding a technical description of any particular adjustment method. An example of a description that is too technical for the general public is that of the Fisher index that can be found on Statistics Canada's web site.[17]

Accordingly, statistical agencies should provide "popular" metadata on seasonal adjustment, i.e. a layperson's explanation of this adjustment. Two examples are provided by the U.S. Bureau of Economic Analysis[18] and by Statistics New Zealand,[19] the latter being more technical than the former.

Recommendation 9 *Statistical agencies should disseminate a non-technical explanation of seasonal adjustment and its interpretation for the benefit of and aimed at the general public.*

For the second group of users, i.e. the informed users, the Statistics New Zealand's description of seasonal adjustment appears appropriate. However, the more relevant questions with respect to their needs are: which components, if any, of the seasonal adjustment decomposition should be included in a detailed publication, and which statistics describing the quality of seasonal adjustment should be included?

Given our definition of informed users as those requiring more detailed results than those provided to the general public, or requiring specific information about how the statistical program was carried and its reliability, the need for other components than the raw and seasonally adjusted estimates is limited. However, precisely because of their information needs about the reliability of the results, they require statistics describing the quality of the seasonal adjustments performed.

A good starting point is provided by the U.S. Bureau of the Census publication ***Manufacturers' Shipments, Inventories, and Orders***.[20] No matter which seasonal adjustment method is used, one can obtain the following fundamental seasonal decomposition model from which pertinent quality statistics can be computed:

$O = C + S + Td + X + I$

where

O is the original unadjusted series;
C is the trend-cycle;
S is the seasonal component;
Td represents the trading-day, variable holidays and other specific calendar variations;

[17] See http://www.statcan.ca/english/concepts/chainfisher/methodology.htm.

[18] See http://www.census.gov/mcd/mcdfaqs.html

[19] See Seasonal adjustment in New Zealand.

[20] Available at: http://www.census.gov/indicator/www/m3/bench/bench.htm. See the accompanying document ***Pages from m3-01 on seasonal adjustment.pdf*** **.**

X represents the correction for the extreme observations identified during the seasonal adjustment process; and
I is the irregular component (excluding the extreme observations).

Following Ladiray & Quenneville (2003, p. 169*ff*), denote by $\overline{\mathbf{A}}$ the average absolute period-to-period change (or percentage change) in series A, i.e. let:

$$\overline{\mathbf{A}} = (\mathbf{n} - \mathbf{1})^{-1} \sum_{t=2}^{n} \left| \mathbf{A}_{t} \; op \; \mathbf{A}_{t-1} - xbar \right|$$

where

op is "-" for an additive model, and "÷" for a multiplicative one, and
xbar is 0 for an additive model, and 1 for a multiplicative one.

Also, let $\%\overline{\mathbf{A}}$ represent the relative contribution in percent of the absolute variations of A in the absolute variations in the original series, i.e.:

$$\%\overline{\mathbf{A}} = 100\overline{\mathbf{C}}^{2} \; / \; \overline{\mathbf{O}'}^{2}$$

where $\overline{\mathbf{O}'}^{2}$ is the sum of the the relative contributions of all components, as described in Ladiray & Quenneville (2003, p. 171).

The pertinent quality statistics related to the above seasonal decomposition are then:

$\overline{\mathbf{O}}$ the average absolute period-to-period (percentage) change in the original series;
$\%\overline{\mathbf{C}}$ the relative contribution of the trend-cycle in the original series;
$\%\overline{\mathbf{S}}$ the relative contribution of the seasonal component;
$\%\overline{\mathbf{Td}}$ ..the relative contribution of the trading-day, variable holidays and other calendar variations;
$\%\overline{\mathbf{X}}$ the relative contribution of the extremes;
$\%\overline{\mathbf{I}}$ the relative contribution of the irregular component;
M7 is the value of the combined test for the presence of stable and moving seasonality as described in Ladiray & Quenneville (2003, p. 178); and
Q is the overall quality statistic for seasonal adjustment as described in Ladiray & Quenneville (2003, p. 179).

Note that all these statistics can be set out in one table and all can be obtained from the standard output of X-11-Arima and X-12-Arima. Hence the following recommendation:

Recommendation 10 *For the benefit of users requiring information about the validity of the seasonal adjustment applied, statistical agencies should provide a minimum standard of information facilitating an assessment of the reliability of each seasonally adjusted series.*

Finally, for analytic users, we believe that no additional elements than those listed for informed users and presented in the publication (whatever its format) dedicated to the statistical program need be added. But for analytic users, metadata is of paramount importance.

The main elements of this metadata could include the following: a short standardize descriptor of the method used, all the main parameters of the adjustment (e.g. additive versus multiplicative decomposition model), and some of the derived information (e.g. the trading-day weights). The principle to be followed is that the metadata should be of sufficient extent to enable an analytic user to seasonally adjust in a

consistent way other series from the same statistical program which may not have been adjusted, or to compare the results obtained from using different options or methods for seasonally adjusting the same series.

We note that, to a large extent, the knowledge of which software was used and of the parameters specified for the seasonal adjustment of a particular series is generally sufficient to replicate the process. However, this information does not need to be disseminated given its limited use. Nonetheless, it should be available upon request.

We also note that the main seasonal adjustment programs, such as X-11-Arima, X-12-Arima, Tramo-Seats and Demetra, currently used "proprietary" input formats, although they have many parameters in common. With the advent of XML (the eXtensible Markup Language) and its increasing wide acceptance for various applications, it would be worthwhile that their developers prepare a common specification based on XML for the inputs and outputs of their programs. If such a standard was developed, it would ease tremendously the documentation of the parameters used, as well as their sharing with interested users, as well as the integration of seasonal adjustment in state-of-the-art production environments.

Therefore, we conclude with the following two recommendations:

Recommendation 11 *Statistical agencies should maintain metadata on seasonal adjustment of sufficient extent to enable outside users to seasonally adjust in a consistent way other series from the same statistical program that may not have been seasonally adjusted.*

Recommendation 12 *To present quarterly or monthly growth rates at annual rates, annualized period-to-period growth rates should not be used; the year-over-year growth rates are preferable. However, it is recommended that the annualized semi-annual growth rates should be considered instead of the year-over-year ones as they react more quickly to current economic conditions, and as they are much less volatile than the annualized period-to-period growth rates.*

4. Our recommendations

To conclude this paper, we recapitulate here our recommendations.

Recommendation 1. *When seasonality is present and can be identified, sub-annual indicators should be made available in seasonally adjusted form. The level of detail of indicators to be adjusted should be chosen taking into account user demand and cost-effectiveness criteria. The adjustment should be applied appropriately using the method chosen as a standard by the agency. The method used should be explicitly mentioned.*

Recommendation 2. *When series are adjusted for seasonal variations, including trading-day effects and other regular calendar variation if present, they should be referred to as* ***seasonally adjusted.***

Recommendation 3. *Series with no identifiable seasonal variations but with identifiable regular calendar variations, such as trading-days, should be so adjusted with the most appropriate techniques, and should be referred to as* ***calendar adjusted.*** *When no seasonal effects are contained in the raw series, the seasonally adjusted results are equal to the calendar adjusted figures. When no calendar effects are present in the raw series, the calendar adjusted results are equal to the raw data.*

Recommendation 4. *When applicable, the focus of press releases concerning the main sub-annual indicators should be on their appropriately seasonally adjusted version. Where there is a user demand, the agency may also disseminate intermediate components of the seasonal adjustment process (e.g. series*

adjusted for calendar effects) but it should be clearly indicated that the focus is on the seasonally adjusted data.

Recommendation 5. *For sub-annual data expressed in levels, seasonally adjusted figures should be presented in their natural form; i.e. seasonally adjusted sub-annual data expressed in levels should not be grossed up and presented in annual terms.*

Recommendation 6. *Press releases presenting seasonally adjusted flow series should at the minimum provide the period-to-period change in levels and, where space permits, the period-to-period growth rate for the latest period.*

Recommendation 7. *To present quarterly or monthly growth rates at annual rates, annualized period-to-period growth rates should not be used; the year-over-year growth rates are preferable.*

Recommendation 8. *It is recommended that the annualized semi-annual growth rates should be considered instead of the year-over-year ones as they react more quickly to current economic conditions, and as they are much less volatile than the annualized period-to-period growth rates.*

Recommendation 9. *Statistical agencies should disseminate a non-technical explanation of seasonal adjustment and its interpretation for the benefit of and aimed at the general public.*

Recommendation 10. *For the benefit of users requiring information about the validity of the seasonal adjustment applied, statistical agencies should provide a minimum standard of information facilitating an assessment of the reliability of each seasonally adjusted series.*

Recommendation 11. *Statistical agencies should maintain metadata on seasonal adjustment of sufficient extent to enable outside users to seasonally adjust in a consistent way other series from the same statistical program that may not have been seasonally adjusted.*

Recommendation 12. *To present quarterly or monthly growth rates at annual rates, annualized period-to-period growth rates should not be used; the year-over-year growth rates are preferable. However, it is recommended that the annualized semi-annual growth rates should be considered instead of the year-over-year ones as they react more quickly to current economic conditions, and as they are much less volatile than the annualized period-to-period growth rates.*

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