Application of Concurrent Seasonal Adjustment to the Consumer Price Index[1]

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Key words: seasonal adjustment, concurrent adjustment, seasonal revisions, forward factors, CPI, BLS, Australian Bureau of Statistics, SEASABS, X-12-ARIMA

GENERAL INTRODUCTION

Background

The use of concurrent seasonal adjustment has received increasing attention from national and international statistical organizations for over 20 years. The long term trend toward greater demand for timely and accurate data, dramatically declining computation costs, and advances in statistical methodologies has led to a growing willingness to consider and adopt new methods of seasonal adjustment such as concurrent adjustment. Furthermore, the presence of established users of concurrent adjustment (Statistics Canada, US Census Bureau) and relatively recent users (US Bureau of Labor Statistics Current Employment Survey, Australian Bureau of Statistics Retail Trade Series) indicates that the benefits of switching to concurrent adjustment from the more established forward factors method are well understood by these organizations and many others worldwide. As the practice and understanding of concurrent adjustment increases, analysts will continue developing new methods to generate the most current and accurate seasonal data. In keeping with this growing trend, this paper seeks to evaluate the concurrent method for use on the US Bureau of Labor Statistics Consumer Price Index (CPI) and draws upon the approach developed by the Australian Bureau of Statistics (ABS) for its retail and business time series (Quarterly Economic Activity Survey (QEAS)).

A major distinction between forward factor seasonal adjustment and concurrent adjustment is the use of the most recent 12-months seasonal factors under the forward method as a proxy for current period seasonal factors. Concurrent adjustment uses the most recent data up to the current time period (month or quarter) to estimate the seasonal component. The former provides static estimates once per year and the latter creates accurate but less static estimates as new data are introduced each time period. Since 1996, the CPI has used the X-12-ARIMA forward factor approach to compute new seasonal factors to be applied to monthly unadjusted indexes in the upcoming new year. The estimates of the entire previous year's factors are created and then revised with the next annual data, resulting in more stable backward revisions. This provides more conservative estimates based on longer term trends that are allowed to develop more fully before factor calculations are made. However, limiting the number of revisions using longer-span data may not be as precise in reflecting contemporaneous movements that can give earlier indications of trends. By more frequently updating estimates of trend, irregular, and seasonal components the concurrent adjustment method produces more dynamic and hence more accurate estimates, on average, of the final seasonally adjusted benchmark values of a time series. This frequent revising is an advantage because concurrent uses past data to generate up-to-date versions of seasonally adjusted values for the current time period. Every adjusted observation is thus more likely to converge and stabilize to its long run final values during subsequent estimates.

This study uses the ABS' approach outlined in "Review of Concurrent Adjustment for Retail and its Application to QEAS" (2001) using monthly data and a longer data span. It also draws upon some of the ABS' prior work in its Information Paper, "Introduction of Concurrent Seasonal Adjustment into the Retail Trade Series" (1999). Readers should refer to these papers for further background details as some aspects of their applications are only summarily or briefly addressed here. The ABS work provides a unified framework, clear analytic observations, and a practical application of concurrent adjustment. Rather than focusing on concurrent adjustment theory, this analysis emphasizes the application of the concurrent method using simulations of monthly CPI data. It also relies on the SEASABS software which is an X-11(enhanced) based approach for adjusting time series data.

Compared to its traditional forward factors method, the ABS finds "there are substantial gains in accuracy for concurrently adjusting quarterly series"(2001)[2] and demonstrates that the more frequent revisions compared to forward adjustment result in faster convergence to standard benchmark values for any given quarterly observation within a sub-span of concurrently run values. These results are expressed as average absolute revisions (AAR), or the mean absolute difference between the concurrent revisions and benchmark values versus the differences between forward revisions and benchmark at given lags of the time series. Graphs of the average revisions show clearly that percentage changes in revisions are fewer under concurrent adjustment compared to forward adjustment, with supporting evidence provided by measures of period-to-period movements, stability of trend and adjusted series rating (STAR), and level estimates of change.

In its application of concurrent adjustment to higher level aggregate series, the ABS expected that:

[2] Mark Zhang and Andrew Sutcliffe "Use of ARIMA Models for Improving the Revisions of X-11 Seasonal Adjustment" Time Series Section, Australian Bureau of Statistics, November 2001, page 1

> the gains from using concurrent to be even greater for the disaggregated lower level series, where the data would be expected to contain a higher degree of volatility. The ABS has examined the performance of the concurrent methodology on many of the component series in the retail trade group and found that there were consistent gains for the group as a whole (2001).[3]

For the CPI, the stability and quality of lower level components is also important because these lower level components are adjusted before aggregation to US All items and other special aggregates.

Another observation by the ABS is that concurrently adjusted quarterly data are more stable than monthly data, and that revision gains would be less substantial with monthly data (2001)[4]. By using monthly CPI data for US level series, we can observe the extent of gains, if any, under concurrent adjustment and determine how monthly series exhibiting varying levels of volatility behave compared to the forward factor method. An additional feature of the study is based on the ABS' observation "it is important to use a long data span when estimating average revisions so that the results will be representative" (2001)[5] for which the CPI analysis used 12-15 years of data, versus approximately 5 years in the QEAS study.

Before CPI concurrent simulations are run, the test input series are analyzed using standard quality control diagnostics. Several stability measures (F(s), F(m), M7, and Q) are reported for each test component series after estimation in X-12-ARIMA. These measures are used during the annual CPI seasonal analysis as guides for evaluating and maintaining the quality of the seasonal data. They are also applied to the concurrent simulations to identify similarities or differences in results produced during the most recent annual seasonal work.

There are also several issues related to implementing concurrent adjustment that need to be examined, such as: how to use all currently available data to estimate seasonally adjusted trends in a monthly production process; determining how frequently revisions are to be made to previous estimates; setting policies regarding publication of concurrent data; establishing intervention analysis procedures; and developing seasonal adjustment diagnostics. Data quality, timeliness, transparency, and relevance are thus fundamentally important to the CPI program and to the data-using community. Identifying opportunities for improving methods and practices while establishing and remaining consistent with acceptable standards for concurrent adjustment standards is a worthy goal. This paper takes the first step in measuring the effects of estimating concurrently adjusted data using monthly CPI-U, US level time series indexes.

The paper is divided into 6 major sections with an overview of key concepts in CPI seasonal adjustment followed by a discussion of concurrent seasonal adjustment background, an outline of the study's design, the concurrent analysis results, a summary and discussion, and appendices.

<u>Seasonal Adjustment in the CPI</u>

CPI seasonal factors are computed for the most recent past year and are applied to the upcoming 12 months of unadjusted data. While 8 years of data are used in seasonal computation, forward factors are revised for 4 years following an observation's first year estimate. This results in a final value that is 5 years old and expected to be closer to the true seasonal trend.

There are 73 seasonally adjusted components of the CPI-U, US All items index (see list in the Appendix A). The seasonal movement of the All-items index and other aggregations are derived by aggregating seasonally adjusted component indexes. Each January the seasonal status of every index series is reevaluated based upon statistical criteria. An index can change seasonal adjustment status from seasonally adjusted to non-seasonally adjusted, or vice versa. During mid-February each year when January data are released, revised seasonally adjusted indexes are published and new seasonal factors for the upcoming year for these items are available to data users. The CPI uses the U.S. Census Bureau's X-12-ARIMA (auto-regressive integrated moving average) seasonal adjustment software. X-12-ARIMA was developed as an improvement over the previously used X-11-ARIMA methodology. X-12-ARIMA uses the X-11 seasonal adjustment method in conjunction with regression-ARIMA modeling for intervention analysis and data extension.

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[3] Ibid, page 28
[4] Ibid, page 30
[5] Ibid, page 40

Seasonal statuses of CPI series are evaluated each year, resulting in a decision to either "adjust" or "not adjust". The X-12-ARIMA procedure is applied to adjusted series. Non-adjusted series are combined with adjusted series and aggregated to estimate seasonally adjusted data for the higher level (i.e., indirectly adjusted) All-items, major groups, and special aggregates. Quality control diagnostics are used to monitor any residual seasonality which might exist in the irregular component of each series.

Concurrent Adjustment Studies

Numerous studies have demonstrated the advantages of concurrent adjustment. Kenny and Durbin's (1982) empirical study found "significant overall advantages" to concurrent adjustment over forward adjustment in improving local trend estimates. This work was supported by McKenzie (1984) who found greater general accuracy in estimates of the final level and month-to-month movements for Census Bureau data using X-11, as well as fewer extreme deviations from the final values. Shulman (1984) identified overall improvement in X-11 based concurrent trend estimations versus projected factors. Dagum and Morry (1984) noted the existing literature on the advantages of concurrent but added "the benefit of using concurrent seasonal factors is practically null, however, if seasonality is very regular or if the most recent values are strongly contaminated by outliers". Dagum (1986) analyzed the consistency of forward and concurrent filters on revision frequencies and recommended combining the two revision methods. Pierce and McKenzie (1987) showed the theoretical expected gains from concurrent factors relative to forecast-augmented factors and to the amount of preliminary data error in the not-adjusted series. Bobbitt and Otto (1990) tested the improvement in X-11 forecasts via extensions to concurrently adjusted series and found these forecasts did no worse than ARIMA fitted models.

Within BLS, a study of industry employment statistics by Kropf, Manning, Mueller, and Scott (2002) concluded that concurrently adjusted employment data are more accurate, leading to fewer revisions between the primary estimates and final benchmark series. They also observed that using concurrent adjustment would be advantageous during the Current Employment Survey (CES) program's conversion to NAICS. Methee and McIntire (1987) found noticeable improvements in both the level and the month-to-month changes for employment/unemployment component series using concurrent adjustment. Buszuwski (1987) found that using concurrent adjustment combined with ARIMA forecasting reduced the mean absolute error of seasonal revisions relative to estimates without forecasting.

In addition to consideration of concurrent adjustment, improvements and streamlined seasonal adjustment practices in the CPI have a long history. Development of BLS seasonal adjustment concepts and practices was first described in the published bulletin, "The BLS Seasonal Factor Method (1960)", in which seasonal adjustment was initially applied to labor force series. CPI seasonal factor data first appeared in 1963 on a limited basis for 66 selected series from 1953-1961. This data was revised in the early 1960's incorporating refinements in seasonal methodologies and in computer punch-card programming techniques. Furthermore, advances in mainframe computer technology in the 1970's allowed faster and more systematic analysis of seasonal indexes. By 1980 the development of the Census Bureau's X-11 program (and later versions) further raised processing speeds and allowed increasingly sophisticated calculations. In 1989-1990, the CPI began using the X-11-ARIMA and RAMP programs to automate and improve the quality of seasonal adjustments. In 1993 the CPI switched to the improved version of X-11-ARIMA program known as X-11-ARIMA/88.

Official CPI adoption of the X-12-ARIMA standard in 1996 included development of a special graphical user interface (known as Vx12) plus several analytic support improvements introduced in subsequent years. In 2001 the CPI switched from using the special seasonal aggregation weights that had been used since 1982 and began applying the biannually updated aggregation weights used to calculate the monthly unadjusted indexes.

ANALYSIS DESIGN

Component Series and Testing

In simulating the ABS method using monthly CPI-U data, several seasonally adjusted test series were chosen to provide enough variability in results by reflecting a mix of characteristics such as the degree of volatility, the number of interventions, and experience with the series during previous seasonal adjustments. The initial sample consisted of the 73 seasonal components to All items, with a 9 series sample selected according to their weight and the characteristics above. The test series and corresponding item code identifiers are as follows: Owner's equivalent rent of primary residence (SEHC), Motor fuel (SETB), Electricity (SEHF01), Video and audio (SERA), Women's apparel (SEAC), Men and boys' apparel (SAA1), Utility (piped) gas service (SEHF02), Cereals and bakery products (SAF111), and Dairy and related products (SEFJ).

The simulation data span is 15 years plus 4 months from January 1990 to April 2004, a sufficient period for the movement patterns to fully develop in the unadjusted indexes. However, one series, Video and audio, was first calculated for the CPI in January 1993 so only 12 years and 4 months of data were available. Concurrent simulation results for this shorter series were compared to the longer-dated series and thus permitted some insight into the quality of concurrent adjustment resulting from a shorter span. Using 12-15 years of monthly data is a reasonable assumption based on the fact that concurrent results will be more representative with longer lengths. Both the forward and concurrent estimation use these 12-15 year spans to generate benchmark estimates. Concurrent estimates are generated using a 4 year plus 4 month subspan (January 1997 to April 2001) within the benchmarks.

Based on an enhanced version of X-11, SEASABS provides users with default options to automatically detect and fix specific data problems such as trend-breaks, trading day, and moving holiday and thus adjust for significant events specific to Australia (eg, Australia Day, Chinese New Year, Easter, Father's Day). None of these effects are required for CPI seasonal adjustment so the automatic options to apply the ABS corrective measures were not activated.

Other options available in SEASABS allow adjustments similar to those under X-12-ARIMA based seasonal adjustment. The SEASABS test options include application of 3x5 final seasonal filters; using 13 term Henderson filters to final factors; seasonal decomposition via multiplicative adjustment; and applying the default sigma limits (1.50 lower, 2.50 upper) for weighting extreme values. The 9 test component series' concurrent simulations consisted of simple SEASABS runs of non-interventioned 12-15 year data spans. These series are termed "Series1".

Stability Diagnostics

One indication of the quality of a concurrently adjusted series is the stability of final seasonally adjusted values and trend estimates. Seasonal stability in this paper is measured using diagnostic statistics calculated and reported along with outputs from seasonal adjustment programs such as X11 and X-12-ARIMA. They are used to determine if a time series' seasonality is present and identifiable in an adjusted series.

The statistics routinely used in the CPI (F(s), F(m), M7, and Q) are explained in more detail here.

F(s) is a test for the presence of seasonality assuming stability. Values greater than 7.0 indicate seasonality is present. Reported in Table D8 of X-12-ARIMA's output file, this diagnostic is the most important one used during seasonal adjustment.

F(m) is used to determine if the seasonal component is identifiable in the presence of moving seasonality. If moving seasonality is weak or not present, an acceptable F(m) value is 3 or less. It is reported in Table D8 of the X-12-ARIMA diagnostic output file.

M7 is the ratio of the amount of stable seasonality to the amount of moving seasonality. There are eleven M-values produced by X-11 based programs each measuring a different type of problem in the data series. M7 carries the highest weight among them and is sensitive to the overall quality of seasonal adjustment. Values can range from 0 to 3 but values less than 1 indicate the presence of identifiable seasonality.

Q is a weighted average of the 11 M-statistics generated in X-11 based programs. It is a global measure of the quality of seasonal adjustment. Values less than 1 indicate a good overall adjustment.

The **AIC** (Akaike's Information Criterion) is normally used to compare the goodness of fit among different ARIMA models using the same time series. In this paper, if X-12-ARIMA is unable to automatically fit a model, no AIC value will be reported. If a series without an AIC value improves with an adjustment procedure, a value will be reported. SEASABS version 2.4 does not contain a fully integrated X-12-ARIMA program so AIC values are not reported for concurrently adjusted series.

Stability is an important consideration in comparing concurrent and forward factor methods. Ideally, earlier observations should stabilize (i.e., not be subject to significant revisions) at some time point, while subsequent observations should converge quickly and smoothly to the final benchmark. We also expect series with lower STAR (Stability of Trend Analysis and Revision)[6] values, which measures the volatility of a time series, to have better stability statistics than series with higher STAR values. These are effects that can be tested through application of the concurrent method to monthly data.

Stability of Test Series

Prior to simulating concurrent adjustment, an evaluation of the suitability of the Series1 test series is needed to determine if they are stable enough to provide meaningful concurrent output. Each one was run using X-12-ARIMA with the default specification files normally applied during CPI annual production. The following results compared to the desired thresholds were obtained:

Table 1.	**F(s)>7**	**F(m)<3**	**M7<1**	**Q<1**	**AIC**
Series1.REQ.SEHC	15.483	3.183	0.731	0.39	31.6913
Series1.MotorFuel.SETB	6.960	4.112	1.179	0.86	NA
Series1.Electricity.SEHF01	414.124	6.466	0.179	0.20	475.3353
Series1.VideoAudio.SERA	15.672	1.634	0.616	0.39	135.8315
Series1.WomensApparel.SEAC	225.662	4.843	0.128	0.36	NA
Series1.MenBoysApparel.SAA1	112.010	3.877	0.288	0.38	417.6443
Series1.UtilityNatGas.SEHF02	10.538	2.539	0.833	0.63	NA
Series1.Cereals.SAF111	30.055	1.469	0.436	0.26	278.6636
Series1.Dairy.SEFJ	13.383	12.345	1.283	0.65	486.3780

"NA"=Not Applicable; X-12-ARIMA did not choose an acceptable model for this series.

In the CPI, all adjusted series are required to pass certain statistical diagnostics in order to be considered an acceptable adjustment. Table 1 column headings report the generally acceptable thresholds expected for seasonal stability. In some cases X-12-ARIMA did not identify acceptable ARIMA models and thus seasonally adjusted but did not provide AIC values for SETB, SEAC, and SEHF02. Interestingly, the results are generally acceptable when using the larger time span. F(m) results appears worrisome but F(m) is a minor diagnostic. F(s) is generally the most significant diagnostic showing total stable seasonality. M7 and Q also tend to be within acceptable ranges with some M7 results slightly above 1. Overall, using the longer-term, non-IASAed, unadjusted data will be reliable for SEASABS concurrent simulations. It is also expected that the problems encountered above will be mitigated to some degree by the more frequent revisions required as each month's data are adjusted concurrently.

Several of these series are subject to "intervention analysis for seasonal adjustment" to remove the effects of outliers and level shifts. For this paper, level shifts and outliers remain in the unadjusted test Series1 observations and are allowed to influence the concurrent simulation results.

Testing and Extreme Outliers

The issue of how to treat outliers and level shifts in a concurrent system deserves attention. The presence of these volatile data movements introduces a degree of error and bias into the resulting seasonal factors and adjusted time series.

Under the existing forward factors approach for the CPI, problematic outliers and level shifts are identified in the unadjusted data spanning the previous eight years. The extreme observations are carefully selected and analyzed. When significant outliers and level shifts are identified by the analyst, the Census Bureau's X-12-ARIMA software is used to estimate replacement values for the month(s) where the effects occur. The level shifts and outliers are removed from the original series prior to estimation of the seasonal factors. The seasonal factors are applied to the original series, and as a result the interventions remain in the seasonally adjusted data.

Monthly identification and removal of level shifts and outliers is problematic because their true magnitude, duration, and direction are revealed with only the addition of subsequent data. Unlike the benefit of hindsight permitted under a forward factor method, no confirming evidence in the current month will likely exist to indicate how an outlier or level shift movement will evolve in future months. This leads to ad hoc assumptions about the identification and removal of outlier/level shift effects, particularly among volatile CPI series such as motor fuels. This in turn creates uncertainty about

[6] See the next section, "The ABS and Concurrent Adjustment".

the appropriateness of choosing current and past outliers/level shifts, raising the potential for biased factor estimates at each concurrent revision.

One solution is to allow extraneous effects to remain rather than guess the direction, timing, and mix of level shifts and outliers. For some series this may mean waiting until December data are available and conducting an annual analysis in January. Given the complexity of CPI seasonal adjustment, any problems accurately identifying level shifts and outliers under a concurrent process would present difficulties in producing reliable estimates. Thus, demonstrating the revision gains from seasonally adjusting the CPI concurrently is the primary focus of this study, with the treatment of outliers and level shifts reserved for treatment in the section, "Adjustment for Extreme Outliers and Level shifts". Measuring the level of revision improvement from concurrent adjustment after the removal of level shifts is described in a later section.

This study assumes frequent updating will reduce the effects of outliers and level shifts on seasonal time series. Concurrent estimation is tested without resorting to problematic short-term identification decisions that can introduce bias and errors. Permitting level shifts and outliers to remain in the series during concurrent simulations allows more consistent assessments of how well the SEASABS method operates using different CPI series.

Summary

In determining the scope and level of simulations, several factors had to be considered. The quality of concurrent adjustment is a function of the frequency of revisions a given time series is subjected to, which is dependent on the number of observations. As more data are added, the X-11/X-12-ARIMA asymmetric filters become more accurate in extending the endpoints of the time series with forecasts and backcasts to estimate the final adjusted series. Shorter series tend to result in greater forecast errors, and thus greater error in estimates of trend and irregular components. As the number of observations grows, improved estimates of the seasonal patterns become apparent.

This is a volatility-based study of initial test series representing the wider-ranging patterns found in the monthly CPI. Noisy data purportedly can be adjusted more accurately under concurrent compared to forward adjustment due to the higher number of revisions. Less noisy data should show little gains from revision. Thus, choosing series with various volatilities provides insights at the range of gains under a concurrent CPI system. Emphasis is placed on three areas: (1) comparative analysis of stability statistics, (2) simulating the average revisions between the concurrent and forward factor methods, and (3) discussion about outliers and level shifts.

THE ABS AND CONCURRENT ADJUSTMENT

Readers may refer to the ABS papers for a more complete discussion on the application of concurrent adjustment. A condensed summary of concepts necessary for further reading are provided here. Monthly data are assumed in this section although this concept can be applied to other frequencies.

Average Absolute Revision

Several years of additional data from the initial introduction for a given month is needed for that observation to stabilize and thus be subject to very few revisions. This historically adjusted series is referred to as the "benchmark" estimate, or $X_{t,T}$, where X represents either the level or period movement of a series, t is a monthly point in time, and T is 3 years from the end of series. However, an updated simplification by the ABS for this algorithm requires only that the entire span including T be run to produce the benchmark series.

The concurrent method produces seasonally adjusted values using the data from the start of the span up to the latest observation. Each time this is done for a new observation, prior monthly estimates are revised with new seasonally adjusted values. Each monthly concurrent update produces revised values that are more likely to converge to the benchmark.

To compare forward and concurrent simulations, revisions against the benchmark for t are run for a sub-span of data between 7 years after the first observation and 3 years (T) before the end of the series. Seven years are needed to produce reliable estimates and 3 years at the end of the series are isolated to keep the final estimates from being changed by revisions. The revision against the benchmark is interpreted as the total level of revision required for an estimate to reach the benchmark; i.e. the estimate for a particular time t after more than 3 years (T) of additional data becomes available. Thus, T represents the total remaining revision from the concurrent estimate from *k* periods ago (or lag k) to the final estimate.

The revision against the benchmark at a given month t is initiated by the addition of an unadjusted observation at each point in a defined lag k range. For example, lag k=0 indicates estimating the seasonally adjusted value up to and including the month of interest t; k=1 indicates the seasonal adjustment using the month ahead data from t; k=2 is the estimated value two months ahead of t, etc. At the end of lag k, the revision restarts with (t+1, k), (t+2, k),..., (T-t, k). The longer the value of k the more frequently the earlier or "lagged" data will be revised.

For all values t there is a set of revised seasonally adjusted values. As more observations across t and k are used in the sub-span of the benchmark, the frequency of revisions to observations increases, and hence the faster the convergence to benchmark. Estimates of the revision experience of a sub-span generated during a concurrent simulation will usually measure the level of revision that can be expected for the entire time series. The earliest observations will be revised most often and not converge as quickly as later observations, but are more accurate compared to forward factors in those time periods. However, as newer data are received and because the information contained in them is more recent, the improved seasonal estimates converge more closely to the benchmark compared to forward factors.

The percent revision for each observation X in period (t,T) and for lag k is defined below in Equation 1:

$$R_{t,k}^{X} = 100\left[\frac{\left(\hat{X}_{t,k} - X_{t,T}\right)}{X_{t,T}}\right]$$

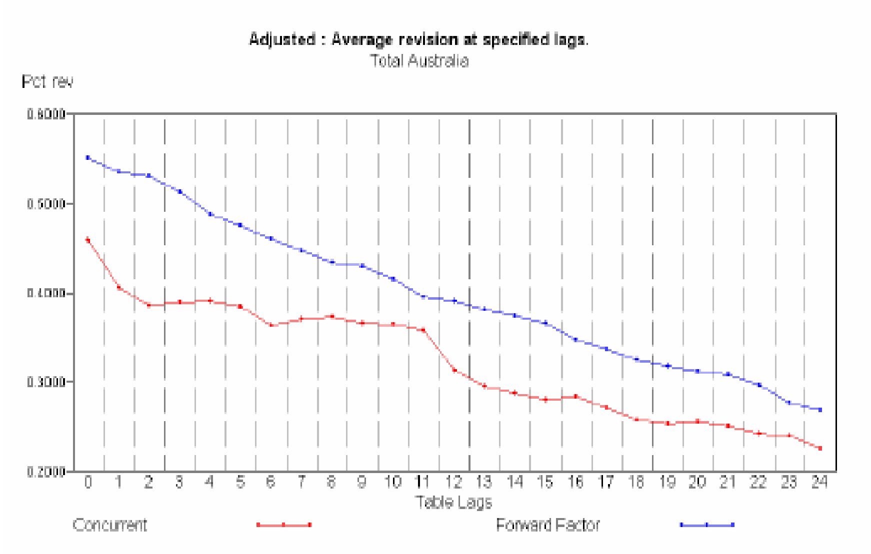
Where $\hat{X}_{t,k}$ is the estimate of the quantity of interest as either the level or period-to-period movement of the seasonally adjusted series at period t using all data up to t+k. $X_{t,T}$ is the benchmark estimate for t using all data up to T.

The Average Absolute Revision (AAR) is defined as measurement of the revisions at a specific lag k, in Equation 2:

$$\overline{R}_{k}^{X} = \frac{1}{n_k}\sum_{t=s}^{e}\left|R_{t,k}^{X}\right|$$

where t=s is the start and t=e is the end of the simulated revision span, respectively, and n_k is the number of observations in the simulated revision span at lag k. This formula measures the average absolute revision between the benchmark at time t versus the simulated estimates produced at time t for each k period observation in the future, for all values of t. Equation 2 is applied to both concurrent and forward factor methods to compare the rates of convergence to their respective benchmarks.

The AAR can be depicted graphically to map the percentage movements and levels of convergence at each lag k. In the ABS example below, the dot points represent the AAR, to the level estimates, at specified lags for k=24. The blue and red lines are the AAR, to the level estimates, experienced under forward factor and concurrent analysis, respectively. At each lag, the concurrent point/line segment is lower than the forward factor's, indicating faster convergence to benchmark and greater gains from seasonal revisions by switching to concurrent adjustment.



Stability of Trend Analysis and Revision

In addition to the AAR, the ABS applies the Stability of Trend and Adjusted series Rating (STAR) developed by Sutcliffe (2000). It is a summary measure of the amount of average absolute percentage movement in the irregular component of an adjusted series, defined in Equation 3:

$$STAR = \frac{1}{N-1}\sum_{t=2}^{N}\left|100\,\frac{(I_t - I_{t-1})}{I_{t-1}}\right|$$

where I_t is the irregular component at time t and N is the number of observations in the time series. The larger the STAR value, the greater the volatility and thus the greater expected gains from seasonal adjustment and trend revision. Series with lower volatility will generally have lower STAR ratings, indicating that average revisions are smaller and convergence faster than relatively more volatile series. Although revision gains are expected to be greater for higher STAR values, it is more desirable that revisions are minimized at each update and that adjusted estimates converge quickly to final benchmark values.

The ABS study notes that the STAR measure is a rough preliminary guide for the actual gains from concurrent, as each series varies in the amount of volatility and in the quality of seasonal adjustment when new data are added. Values greater than 10 for monthly time series are considered volatile; however, volatility definitions will vary depending on the type of data series, how it is generated, its historical patterns, and the data users' experience. Both X-11 and X-12-ARIMA estimate this value as an automated output statistic found in Table F3A, the first row of column D13-I. The degree of stability or instability for time series cited in this paper is determined by the range of variation in the STAR values produced by the seasonal adjustment methods.

ANALYSIS RESULTS

Concurrent Test Series

Application of concurrent methodology using SEASABS on SERIES1 with a 15+ year span of data is compared to results of the original X-12-ARIMA forward factors results calculated using 5-8 years of data as is done in CPI production. These X-12-ARIMA forward seasonal adjustments are termed "Standard Benchmark" (StdBench). The goal of this work is to determine if concurrent adjustment compares favorably to the standard CPI adjustment methodology. By contrast, for the ABS papers and AAR graphs, "standard benchmark" refers to the X-11 adjustment of the entire data span (typically 15 years in this study) to measure the rates of convergence between the forward and the concurrent methods. The standard benchmark for concurrent simulation purposes is the seasonal adjustment using the entire dataspan of each time series.

Quality control statistics and Annual Average Revisions (AAR) graphs for seasonal factors are reported for each simulation. Note that the concurrent runs, which include the forward factor simulation, can only be applied to directly adjusted series.

This is because forward factors cannot be simulated for indirectly adjusted series. Thus, the following examples are direct adjustments only.

Dairy and related products Example

Series1 concurrent adjustment uses a 15 year plus 4 month span, versus 8 years for the X-12-ARIMA forward adjustment, Dairy(StdBench). Concurrent adjustment should result in increased overall gains, on average, to seasonal factors compared to the forward factor method. Contrary to expectation of divergent results between StdBench and Series1, the results here demonstrate consistent gains in both the simulated concurrent method and the status quo forward factor method:

Table 3a.	STAR	F(s)>7	F(m)<3	M7<1	Q<1	AIC
Dairy, Series1	0.37	12.593	10.612	1.240	0.92	****
Dairy (StdBench)	0.32	14.578	10.206	1.136	0.58	305.1596

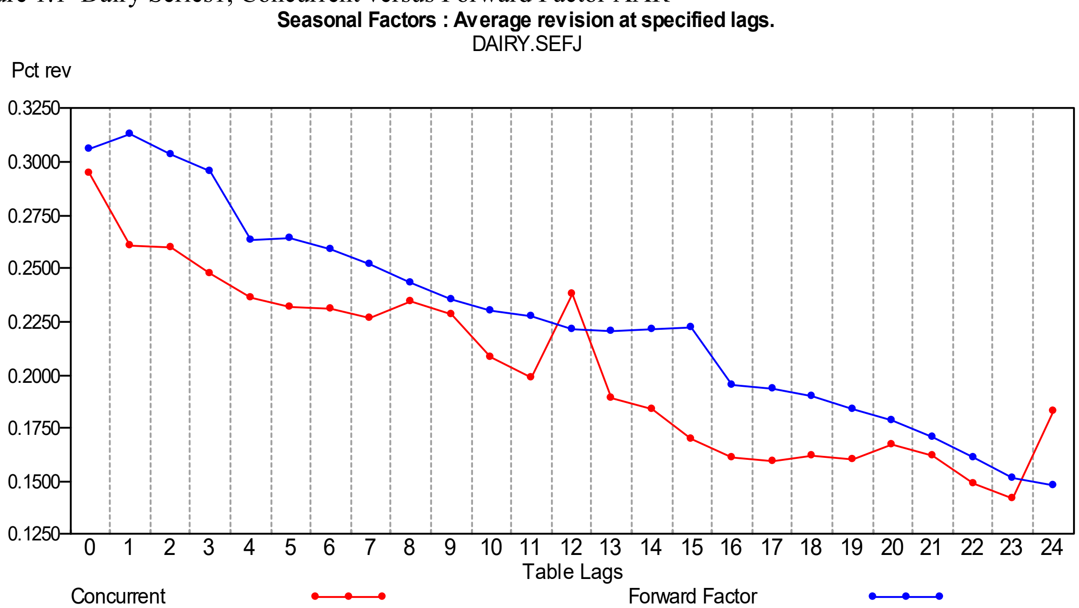
**** Not available.

Both results are generally unstable with high F(m) and M7 values, although DairySeries1 is marginally more unstable than Dairy(StdBench). The STAR values, while very low (clearly less than 1), is highest for Series1, indicate slightly worse volatility. F(m) is quite high in both cases. This indicates that high levels of seasonality remain undetected by the two methods, compared to the fairly stable F(s) values that indicate some acceptable stability in the series. The time series is a candidate for further investigation and work, but the results are not inconsistent.

Graphically (Figure 1.1), Series1 concurrent adjustment converges faster on average than its forward factor method. The blue forward factor AAR line of Figure 1.1 is the expected convergence path for Dairy(StdBench) using the longer span in X-11 and other assumptions of this study. The positive gains from concurrent are the areas of vertical difference in percentage revision (PCT REV) between the blue (forward) and red (concurrent) at the lines and points at every lag. DairySeries1 shows that the concurrent AAR converges overall faster than their forward AARs, thus producing positive gains from revisions under concurrent adjustment at each lag.

The decline of revision efficiency at lags 12 and 24 occurs when a second observation of the same month is available and a better estimate using the symmetric seasonal moving average is used (see ABS (2001) technical notes).

Figure 1.1 Dairy Series1, Concurrent versus Forward Factor AAR



Electricity Example

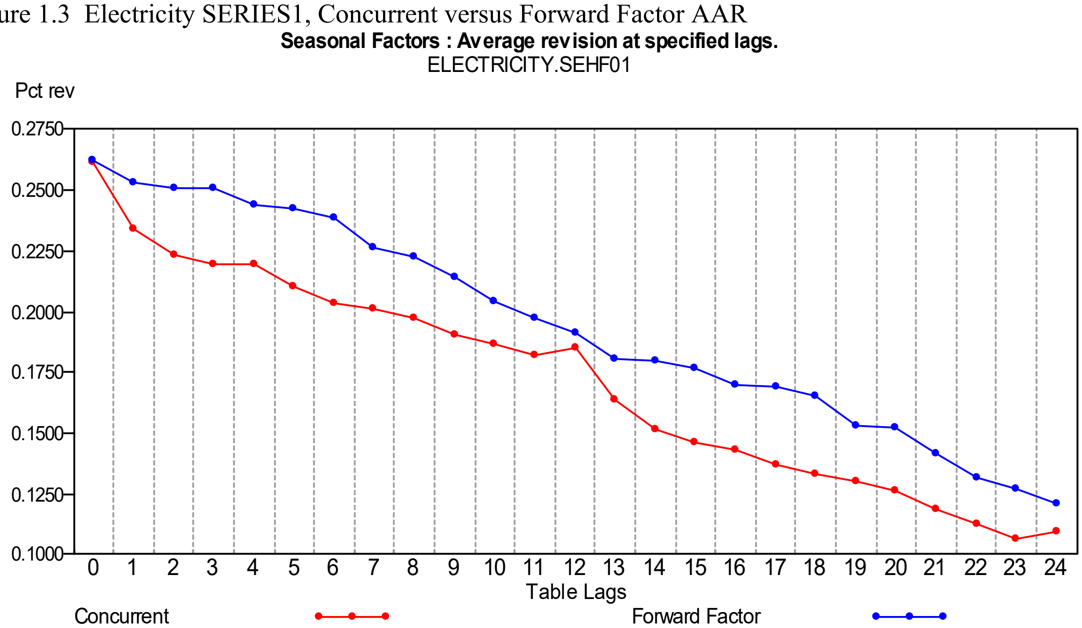
For Electricity (SEHF01), a highly seasonal series with interventions, the results are clearer:

Table 3b.	STAR	F(s)>7	F(m)<3	M7<1	Q<1	AIC
Electricity, Series1	0.41	422.364	6.061	0.173	0.22	****
Electricity (StdBench)	0.28	329.513	5.560	0.190	0.22	260.9612

**** Not available.

As in Dairy, ElectricitySeries1 has the higher relative STAR value compared to Electricity(StdBench), indicating greater volatility in the longer span. Series1 has the greater acceptable F(s) and a larger F(m) compared to StdBench. In actual CPI production, significant level shifts are identified and removed for this series so we do not know beforehand to what extent revision improvements for concurrent estimation would be achieved if IASA was applied. Graphically, concurrent Series1 AAR is superior to forward factors.

Figure 1.3 Electricity SERIES1, Concurrent versus Forward Factor AAR



Motor fuel Example

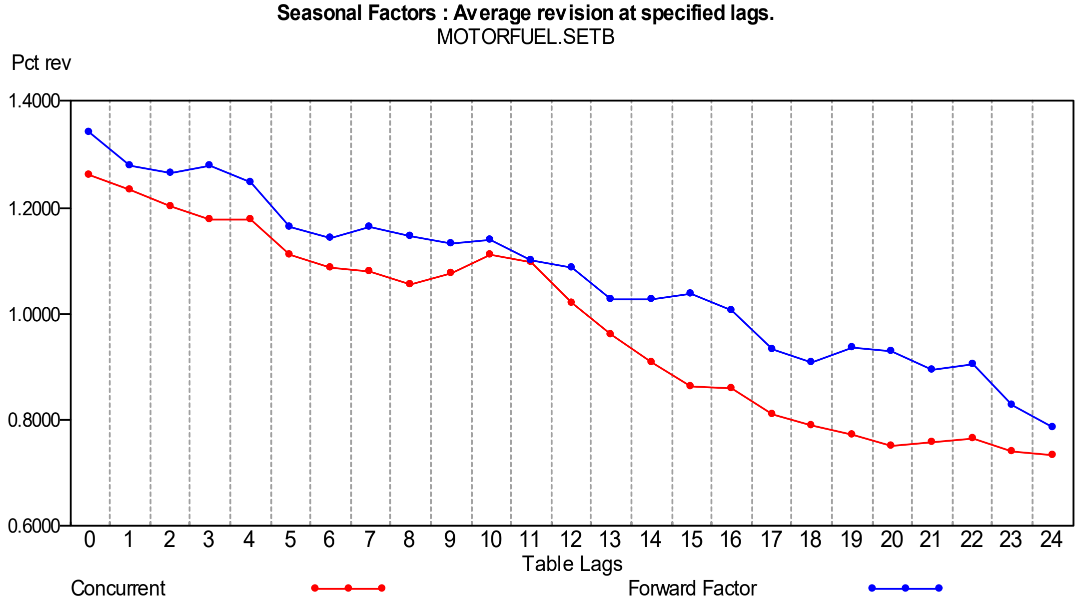
The third IASA series, Motor fuel (SETB), is a more volatile series.

Table 3c.	STAR	F(s)>7	F(m)<3	M7<1	Q<1	AIC
Motor Fuel, Series1	2.03	7.541	3.836	1.108	0.98	****
Motor Fuel (StdBench)	1.14	6.355	4.043	1.227	0.91	**

**** Not available. **No Model Chosen in X-12-ARIMA.

Series1 is a marginal improvement over Motor Fuel(StdBench) although both experience slightly less acceptable F(m) and M7 values and borderline Q. However, X-12-ARIMA was unable to identify an acceptable model for Motor Fuel(StdBench), indicating a high degree of volatility in the the unadjusted series. Series1 should converge faster on average than Motor Fuel(StdBench) based on Series1's larger STAR value, which roughly predicts larger gains in the level of revisions the greater the volatility of a time series.

Figure 1.5 Motor Fuel SERIES1, Concurrent versus Forward Factor AAR



In Figure 1.5, concurrent revisions again show overall better convergence than forward revisions. However, deterioration in the AAR occurs at lags 8-11 following a period of more smoothly declining convergence. Long-lived adjustment effects at those lags deteriorate the quality of AAR revisions before returning to its downward trend slope. The revision point at lag 11 touches but does not exceed the forward factor revision, indicating that extreme adjustment effects are on average modest. Despite the low stability, this series experiences a large average distance of gains in PCT REV between lags 0 and 24 of approximately 0.5 percentage point (1.25 minus 0.75). This is preliminary evidence of gains from concurrent adjustment helping to achieve faster and larger revisions than forward adjustment for volatile time series.

At longer lags, Series1 settles near a PCT REV range of about 0.7 or 0.8. The stable slopes of revision improvement at these longer lags (20-24) suggest the percentage concurrent revisions rate of change are most rapid in the earlier lags 0-7 and at lags 13-20. However, the greatest average gain versus forward factors as shown by the vertical distances between the pathways is concentrated in lags 14-22 at varying degrees due to the less stable forward revisions. The greatest overall revisions are thus still achieved in concurrent adjustment than in forward adjustment.

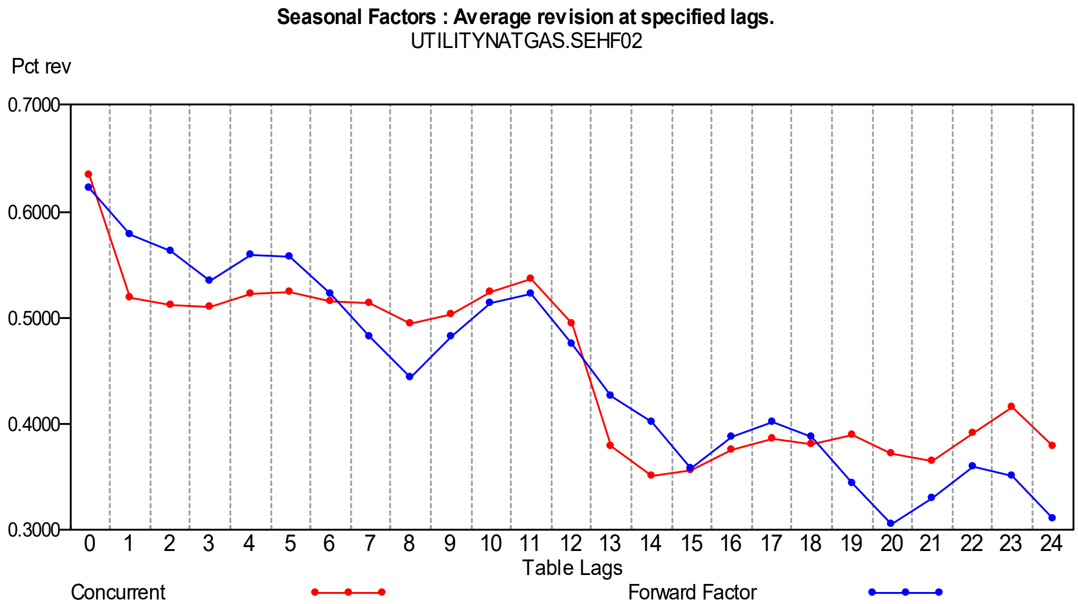
Utility (piped) gas service Example

Unlike the previous examples, Utility (Piped) Natural Gas' Series1 results are generally more acceptable than StdBench while the difference in STAR scores is not excessive. Its F(m) value is just below the acceptance boundary and F(s) is more than twice that of Utility Nat Gas(StdBench) indicating increased stability from the adjustment, although StdBench's F(m) is more acceptable. M7 and Q are also improved, particularly for the M7 ratio which represents whether identifiable seasonality is present.

Table 3d.	STAR	F(s)>7	F(m)<3	M7<1	Q<1	AIC
Utility Nat Gas, Series 1	1.17	11.361	2.751	0.819	0.80	****
Utility Nat Gas (StdBench)	1.05	5.276	1.269	1.012	0.77	500.7268

**** Not Applicable.

Figure 1.7 Utility Natural Gas SERIES1, Concurrent versus Forward Factor AAR



Despite generally better diagnostics, Figure 1.7 shows Series1 produces problematic mixed average absolute revisions. At some lags forward adjustment converges faster than concurrent, and vice versa. Visual inspection reveals that forward adjustment is on average better than concurrent, with cyclical peaks and troughs at certain lags. Concurrent AAR improves initially at lags 0-1 then shows no appreciable declines until lags 12-13. By comparison, forward AAR revisions generally decline in trend but with decreasing amplitude. The mixed effects are due to volatility during the past five years in the unadjusted series making identification of the series' components difficult. Utility natural gas is normally subject to IASA procedures to remove known significant extraneous movements. Hypothetically if its volatility could be accounted for by removal of level shifts and outliers prior to simulation then we should see further improvement in its diagnostics. Without empirical testing however, it is speculative to conclude whether or not such improvement leads to concurrent revision gains over the forward factor case. The AAR trends and lack of clear support for either approach suggests further investigation is needed.

Remaining Test Series Examples

The five remaining CPI test series— Cereals and bakery products (SAF111); Men and boys' apparel (SAA1); Women's apparel (SEAC); Owners' Equivalent rent of primary residence (SEHC) or "REQ"; and Video and audio (SERA)—are components to seasonally adjusted All items. They illustrate several types of convergence profiles that may be more or less typical depending on the data span, whether seasonality is identifiable, and the degree of stability or instability.

Table 3e.	STAR	F(s)>7	F(m)<3	M7<1	Q<1	AIC
Cereals, Series1	0.19	28.606	1.316	0.440	0.32	****
Cereals (StdBench)	0.19	20.109	2.040	0.571	0.47	172.0122
MenBoysApparel, Series1	0.39	119.039	3.799	0.280	0.36	****
MenBoysApparel (StdBench)	0.44	71.403	4.666	0.383	0.39	242.7464
Women's Apparel, Series1	0.59	248.83	5.312	0.210	0.35	****
Women's Apparel (StdBench)	0.56	145.585	5.468	0.248	0.31	**
REQ, Series1	0.06	14.070	5.309	0.900	0.48	****
REQ (StdBench)	0.03	21.756	3.143	0.614	0.51	-56.0527
Video and Audio, Series1	0.20	15.119	1.140	0.590	0.60	****
Video and Audio (StdBench)	0.17	15.215	0.464	0.525	0.38	70.5217

**** Calculated but not reported in SEASABS. **No Model Chosen in X-12-ARIMA.

Except for Owners' Equivalent rent of primary residence and Video and audio, Series1 compares favorably overall against StdBench. F(s) values for Cereals, Men and boys' apparel, and Women's apparel are greater than StdBench. Series1 F(m), M7, and Q (except for Women's apparel) are generally lower than their counterparts. STAR values are at the general levels of StdBench. Note that REQ, a very stable trend series, has a very low STAR measure. Series1 in this case does not improve much over REQ (StdBench). Cereals, another very stable series but only slightly less so than REQ, has identical STAR scores but Series1 is an improvement over Cereals (StdBench).

Despite the other indicators, F(m) is above desired levels in Men and boys apparel, Women's apparel, and REQ, although the more important F(s) is acceptable for all Series1. Like the IASA series, STAR values here are also generally low, indicating that a value near or above 1.0 is likely a more accurate measure of high volatility in CPI-U series. Low M7 and Q scores in Table 3e also indicate generally similar estimates of moving and stable seasonality.

Series1's diagnostics show that its adjustments are better than or similar to their StdBench series. Only Video and audio (StdBench) and REQ (StdBench) appear to show a better quality adjustment over Series1. Series1 F(s) values are generally greater. One explanation is that concurrently adjusted Series1 simulations' longer (12-15 years) data spans are an advantage over the current forward factor method, which for StdBench are adjusted using 8 years of data, the minimum span needed. Another explanation is that the more frequent revision from updating each seasonal adjustment using new observations allows more accurate identification of the trend, irregular, and seasonal components relative to their long run values. The more frequent concurrent updates generate minor instability as indicated by the slightly high F(m) values, but creates more accurate seasonal factor estimates during each revision.

Graphical analysis reveals concurrent converges faster than forward factors to simulation benchmarks in the majority of cases.

Figure 1.9 Cereals Series1, Concurrent versus Forward Factor AAR

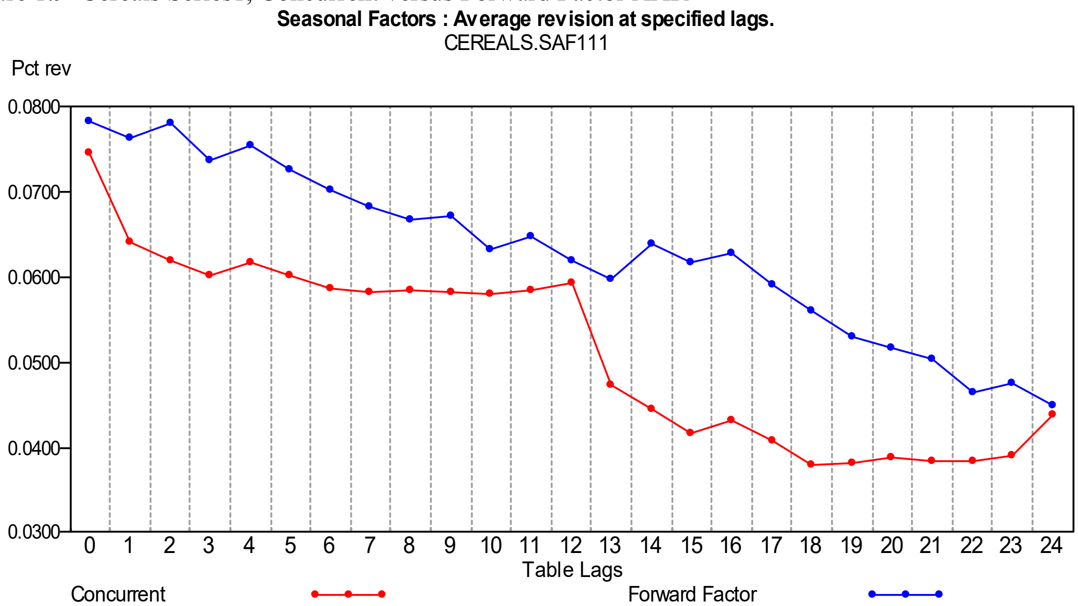


Figure 2.0 Men and Boys Apparel Series1, Concurrent versus Forward Factor AAR

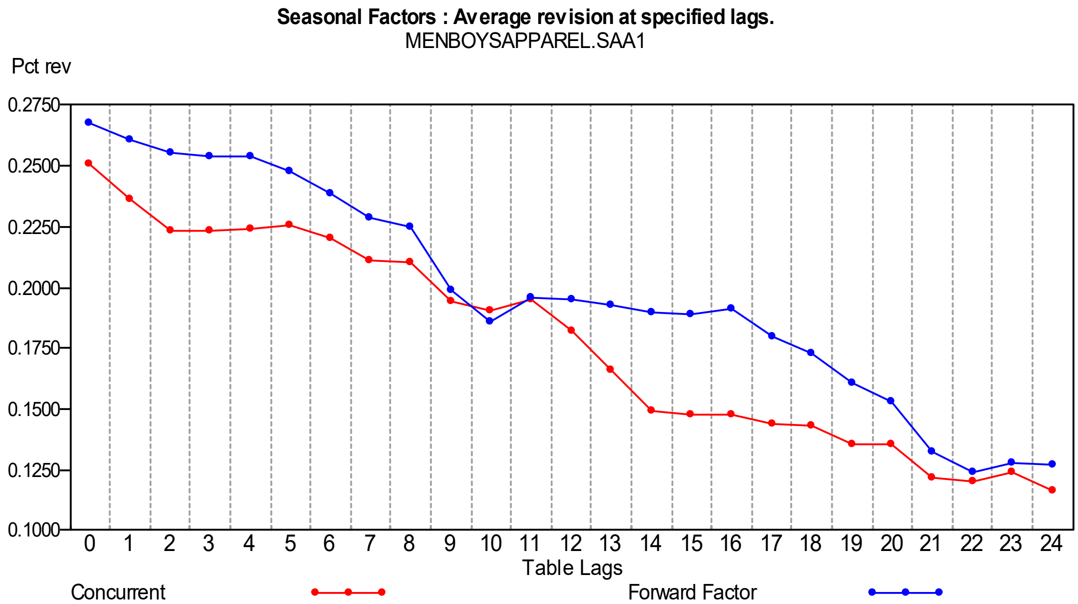


Figure 2.1 Women's Apparel Series1, Concurrent versus Forward Factor AAR

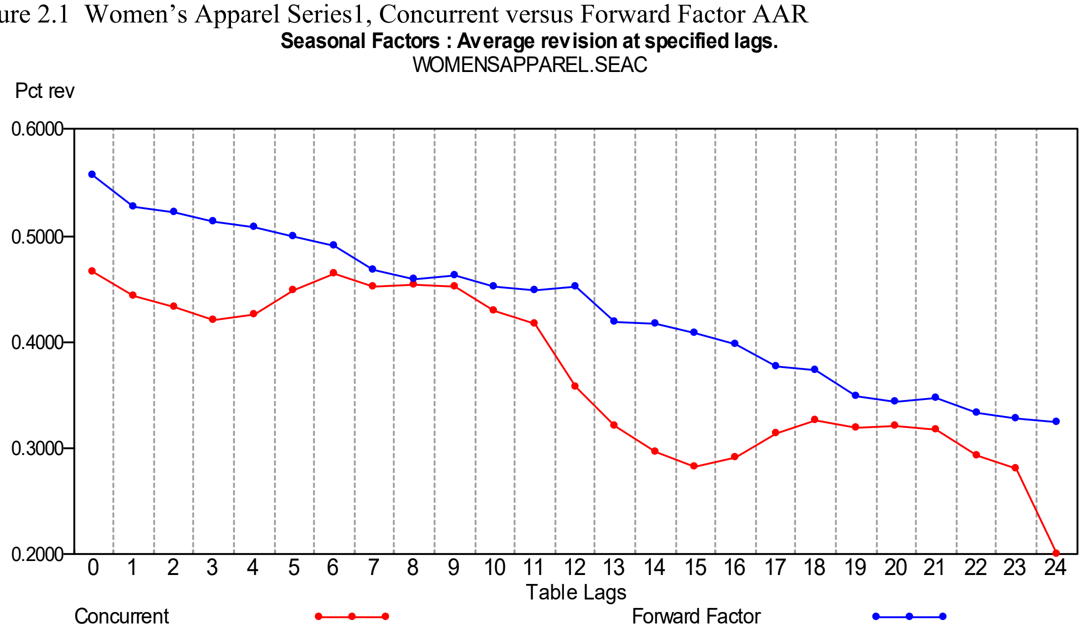


Figure 2.2 Owners' Equivalent Rent Series1, Concurrent versus Forward Factor AAR

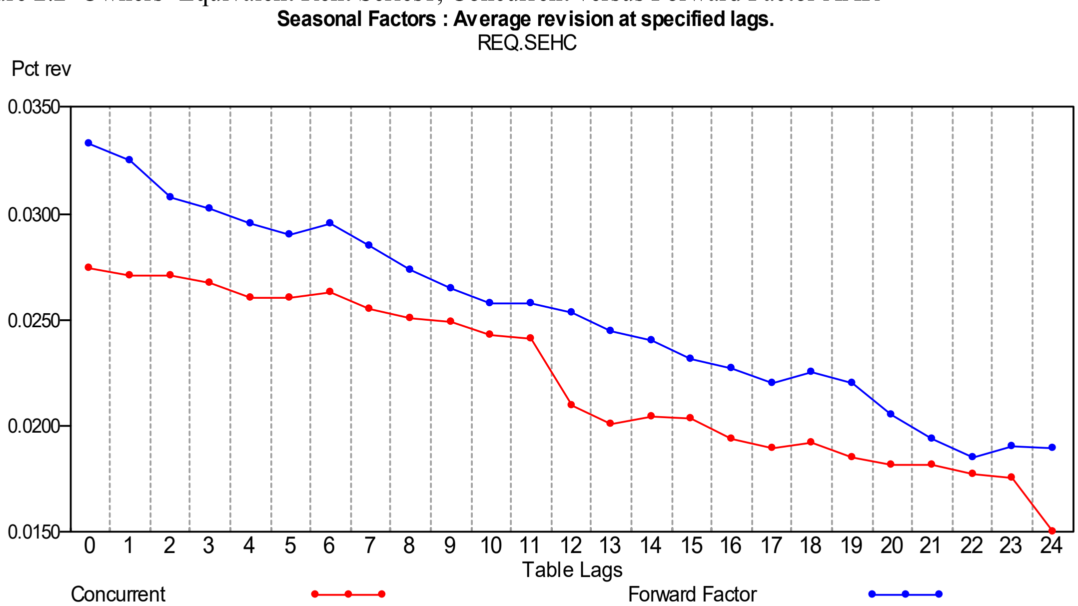
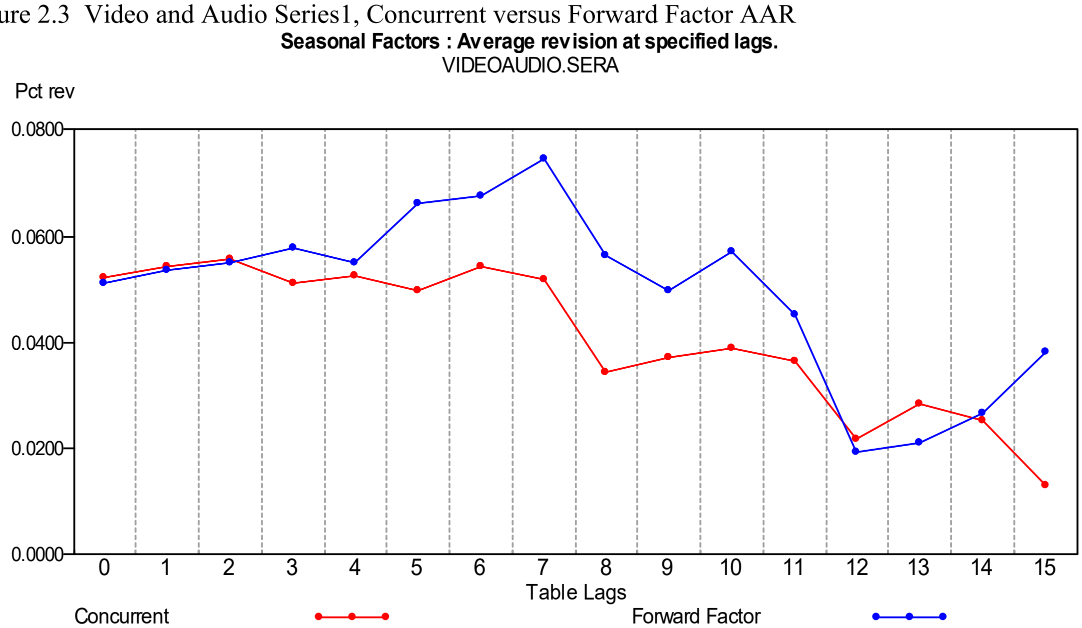


Figure 2.3 Video and Audio Series1, Concurrent versus Forward Factor AAR



Summary

Concurrent AAR graphs can vary widely relative to forward factor AAR, but the majority of cases tend to experience large revision gains in the initial lags. This suggests that positive gains in initial lags provide early indications of the gains that likely can be expected in later lags. Early or mixed losses in concurrent AAR, as in the Video and audio example, will likely indicate no practical comparative advantage of concurrent over the forward factor revisions. However, exceptions such as the Utility natural gas example illustrate that some early initial gains may not always lead to a clear advantage to either revision scheme. Studying how well span length and the degree of stability (or instability) in all seasonal CPI component series affect the performance of their concurrent and forward factor revisions would yield more precise information needed to describe their expected revisions history under a concurrent system. This would also help identify all specific cases where neither concurrent nor forward adjustment yields the greatest advantage and identify in what manner these cases are (or are not) problematic for seasonal factor estimates. This initial study using the SEASABS method of concurrent adjustment on CPI data shows that some unique and special cases do exist but are less common than cases where concurrent average absolute revisions are less than under the forward case.

Adjustment for Extreme Outliers and Level Shifts
This section focuses generally on the mechanics of adjusting for level shifts and outliers rather than on specific data simulations. This section serves as a guide for further investigation on this topic.

The Intervention Analysis Seasonal Adjustment (IASA) technique is used in the seasonal adjustment of the CPI to provide more accurate data. This process offsets the effects that extreme price volatility would otherwise have on the estimates of seasonally adjusted data. Intervention analysis is the prior adjustment of an index series before the calculation of the seasonal factors. Prior adjustment may be called for if an "outlier" or "level shift" occurs. (A "level shift" occurs when a good or service undergoes a unique, large, and rapid change in price level.) An example would be a large decrease in the price of gasoline due to the breakdown of an oil cartel. Removal of the level shift gives a clearer seasonal pattern and lessens the irregular component. When a level shift exists, intervention analysis helps to calculate more accurate seasonal adjustment data. Previous and current level shifts are published each January in the U.S. Department of Labor's January "CPI Detailed Report" http://www.stats.bls.gov/cpi/cpisaia04.pdf.

This study contains simulated concurrent adjustments of several higher-weighted component indexes to the CPI-U All items level. A few of these test series received intervention analysis to produce forward factors during the most recent seasonal production cycle.

The goal of the IASA process is to estimate movement due to unusual non-seasonal economic events (interventions). The resulting seasonal factors, which better represent the seasonality of the series, are then applied to the original series. As mentioned earlier, specifying level shifts and outliers presents challenges for concurrent estimation. Identifying and removing level shifts and outliers on a month-to-month basis in the CPI would likely result in identification errors. In practice, identification of interventions improves as time passes. In some cases, unusual movements can be identified immediately and the cause of the movement is widely known; in most cases, more is known about the cause of the movement months later.

In order to simplify analysis, CPI test series in this study have no IASA procedure applied to them prior to estimation in SEASABS. For volatile series, where IASA procedures are normally employed, concurrent adjustment resulted in better and faster converging revisions estimates to the benchmark than forward factor adjustment without IASA. We hypothesize that for these series, concurrent adjustment combined with IASA procedures will result in better AAR results.

Using level shifts and outliers in concurrent simulations was investigated but developing a reliable methodology was beyond the time allotted for this study. One approach was to remove the known level shift and outlier effects from extended-span versions of actual CPI series receiving IASA treatment in 2004 based on events reported in the January 2005 "CPI Detailed Report". Longer-span data estimated in X-12-ARIMA yield the component series of B1 prior adjustments for extreme movements based on user-supplied variables for level shifts, and outliers. After selecting these B1 data (termed SERIES2) corresponding to their Series1 non-IASA counterpart series, they were used in the X-11 based SEASABS concurrent versus forward factor revisions simulations to produce AAR graphs, STAR values, and stability statistics. Not surprisingly, the concurrent AAR results obtained tended to improve over their forward factor revisions.

A further challenge is the fact that data in this study is used and produced from two separate systems: (1) the X-12-ARIMA method using a CPI-designed GUI (called VX12) to facilitate annual IASA work but which has no concurrent estimation capability; and (2) the X-11 based simulations in SEASABS designed for concurrent and forward revision analysis but which does not provide flexible and efficient IASA capabilities found in VX12 for X-12-ARIMA. Further discussion can be found in Appendix B.

CONCLUSION
In this paper we see that revision gains from concurrent seasonal adjustment are possible for a variety of CPI series. Although these are simulations, the lagged revisions changes in AAR and stability statistics for non-IASA series show patterns consistent with those described by the ABS for quarterly series. We also find that in the case of monthly data the CPI series tend to show a wide range of revision gains relative to forward factors. The two important determinants in

whether the gains are positive, negative, or mixed appear to be the length of the data span used in the concurrent estimation and the volatility present in the series. Given adequate data spans of over 15 years in some cases, which allows enough time for more frequent updates and thus allows lagged revisions to become more stable, uncertainty then lies in the degree to which seasonality is masked by volatility or noise. We have seen that most concurrent test series are consistent with the usual standard benchmark measures for the annual seasonal adjustment. Most test series also experience larger and faster revision gains than their forward factor counterparts, although some instability of concurrent revisions may be expected. The few test series with mixed revision gains suggest further analysis is necessary to determine whether such series can be addressed naturally by the addition of future observations (increased seasonal stability) or by the removal of outliers and level shifts. While the study does not explicitly discuss establishing a revisions policy, this also needs to be carefully considered in light of these findings.

The presence of outliers and level shifts complicates the analysis. Comparison of test series with intervention effects included against counterpart series with intervention effects excluded requires that the original indexes be adjusted for the removal of outliers and level shifts in the B1 values whose seasonal adjustments are estimated in SEASABS. A general process is illustrated in Appendix B that may achieve this.

Advances in statistical methodology continue to produce competing seasonal adjustment processes, particularly in widely used platforms such as TRAMO/SEATS, DEMETRA, and X-12-ARIMA, as well as in seasonal adjustment practices such as revision policies, model selection, and seasonal diagnostics. Concurrent adjustment is one well known alternative that presents the possibility for more timely data. It is more processing intensive than forward factors and may require more frequent monitoring for quality control purposes.

Further study and research is encouraged to address other issues in CPI concurrent adjustment.

APPENDIX A

February 18, 2005

Consumer Price Index: Components for Seasonal Aggregation to All items

NSA = Not Seasonally Adjusted

	Item	Title	Status
1	SAF111	Cereals and bakery products	
2	SEFC	Beef and veal	NSA
3	SEFD	Pork	
4	SEFE	Other meats	NSA
5	SEFF	Poultry	NSA
6	SEFG	Fish and seafood	NSA
7	SEFH	Eggs	
8	SEFJ	Dairy and related products	
9	SEFK	Fresh fruits	
10	SEFL	Fresh vegetables	
11	SEFM	Processed fruits and vegetables	
12	SAF114	Nonalcoholic beverages and beverage materials	
13	SEFR	Sugar and sweets	
14	SEFS	Fats and oils	
15	SEFT	Other foods	NSA
16	SEFV	Food away from home	NSA
17	SAF116	Alcoholic beverages	NSA
18	SEHA	Rent of primary residence	
19	SEHB01	Housing at school excluding board	
20	SEHB02	Other lodging away from home including hotels and motels	
21	SEHC	Owners' equivalent rent of primary residence	
22	SEHD	Tenants' and household insurance	NSA
23	SEHE	Fuel oil and other fuels	
24	SEHF01	Electricity	
25	SEHF02	Utility (piped) gas service	
26	SEHG01	Water and sewerage maintenance	
27	SEHG02	Garbage and trash collection	NSA
28	SAH3	Household furnishings and operations	
29	SAA1	Men's and boy's apparel	
30	SEAC	Women's apparel	
31	SEAD	Girls' apparel	
32	SEAE	Footwear	
33	SEAF	Infants' and toddlers' apparel	
34	SEAG	Jewelry and watches	
35	SETA01	New vehicles	
36	SETA02	Used cars and trucks	NSA
37	SETA03	Leased cars and trucks[1]	NSA
38	SETA04	Car and truck rental	
39	SETA09	Unsampled new and used motor vehicles[1]	NSA
40	SETB	Motor fuel	
41	SETC	Motor vehicle parts and equipment	NSA
42	SETD	Motor vehicle maintenance and repair	
43	SETE	Motor vehicle insurance	

44	SETF	Motor vehicle fees	NSA
45	SETG	Public transportation	
46	SAM1	Medical care commodities	
47	SAM2	Medical care services	
48	SERA	Video and audio	
49	SERB01	Pets and pet products	NSA
50	SERB02	Pet services including veterinary	
51	SERC	Sporting goods	NSA
52	SERD01	Photographic equipment and supplies	NSA
53	SERD02	Photographers and film processing	NSA
54	SERD09	Unsampled photography[1]	NSA
55	SERE01	Toys	NSA
56	SERE02	Sewing machines, fabric, and supplies	NSA
57	SERE03	Music instruments and accessories	NSA
58	SERE09	Unsampled recreational commodities[1]	NSA
59	SERF01	Club membership dues and fees for participant sports	
60	SERF02	Admissions	
61	SERF03	Fees for lessons or instructions	
62	SERF09	Unsampled recreation services[1]	NSA
63	SERG	Recreational reading materials	NSA
64	SEEA	Educational books and supplies	
65	SEEB	Tuition, other school fees, and childcare	
66	SEEC01	Postage	NSA
67	SEEC02	Delivery services	
68	SEED01	Land-line telephone services, local charges	NSA
69	SEED02	Land-line telephone services, long distance charges	NSA
70	SEED03	Wireless telephone services	NSA
71	SEEE	Information technology, hardware and services	NSA
72	SEGA	Tobacco and smoking products	NSA
73	SAG1	Personal care	

[1]This series is not published, but contributes its weight in the calculation of the All items index.

APPENDIX B

Integration of IASA prior adjustments are problematic for comparing Series1 and Series2 because using prior adjusted (B1) data as input into SEASABS for concurrent adjustment results in correct seasonal factors which are then applied to the prior adjusted series, instead of to the original series as is desired. As a result, the seasonally adjusted data will not contain the level shift and outlier movements that are found in the original time series. To accurately measure AAR results between IASA (X-12-ARIMA based) versions and non-IASA (SEASABS, X-11 based) versions of CPI test series, it is necessary to restore the intervention variables removed from the B1 series simulations and apply them to the resulting seasonally adjusted series before performing statistical tests on the seasonally adjusted data. Both systems generate data used in the steps outlined below.

Step1
For each CPI series with IASA treatment applied to it during the 2004 CPI seasonal adjustment, run the seasonal adjustment in X-12-ARIMA using the same outliers/level shifts with the extended data span (15 years plus 4 months) instead of the 8 years used in CPI seasonal adjustment. Obtain the B1 priors and run it in SEASABS concurrent simulation (Series2).

Step2
Our goal is to obtain the following, assuming monthly time series:

(1) SeasAbs(SA) * PF = OrigSA

where,

- SeasAbs(SA) is the set of monthly seasonally adjusted indexes produced using the SEASABS program on the B1 priors from Step1 (aka, Series2)

- PF is the Prior Factors (Original Index / B1) derived from X-12-ARIMA in Step1

- OrigSA is the desired time series originally estimated in X-12-ARIMA and containing the level shifts and outliers in PF.

Step3
Alternatively, (1) and (2) are equivalent:

(2) OrigIX / SF(Abs) = OrigSA

where,

- OrigIX is the set of monthly unadjusted indexes used for X-12-ARIMA seasonal adjustment in Step1

- SF(Abs) is the Series2 factors produced in SEASABS from B1 priors as the input data

- OrigSA is the desired time series originally estimated in X-12-ARIMA and containing the level shifts and outliers.

Step4
Transform (2) as,

(3) (OrigIX / PF) * (1 / SF(Abs)) = OrigSA / PF

Let (3)=(4), where

(4) SeasAbs(SA) = OrigSA / PF

(5) SeasAbs(SA) * PF = OrigSA

Step5
Run OrigSA in SEASABS (SERIES3) and do the concurrent simulation versus forward factors. Compare Series3 (OrigSA, IASA-adjusted) to Series1 (non-IASA test series).

As shown above, (1) is equivalent to (5). Both methods shown in (1) and (2) result in the SEASABS seasonally adjusted indexes (using B1 as input from X-12-ARIMA with IASA treatment) to be multiplied by PF (the ratio of Original Indexes to B1 priors derived from the extended span simulation and IASA application). The B1-based SEASABS seasonal factors should reflect the IASA effects removed. It is used to adjust the original unadjusted data (OrigIX / SF(Abs) = OrigSA) for all user-specified level shifts identified and published as IASA events during the annual seasonal adjustment procedure. OrigSA should be equivalent to the SEASABS seasonal indexes (B1 itself seasonally adjusted) multiplied by the prior factors (PF).

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http://www.census.gov/srd/www/x12a/x12down_pc.html

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