Re-stating the case for complete, model-based seasonal adjustments

and reporting both NSA and SA detail

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Seasonal Adjustment Overview

Issues – Observations

- Seasonal effects on almost all economic processes and data are large and have noticeable consequences.
  Example: Seasonal variation in quarterly GDP growth is about 4 times as large as seasonally adjusted variation.
- Simple approach to handling seasonals – compare to same quarter/month last year – is not satisfying.
- In the 1960s, X-11 was developed at the US Census Burea to be 'model-free' and uses weighted-average based algorithms. X11 and its successors (X-12 and X-13) dominate SA procedures at US statistical data agencies (Census, BEA, BLS, FRB ...)
- All seasonal adjustment (SA) methods break a time-series of **one item into at least 3 distinct parts**:
  Trend+Cycle Seasonal Irregular (unexplained residual)
  There is no unambiguous way to create 3 from 1
  (this is an under-identified system)

Seasonal Adjustment Overview

More Issues and Observations

- Early X-11 implementations (1960s, 1970s, 1980s) were limited by available computations resources and available staffing.
- Decisions still need to be made (even without a specified model) – using the default X-11 options is not really decision free.
- European ARIMA approach was developed as model-based alternative to X-11, and is now a choice in the X13-SEATS but is a completely different solution that has proven to be robust.
- Once an approach/method is selected it tends to become locked in.

Seasonal Adjustment Overview

Problems with X-11 as the US Traditional SA Approach

- The X-11 methodology for seasonal adjustments is not taught in Econometric courses and Data Science programs. **ARIMA modeling is.**
- Moving average based seasonal factor estimates are susceptible to undesirable forward and backward echo effects from shocks (weather, recessions, trade disruptions, oil prices, COVID ...).
- Research applying X-11 methods to simulated data consistently show that these procedures use moving average windows that are 'too short' and thus create excessive seasonal adjustment.*

* See J. Wright's Keynote Address at the Third Seasonal Adjustment Practitioners Workshop (November 20, 2019)

Traditional X-11 Approach

Steps

- Prepare data series, pick date range.
- Decide on additive or multiplicative adjustment.
- Identify any obvious outlier observations and/or exogenous effects and pick a 'solution'. (Step often skipped, I think.)
- Run the SA process (create a spec file for the X13-SEATS program).
    1. De-trend and de-cycle the NSA series (Henderson filter).
    2. Estimate initial two-sided, moving-average based seasonal factors (and holiday effects).
    3. Re-evaluate for outliers (from irregular component estimates) and remove these for the next round of estimates.
    4. Repeat de-trend/de-cycle and estimation of seasonal factors and holiday effects.
    5. Apply estimated seasonal factors (as additive or multiplicative adjustments).
- Accumulate and report results

Traditional X-11 Approach

Problems

- Both de-trending and moving average specification matters greatly. but the methods are not picked as truly 'optimal' for the series and typically kept at the default options.
- Tendency for excessive adjustment – shocks that happen to happen in a season are at least partially attributed to moving seasonals.
- Pre-testing for seasonality and leaving some items unadjusted tends to create residual (un-accounted for) seasonality in aggregates.
- The process encourages a one-series-at-a-time approach without any cross-system effects or consideration of possible improvements in estimation from a 'system' framework.
  –Economic data is treated as measurements from independent 'islands'.
- Direct seasonal adjustment of a 'headline' aggregate is discouraged by the typical process: adjust piece-parts and then aggregate.

THE X-11 VARIANT OF THE CENSUS METHOD II SEASONAL ADJUSTMENT PROGRAM

Julius Shiskin,
Allan H. Young, and John C. Musgrave
Economic Research and Analysis Division

Revised: February 1967

In 1955, the original Census Bureau program was replaced with a revised procedure called Census Method II. Since that time, the Census Bureau has conducted an extensive research program designed to improve seasonal adjustment methods. This program has moved forward on two fronts. First, there has been a major effort to improve the ratio-to-moving-average method. This effort has been directed primarily to methods of improving the moving averages used to compute seasonal-factor and trend-cycle curves, the moving-average weights used for computing the ends of these curves, the estimation of trading-day variation from monthly data, and the handling of extreme values. In addition, research intended to exploit parametric methods using multiple regression techniques has been undertaken. Regression analysis allows for explicit functional specifications of the seasonal and trend-cycle components which lend themselves to conventional statistical analysis more readily than the estimates provided by the ratio-to-moving-average method. However, such techniques are presently not as desirable as the moving-average methods in practice, since no regression models have yet been demonstrated empirically to provide sufficiently accurate estimates of the trend-cycle and the seasonal, particularly in the current period.

Traditional X-11 Approach

More Problems

- Standard errors for factors are not computed (as measures of precision).
- Outlier observation decisions are not always understood, conveyed, or applied in a timely manner.
- De-trend - seasonal iteration repeated only 2 times (and 'not repeat until convergence').
- Exogenous effects are rarely considered but surely matter for some (or many) series. Example: weather

Model-based SEATS Approach

Overview

- Model views the data as the effect of independent 'impulses' (trend, cycle, seasonal, residual).
- Pick ARIMA(j,d,k) basic model, adding AR(s) and/or MA(s) seasonal term.
- Model parameters are estimated by maximum likelihood (or an approximately equivalent method).
- The seasonally-adjusted series is a direct model result – remove seasonal AR(s) and/or MA(s) effects.

Model-based SEATS Approach

Main differences from X11 (traditional) approach

- Simultaneous estimation of trend, cycle, and seasonal components.
- Can directly add exogenous effects and use outlier dummies.
- A candidate model specification can be tested or compared to alternatives.
- SA parameters and estimated factors have standard errors.
- Framework can be expanded (multivariate system, indirect+direct, unobserved component specifications, bayesian concepts, ...)

Encouraging the Model-based Approach

- Always provide NSA series.
- Publish enough information to replicate official adjustments from NSA data
  using X13-SEATS.
- Make outlier identification and solutions more transparent.
- Publicize (quietly?) model-based alternatives for headline aggregates, such as:
  GDP, Payroll employment, Unemployment rates, Housing starts ...
  in secondary releases.
- Encourage and archive open-data, open-source alternatives by others.

Why Open Source – Open Data?

Community vs Hierarchy

Analogy:

Bazaar (messy, noisy) vs Cathedral (fixed structured)

- Open source revolution in computer tools has worked out well – in fact, as well as the original open-source proponents predicted.
  Many successes: Linux, Apache, Python, R, Android, ...
- A few 'open data' cases, with some successes
  Example: COVID daily case reporting, CDC forecast aggregation.
- High level of transparency is a natural consequence of openness.
- Documentation of data and procedures is demanded by and created by data user community.
- **Collaboration, collaboration, collaboration**

Why Open Source – Open Data?

Possibilities:

- Could greatly lessen reporting burdens of US Data agencies: Do not create pages and pages of tables, instead make it easy to run report creating procedures on detail data.
- 'Free' double checking (might have avoided the GDP residual seasonals problem).
- Library of exogenous factors, best models, system designs, new ideas ...

Likely to lead to more SA research and greater use of models that will be critiqued and tested, plus improved over time – with little disruption to official reporting.