Estimating the Trend-Cycle in Topsy-Turvy Times

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ESMD Seasonal Adjustment Practitioners Workshop

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Outline

- What is a trend-cycle?
- Method used for estimation at Statistics Canada
  - Initial selection criteria
  - Lessons Learned in the pandemic
- Other options
  - Description
  - Comparison
  - Preferred Option

What is the trend-cycle?

Descriptions:

- OECD Glossary: the component that represents variations of low frequency in a time series, the high frequency fluctuations having been filtered out…variations with a period longer than a certain threshold
- www.statcan.gc.ca: Trend-cycle data represent a smoothed version of a seasonally adjusted time series
- The trend is the long-term upward or downward movement observed in the data over several years or decades. The cycle is a sequence of smooth fluctuations around the long-term trend characterized by alternating periods of expansion and contraction.

In practice:

Best practice involves judging nature of shocks and reacting accordingly

- Convention for which components should absorb different types of "events"

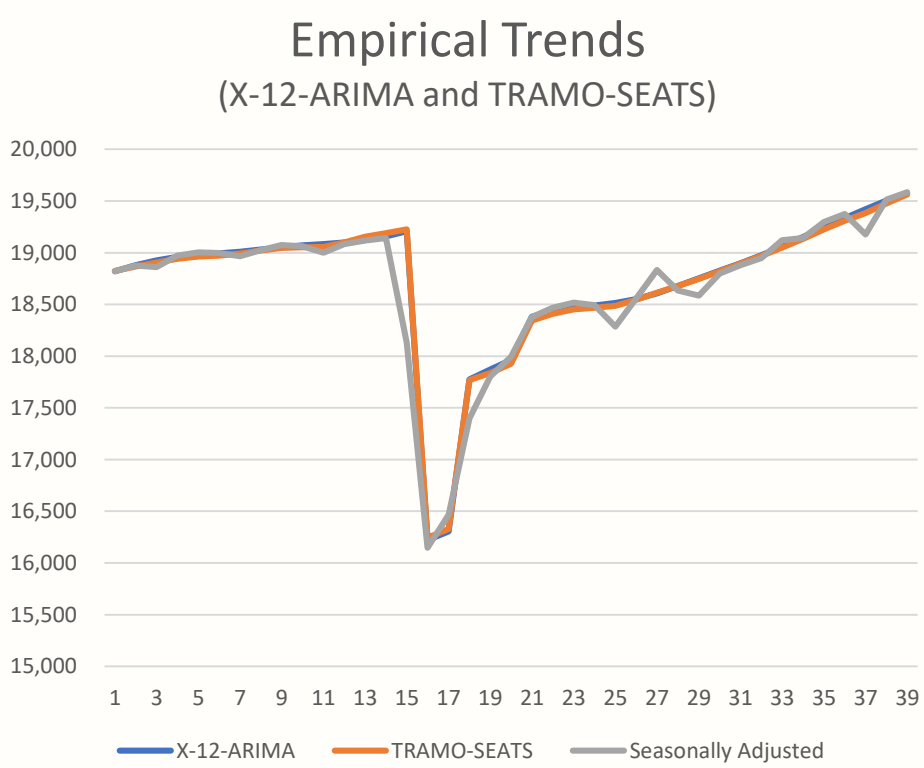
What is the trend-cycle?

We can use tried and true methods to extract empirical trends

- Apply X-12-ARIMA with automatic options, including automatic detection of AO, LS
- Apply TRAMO-SEATS with automatic options, including automatic detection of AO, LS

Resulting Trend-cycle is very similar

* Results from automatic detection of LS and AO seems quite intuitive.



Method Used for Estimation at Statistic Canada

Initial Selection Criteria

- Properties of resulting Trend-Cycle estimates
  - Minimize Revisions
  - Maximize Smoothness
  - Minimize lag and error in detecting turning points
- Transparency of Method
  - Linear / Additive
  - Reproducibility

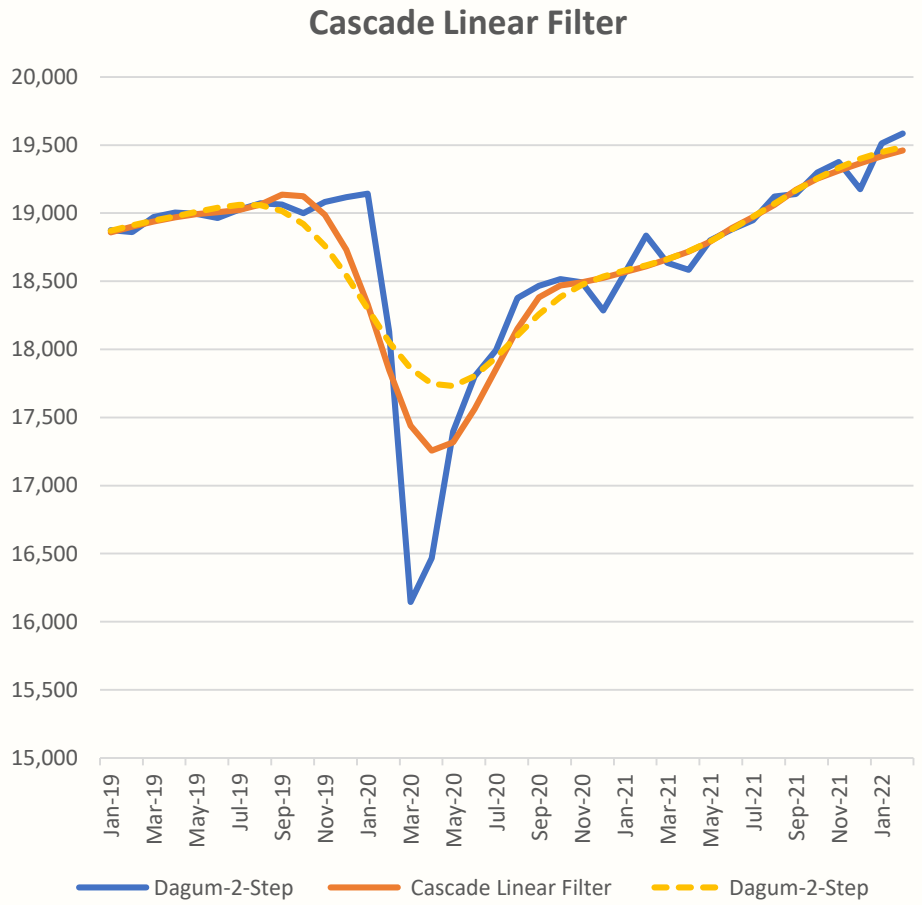
Method Used for Estimation at Statistic Canada

Cascade Linear Filter proposed by Dagum and Luati (2009) has been used at Statistics Canada since 2015 to produce trend-cycle estimates for key economic indicators

- Simplification to Asymmetric Filters “Cut-and-normalize”

A linear approximation to “Dagum 2-Step” proposed in Dagum, E. B. (1996).

- method includes forecasting, outlier detection and smoothing via 2 passes of X-12-ARIMA

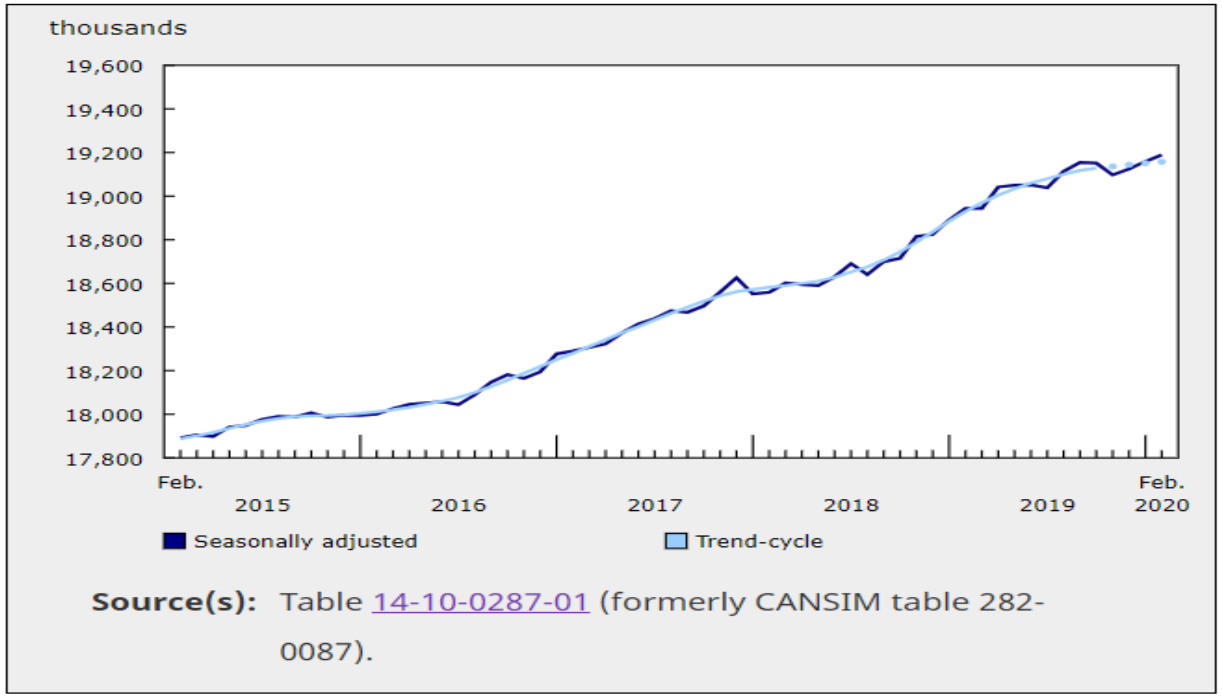


References:

Dagum, E. B. (1996). “A new method to reduce unwanted ripples and revisions in trend-cycle estimates from X11-ARIMA”. *Survey Methodology*, **22**, 77-83.

Dagum, E. B. and Luati, A. (2009). “A Cascade Linear Filter to Reduce Revisions and False Turning Points for Real Time Trend-Cycle Estimation”. *Econometric Reviews*, **28:1-3**, 40-59.

Presentation of Trend-Cycle estimates



Source(s): Table 14-10-0287-01 (formerly CANSIM table 282-0087).

Note(s): The higher variability associated with the trend-cycle estimates is indicated with a dotted line on the chart for the current reference month and the three previous months. For more information, see the note to readers.

Trend-cycle estimates are included in selected charts as a complement to the seasonally adjusted series. These data represent a smoothed version of the seasonally adjusted time series and provide information on longer-term movements including changes in direction underlying the series. For information on trend-cycle data, see Trend-cycle estimates – Frequently asked questions.

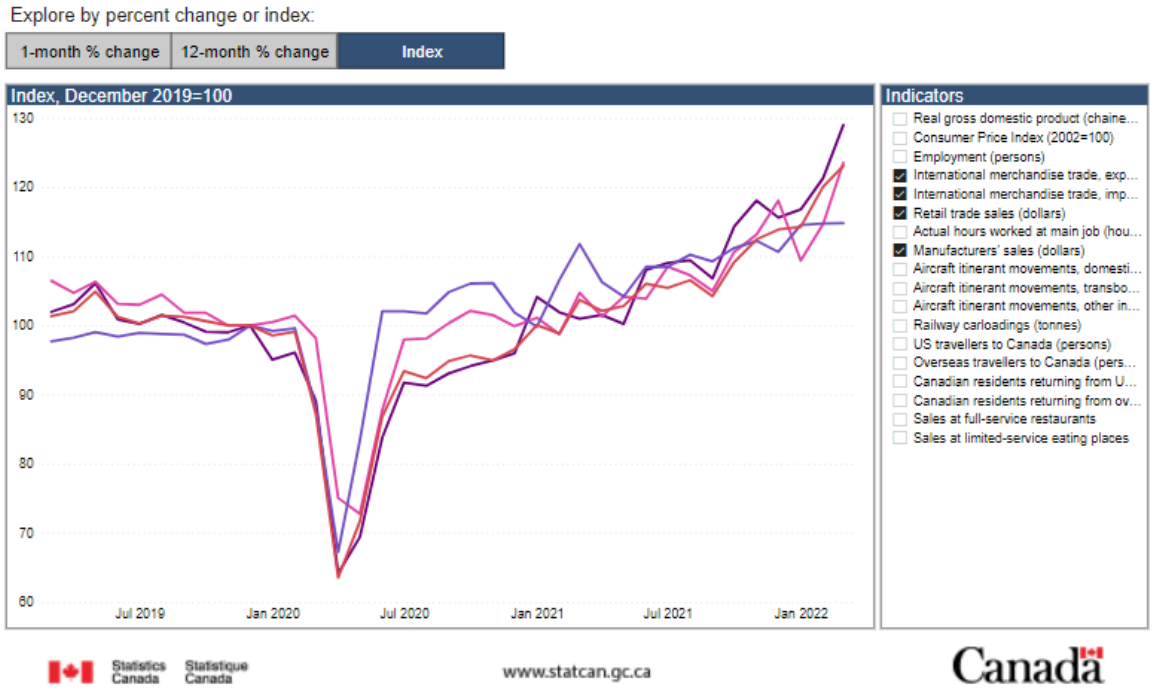
Both seasonally adjusted data and trend-cycle estimates are subject to revision as additional observations become available. These revisions could be large and could even lead to a reversal of movement, especially for reference months near the end of the series or during periods of economic disruptions.

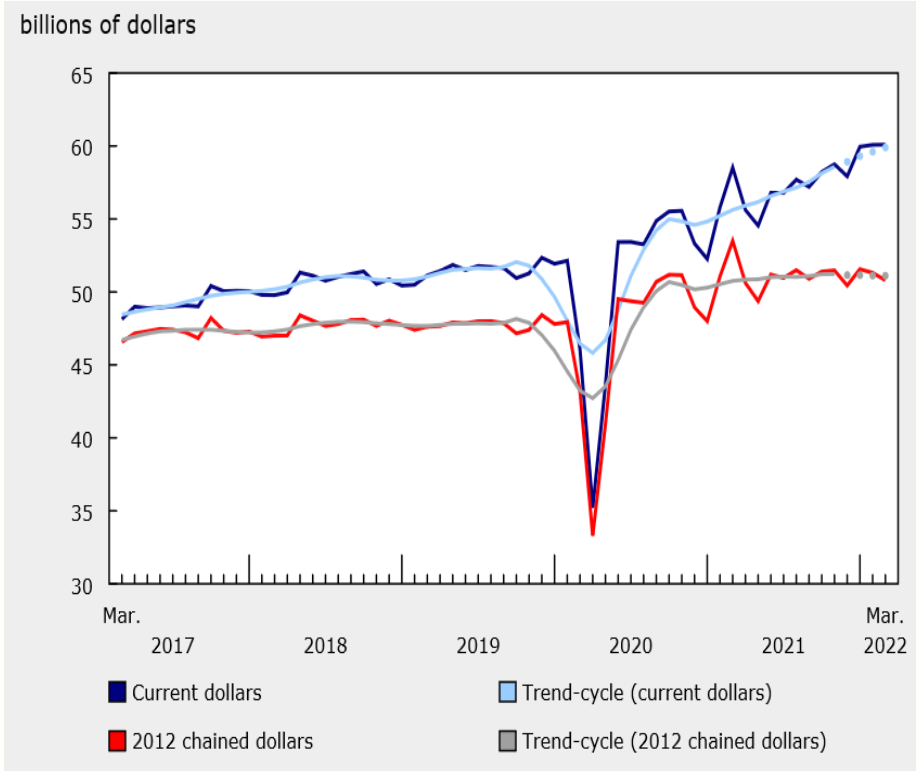
Trend-cycle estimates - Frequently Asked Questions:
https://www.statcan.gc.ca/en/dai/btd/tce-faq

Details on calculation of trend-cycle estimates at Statistics Canada
https://www.statcan.gc.ca/en/dai/btd/trend-cycle

Our experience during the pandemic

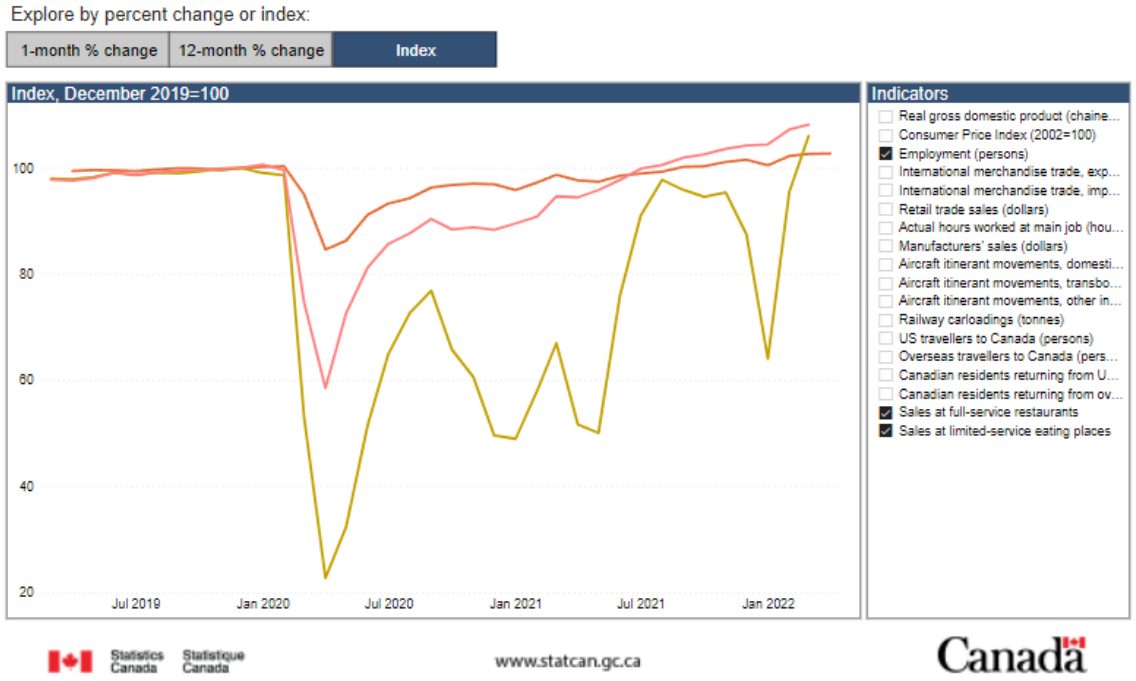
Scenario 1 – Short-term Recovery

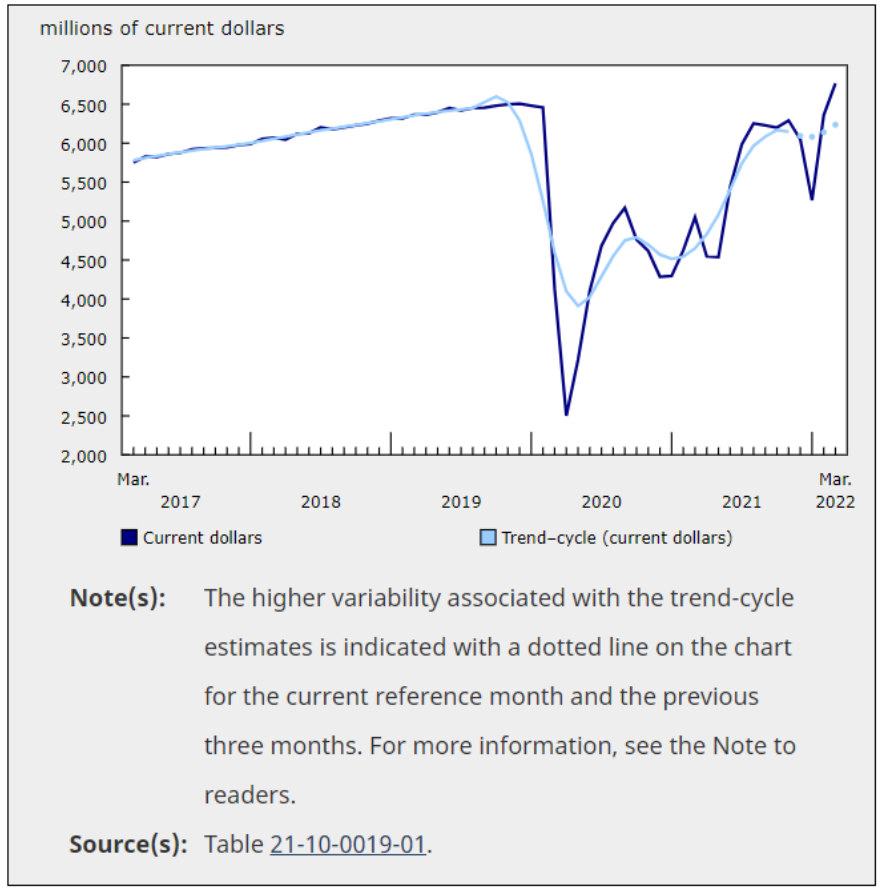




Our experience during the pandemic

Scenario 2 – Extended Recovery



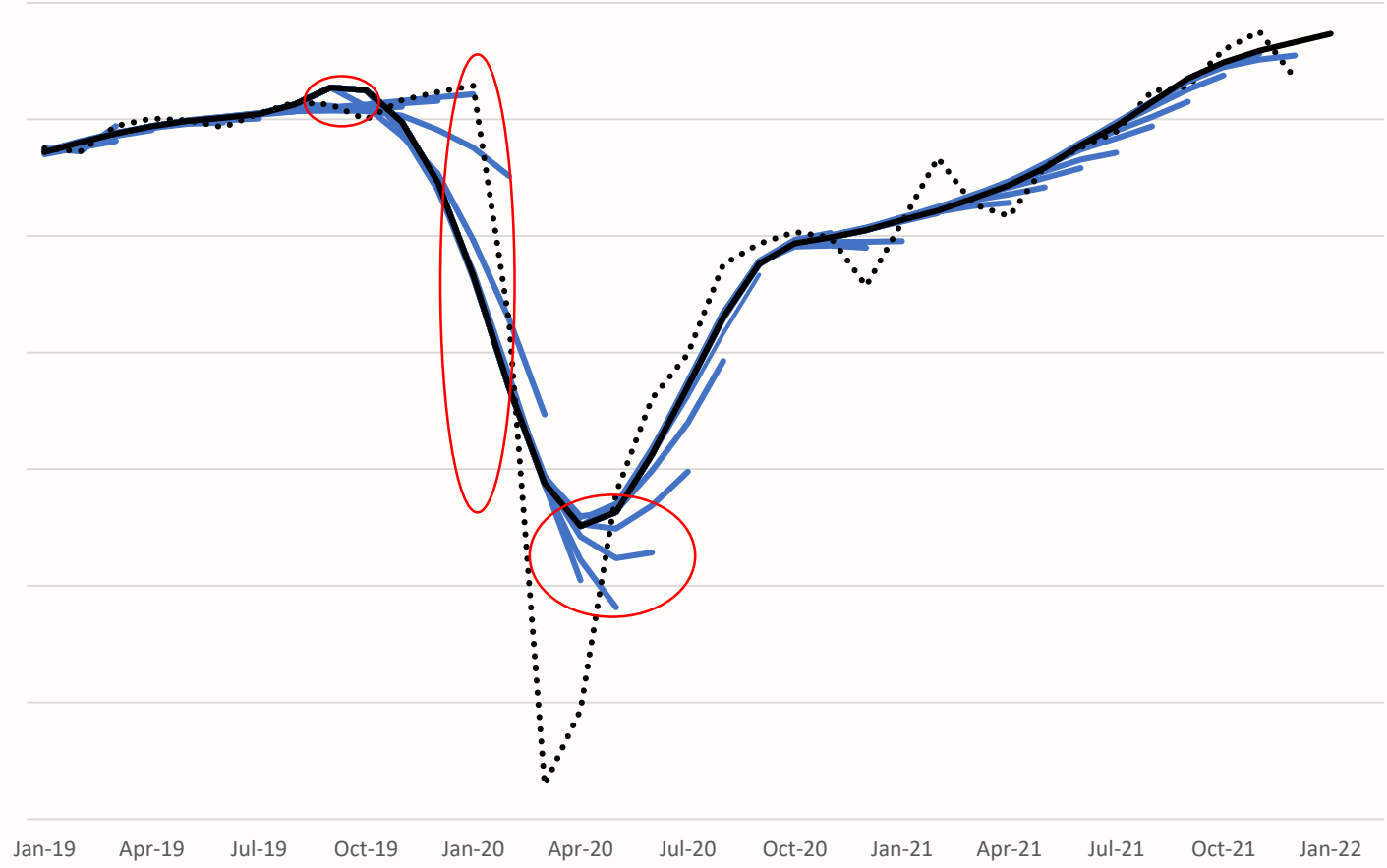


Note(s): The higher variability associated with the trend-cycle estimates is indicated with a dotted line on the chart for the current reference month and the previous three months. For more information, see the Note to readers.

Source(s): Table 21-10-0019-01.

Real-time Trend-Cycles during economic shocks

- Since the onset of the pandemic we observed:
  - Larger than usual revisions
  - Some delay in reacting to pace of change and detected turning points
  - Counterintuitive bumps



Real-time Trend-Cycles during economic shocks

Going forward, we will need to deal with shocks in real-time

- What is the best for the user?
  - Publish concurrent estimates as they evolve in real-time?
    - With appropriate caveats
  - Suspend publication of TC until future periods are available?
    - Start / stop based on objective criteria (TBD)

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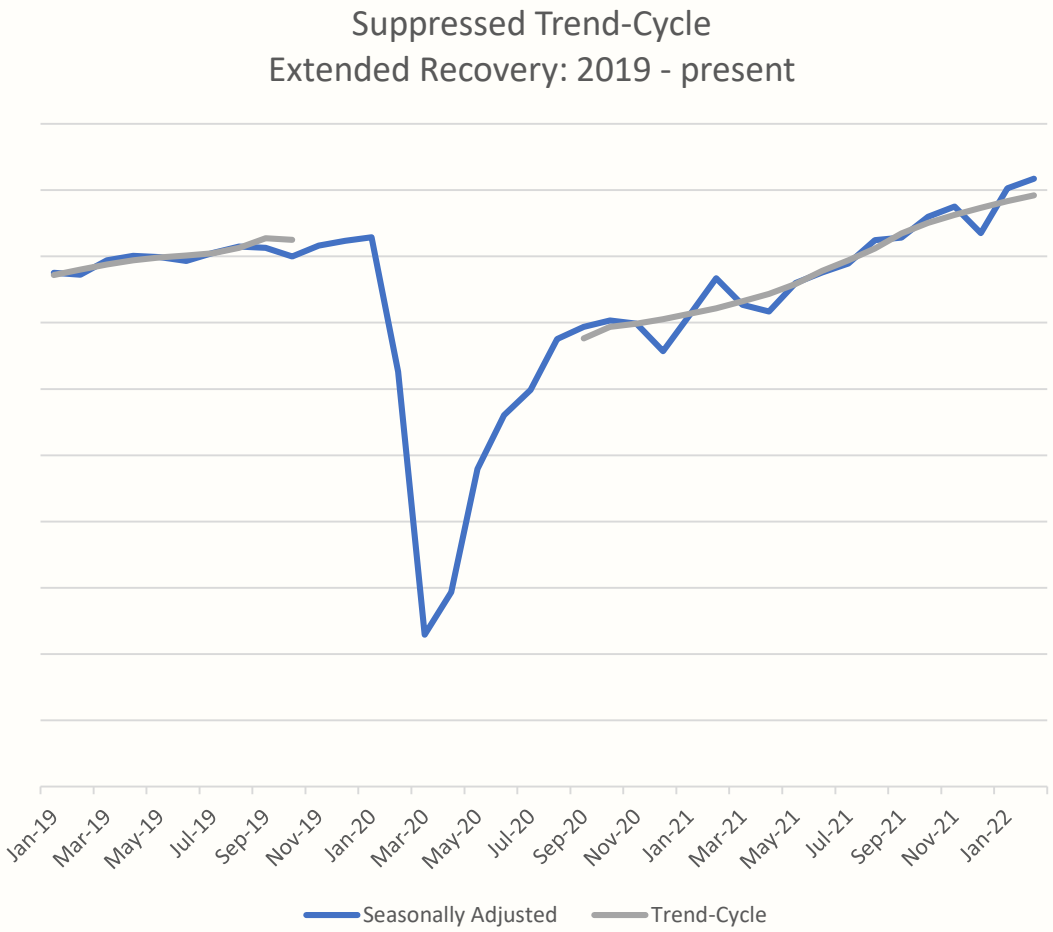
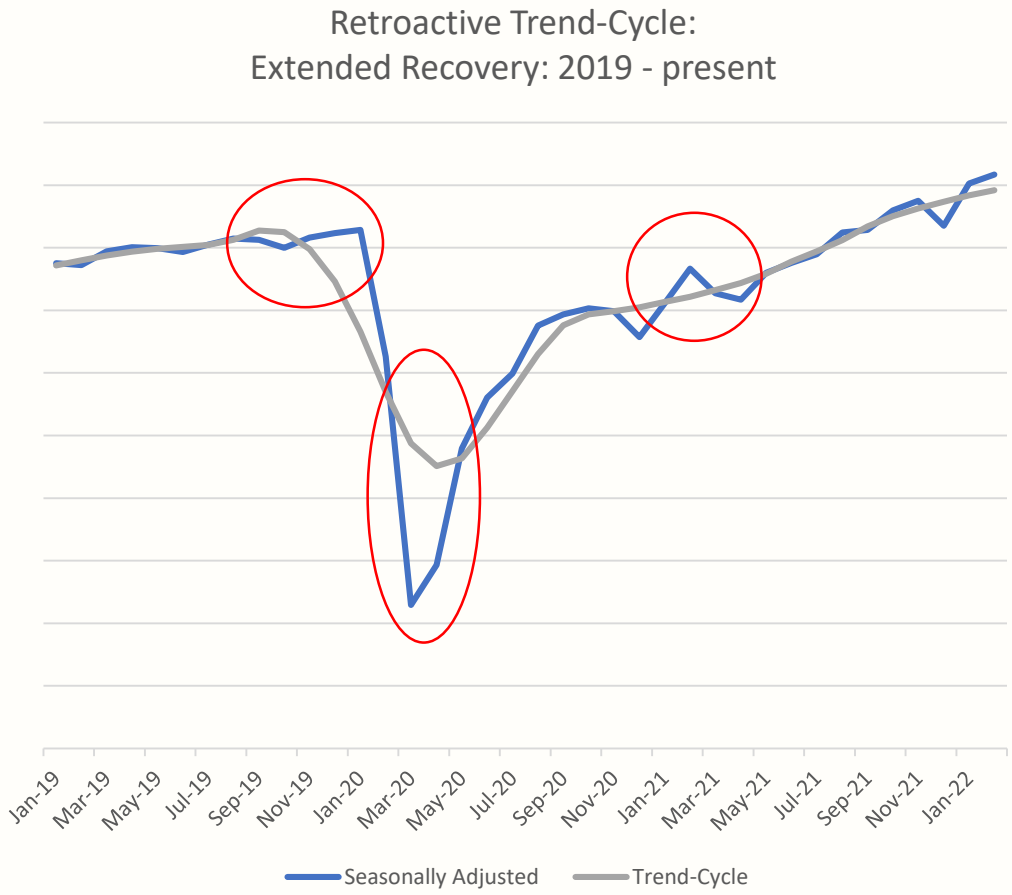


Retroactive Trend-Cycles with economic shocks

- Turning points
  - **Onset** SA: Feb 2020, TC: Sept 2019
  - **Recovery** SA: March 2020, TC: April 2020
- Shocks partially attributed to trend-cycle
  - Consecutive irregular effects with same sign
- Waves
  - CLF smooths out bumps and dips as expected (i.e. filters to irregular)



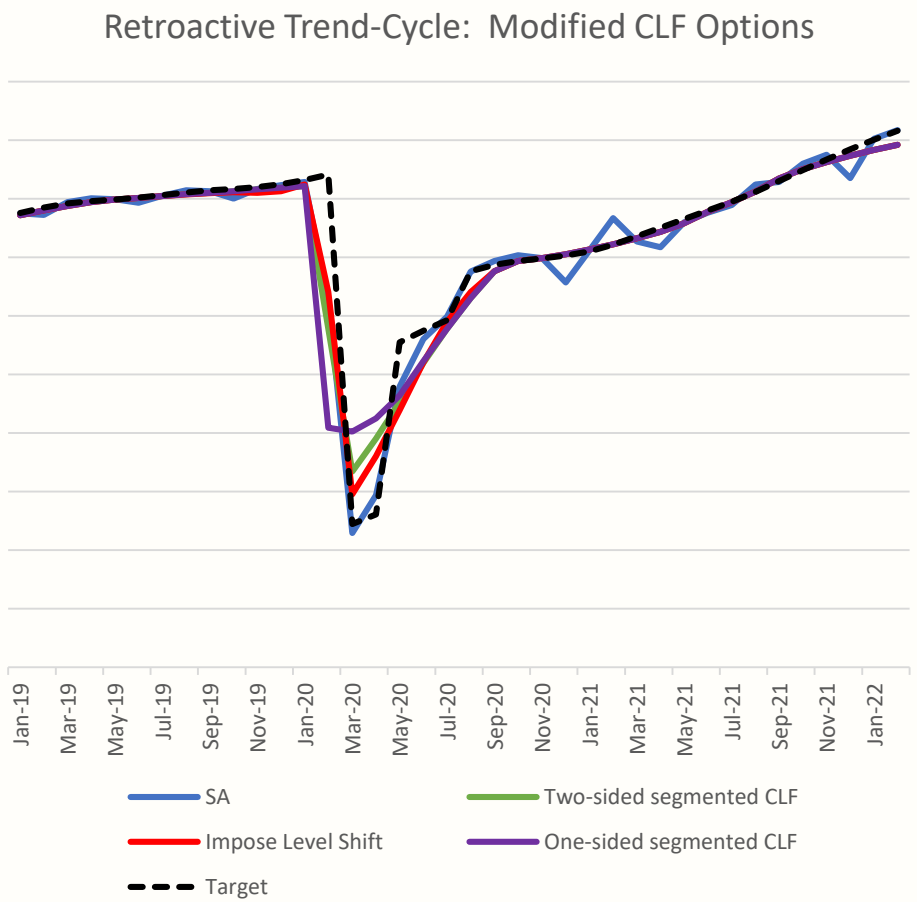
Retroactive Trend-cycles with economic shocks

Modified CLF Options for Trend-Cycle Break (single significant level shift)

Impose Level Shift: Estimate LS in ARIMA model, apply CLF to LS-adjusted series, remove LS adjustment to finalize Trend-Cycle

Two-sided segmented CLF: break series at shock, estimate Trend-Cycle for each segment with CLF, join segments to produce Trend-Cycle

One-sided segmented CLF: estimate entire Trend-Cycle with CLF, overwrite after shock with estimated Trend-Cycle for that segment



Retroactive Trend-cycles with economic shocks

Modified CLF Options for Irregular Break (two opposite significant level shifts in close proximity)

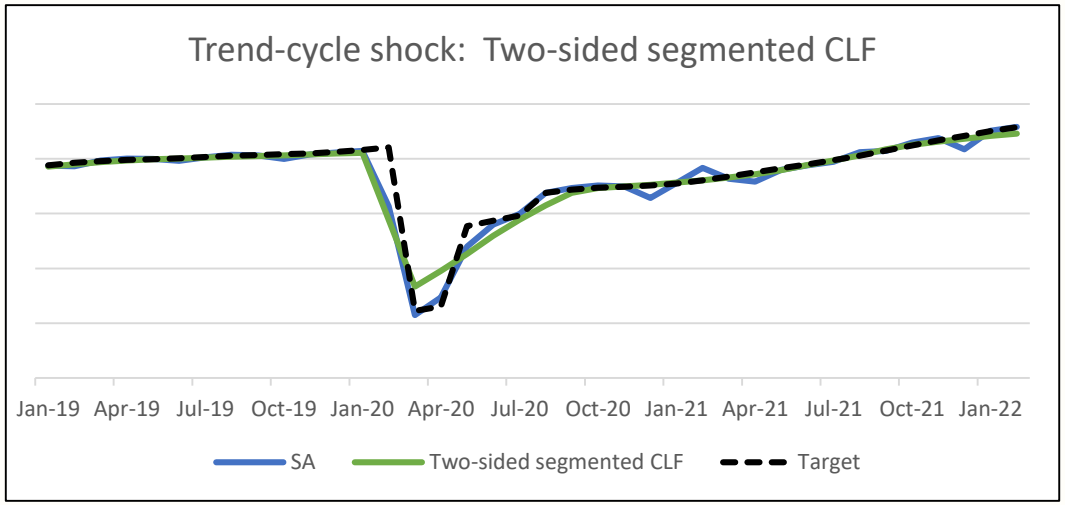
Impose Level Shift: Estimate LS in ARIMA model, apply CLF to LS-adjusted series, undo LS adjustment to finalize Trend-Cycle (Linear interpolation between level shifts)

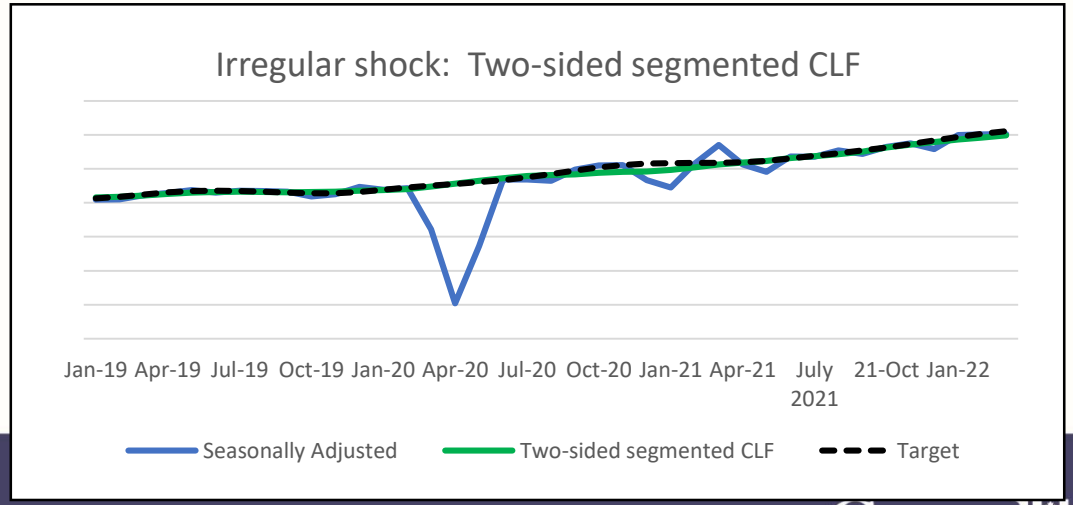
Two-sided segmented CLF: divide series, estimate Trend-Cycle for each segment with CLF, join segments to finalize Trend-Cycle, linear interpolation

One-sided segmented CLF: estimate entire Trend-Cycle with CLF, overwrite with estimated Trend-Cycle for segment after break, linear interpolation

Preferred Option: Two-sided segmented CLF

- Break series and use asymmetric filters before and after
  - Closely approximates target (D12 from X-12-ARIMA)
  - Some loss in transparency
    - Need to specific break points to replicate
  - Linear/Additive
  - Order invariant
  - Preserves desirable properties of Cascade Linear Filters





Next Steps

- Gather feedback from internal analysts for specific programs
- Formalize a standard method for the agency's publications
  - Define criteria and fine-tune parameters
  - E.g.
    - Trend-Cycle Breaks: if Level Shift with t-value > 5, apply revised methodology
    - Irregular breaks: If 2 level shifts within 6 months with t-value > 5 in opposite directions, introduce break at both points and apply linear interpolation in between
- Update calculations in systems and documentation
- Publish Trend-Cycles according to revised methodology in 2023

Thank you / Merci !

- For more information, please contact me at:

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