reviser: Analysing Revisions in Time Series

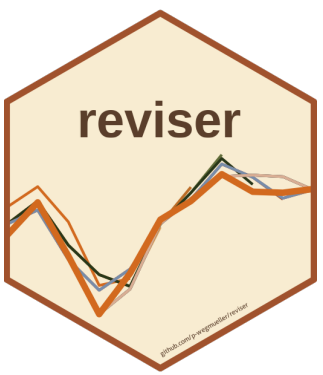
R in Swiss Official Statistics: 2025 Spring Meetup

Philipp Wegmüller, Dr. rer. oec.[1] Marc Burri, Dr. rer. oec.[2]

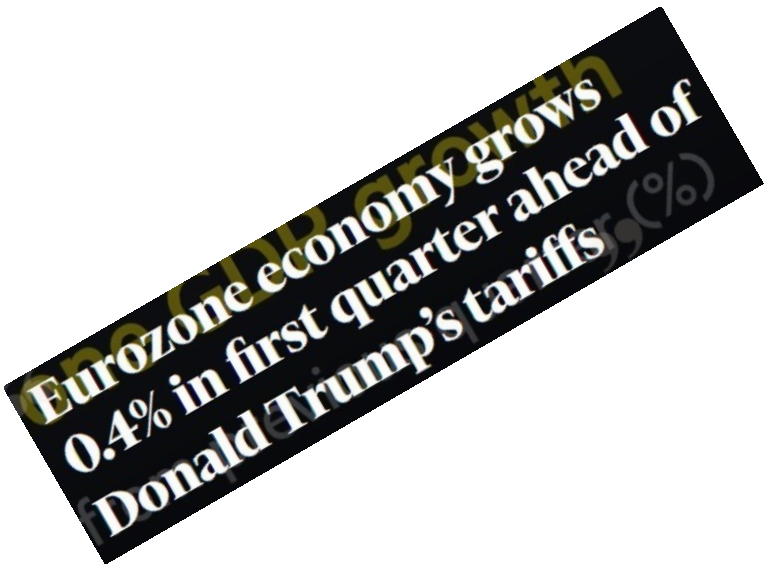
[1]State Secretariat for Economic Affairs (SECO)

[2]University of Neuchâtel

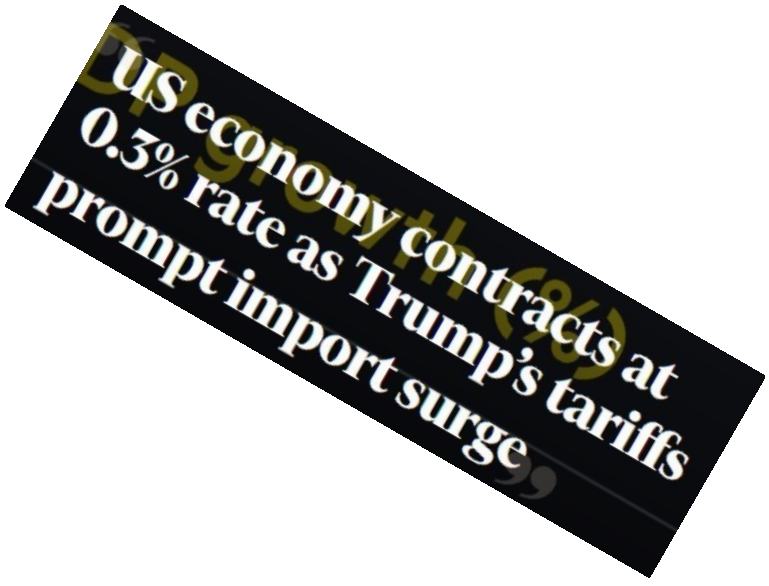
May 8, 2025



Time series in the news



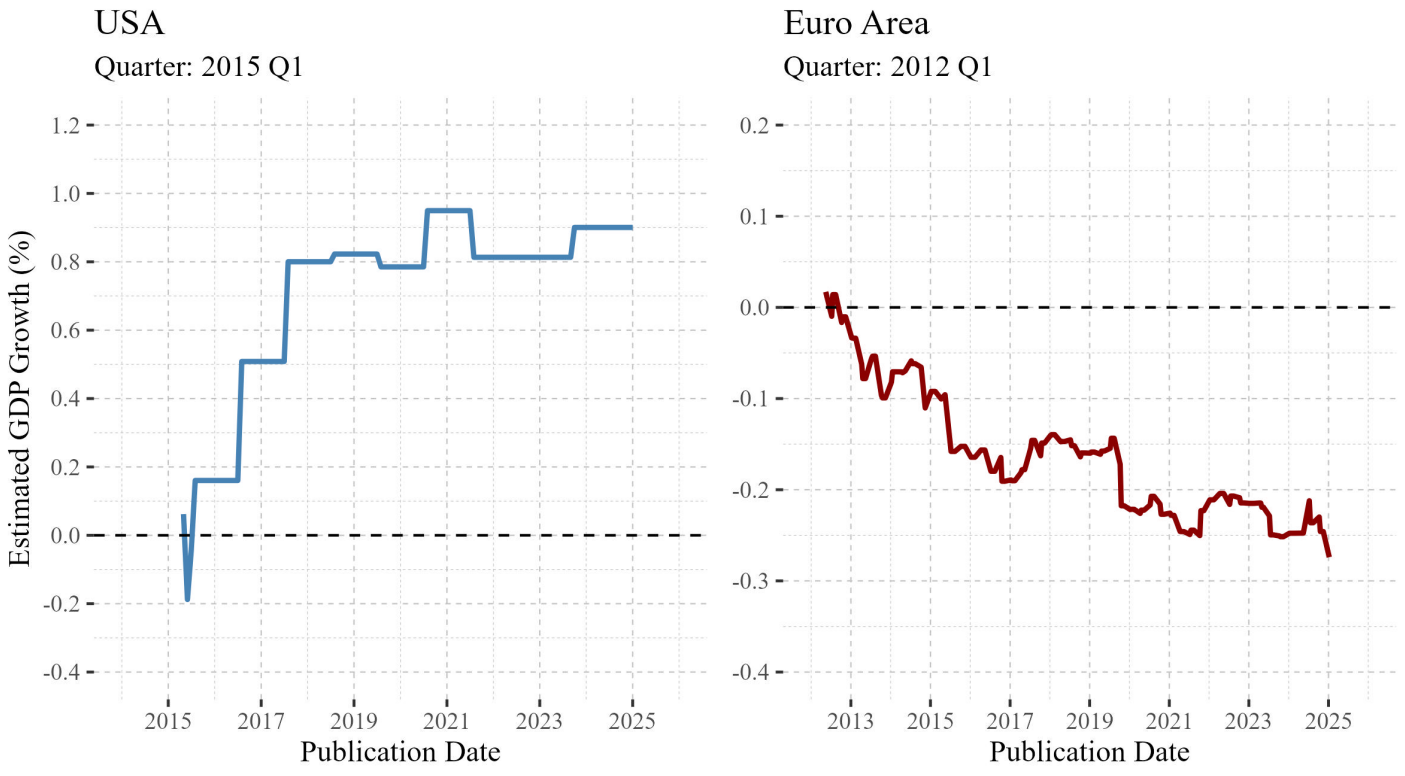
Euroarea GDP



US GDP

Initial GDP estimates hit headlines. But how reliable are they?

Historical experience with time series revisions



Sometimes, the assessment might change as time progressess

Motivation

Background

- Data revisions arise as a matter of course when data are produced
- Take quarterly GDP as an example:
  - Indicators used for temporal disaggregation might revise
  - Seasonal adjustment induces revisions
  - Methodological changes exhibit revisions
- Are revisions in time series data well-behaved?
- How do revisions in time series data affect policy decision making?

reviser

- We provide set of functions to systematically evaluate time series revisions
- Not only allows to study revision patterns, but also to forecast them

How to assess the quality of revisions?

- Let's denote the initial release by x_t^{initial} at time t
- And the "true", i.e., last value is denoted as x_t^{final}
- The revision is given by:

$$r_t^{\text{final}} = x_t^{\text{final}} - x_t^{\text{initial}}$$

- Revisions are "*well-behaved*" if they satisfy the following properties:
  1. **Unbiasedness**: $\mathbb{E}[r_t^{\text{final}}] = 0$
  2. **Smallness**: $\mathbb{V}[r_t^{\text{final}}] \ll \mathbb{V}[x_t^{\text{initial}}]$
  3. **Unpredictability**: $\mathbb{E}[r_t^{\text{final}} \mid x_t^{\text{initial}}] = 0$
- See literature on revisions

Implementation in R

- Vintage data has to be provided in tidy format
- Key columns of tibble have to be `pub_date`, `id`, `time`, `value`
- Functions have dependencies on `tidyverse`, `systemfit` and `KFAS`
- Large set of descriptive statistics:
  - Mean, Min, Max, SD
  - Ratio for sign switch
  - Correlation
  - News/Noise Tests
- Mincer-Zarnowitz regressions to determine first efficient release
- Set of functions for prediction of revisions:
  - Kalman Filter or Generalized Kishor-Koenig

A prominent example: GDP

- Regular GDP release published quarterly at around T+60
- To study revisions over time, we have to collect real-time vintages
- Vintage data has publication date and reference date
- Usually, a vintage dataset looks like the following (revision triangle)

Table 1: Swiss real GDP data vintages (q-o-q) - Snapshot

time	2024-03-01	2024-06-01	2024-09-01	2024-12-01
2023:Q4	0.29	0.34	0.27	0.27
2024:Q1		0.45	0.47	0.35
2024:Q2			0.70	0.63
2024:Q3				0.41

An international comparison

- R-package provides summary tables, and graphs for illustration
- Here a simple exercise with some quarterly real GDP data

Table 2: Revision properties of GDP Estimates

Country	N	Mean	Min	Max	MAR	SD	NS	Corr	Sign
CHE	88	**0.16**	-2.76	1.10	0.38	0.52	0.42	-0.16	87.5
EA	88	**0.08**	-0.79	0.98	0.21	0.27	0.14	**-0.38**	93.2
JP	88	-0.04	-1.17	1.32	0.42	0.55	0.38	-0.13	84.1
US	88	0.01	-0.69	1.18	0.27	0.35	0.26	**-0.26**	93.2

Table 3: Optimality tests: Mincer Zarnowitz regressions

Country	e	alpha	beta	p-value
CHE	1	0.15	0.82	0.08
EA	11	0.02	1.00	0.06
JP	0	0.07	0.85	0.28
US	0	0.05	0.93	0.20

Nowcasting revisions versus initial data release

- Should we believe the first release?
- Or is the first release an efficient forecast of the final release?
- Use simple univariate filtering techniques to test predictability

Table 4: Relative RMSE across models and countries

Country	Classical	Howrey	Kishor-Koenig
CHE	0.99	0.99	1.00
EA	1.66	1.06	0.98
JP	1.00	1.00	1.00
US	1.00	1.00	1.00

- We find cases where the relative RMSE is slightly below 1.
- Filtering techniques might potentially outperform the first GDP release
- In other words, on average the filter estimate is closer to the final release than the first release

Conclusions

- reviser can be applied to any time series, as long as vintages are available

Next milestones

- Package is currently under review with ropensci
- Bring package to CRAN soon
- We are happy if you test it and provide feedback
- https://github.com/p-wegmueller/reviser/

Shout out

- Marc is open for work:
  - marcburri.github.io
  - marc.burri91@gmail.com

Appendix: First Efficient Release

- Apply Mincer-Zarnowitz regression to determine first efficient release
- Let us denote by x_t^i the i-th release of the indicator with initial release $x_t^0 = x_t^{\text{initial}}$.
- For every indicator x and $i = 0, 1, ...,$ perform the following Mincer-Zarnowitz regression:

$$x_t^{\text{final}} = \alpha + \beta x_t^i + \varepsilon_t. \tag{1}$$

- The i-th release is considered efficient if the joint null $\alpha = 0, \beta = 1$ in the above regression cannot be rejected at the 5% significance level, using HAC standard errors.
- The **first efficient release** is x_t^e, where:

$$e = \min\{i \geq 0 \mid i \text{ is efficient}\}.$$

Appendix: Kalman Filter for Predicting Revisions

- Given the predictability of the revisions, it should be possible to apply a statistical filter to get a better prediction than the initial release.
- One simple approach is to use the **Kalman filter**. Here, we treat the true value of the indicator as the hidden state x_t, following an AR(1) process (state equation):

$$x_t = \beta x_{t-1} + \nu_t. \tag{2}$$

- The first release y_t is a noisy measurement of the state:

$$y_t = x_t + \eta_t. \tag{3}$$

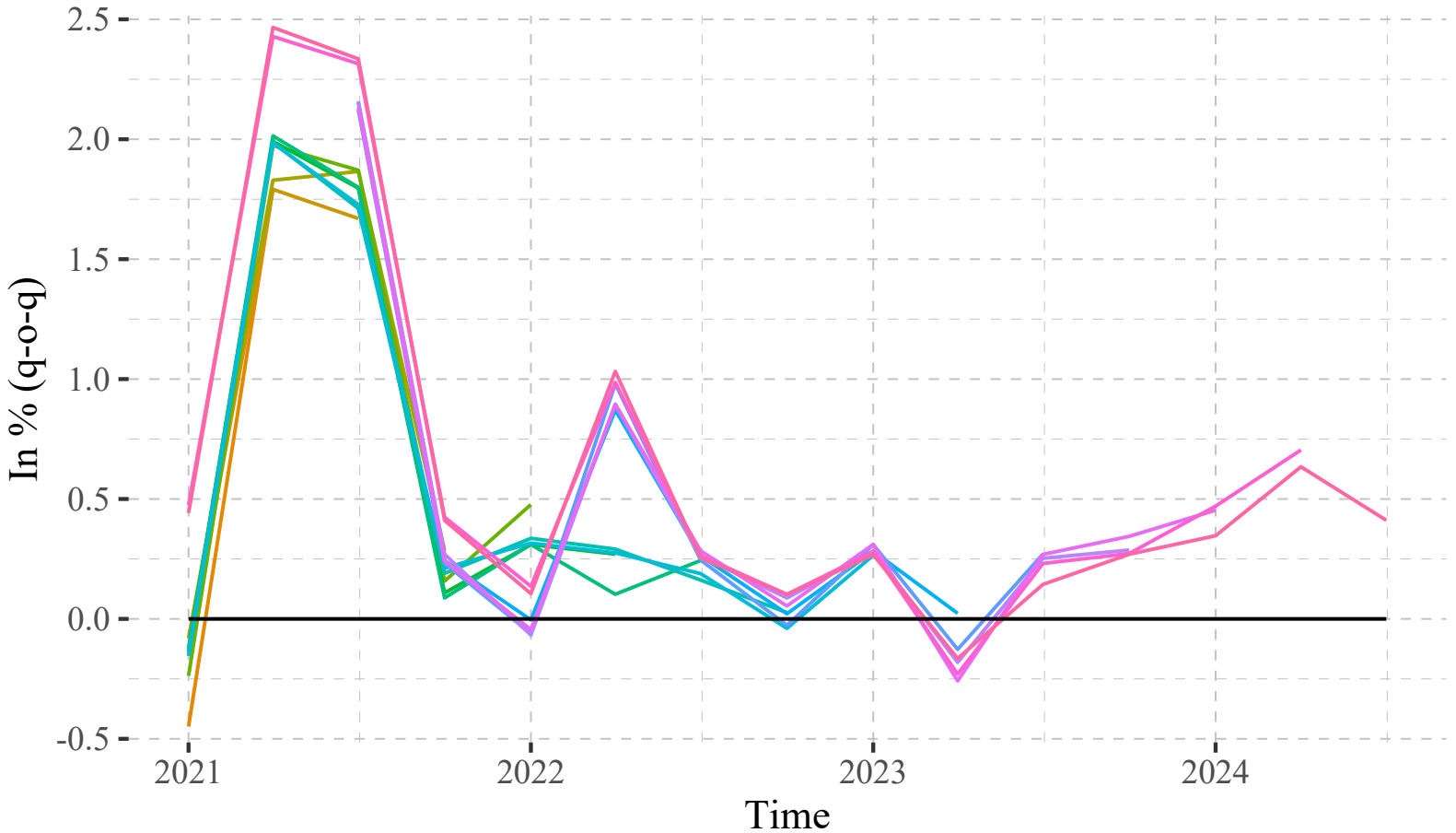
- Here, ν_t and η_t represent random noise.
- Equations (2) and (3) can be estimated using $\{y_s = x_s^{\text{initial}}\}_{s<t}$ and used to produce a nowcast $\hat{x}_t$ of $x_t = x_t^{\text{final}}$, given $y_t = x_t^{\text{initial}}$.

Appendix: Some relevant literature

- News or noise: An analysis of GNP revisions, Mankiw and Shapiro (1986)
- Monetary policy rules based on real-time data, Orphanides (2001)
- Data revisions are not well behaved, Aruoba (2008)
- Frontiers of real-time data analysis, Croushore (2011)
- Modeling data revisions: Measurement error and dynamics of true values, Jacobs and van Norden (2011)
- Data revisions and real-time forecasting, Clements and Galvao (2019)
- Data revisions to German national accounts: Are initial releases good nowcasts? (Stohsal and Wolf, 2020)

Growth rates may revise substantially

Figure 1: Real GDP data vintages (q-o-q)



Benchmark revisions are clearly visible

Figure 2: Real GDP data vintages (level)