Seasonal Adjustment Post-Pandemic

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U.S. Census Bureau

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U.S. Census Bureau seasonal adjustment, usual practice

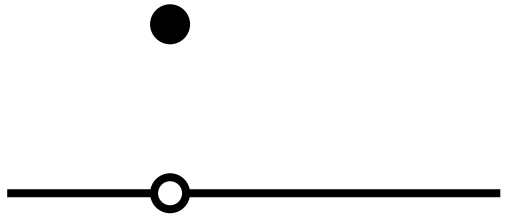
- Program areas have reviewers who set the seasonal adjustment options once a year
- Most program areas review settings once a year and use those settings for the next year
  - “Concurrent” seasonal adjustment
  - Only changes allowed are new outliers

Scenes from a grocery store, March 2020

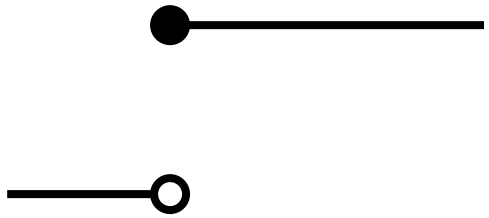
- Photos are courtesy of Suzanne Dorinski, U.S. Census Bureau

Primary outlier types

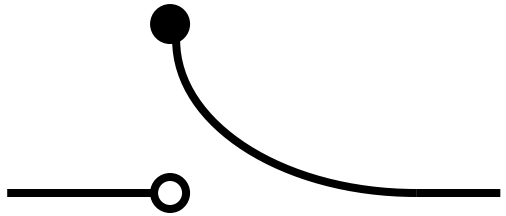
Additive Outlier (AO)



Level Shift (LS)



Temporary Change (TC)



U.S. Census Bureau surveys

- Time series in this presentation are estimates from surveys and are subject to sampling and nonsampling error
- Information about the data collection and estimation is online at:
  - Quarterly Services Survey (QSS) census.gov/services/qss/how_the_data_are_collected.html
  - Monthly Retail Trade and Food Services (MRTS) census.gov/retail/how_surveys_are_collected.html
  - Monthly Wholesale Trade Survey (MWTS) census.gov/wholesale/www/how_surveys_are_collected/monthly_methodology.html
  - Construction Spending census.gov/construction/c30/meth.html

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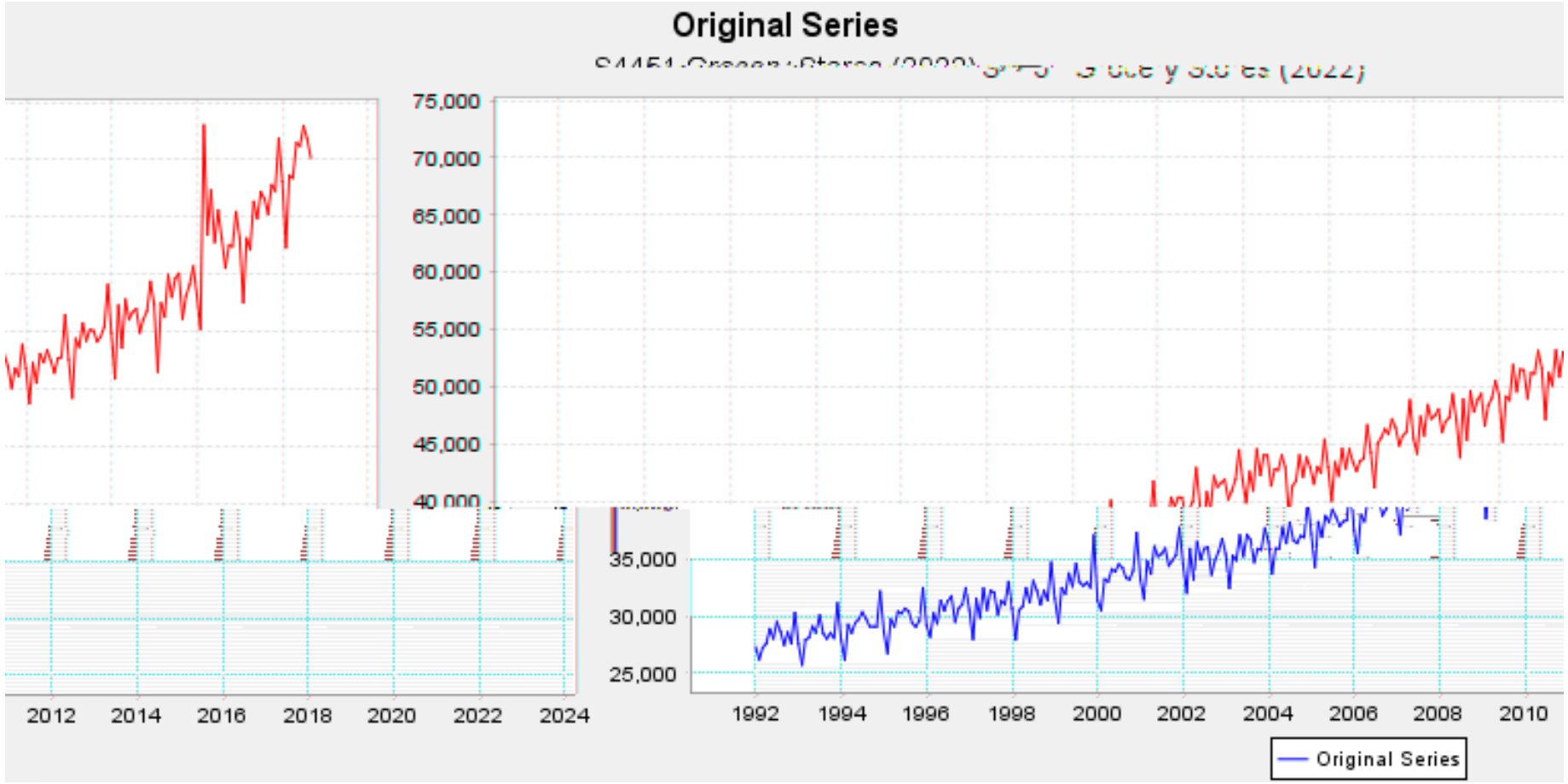
Brief example from Monthly Retail Trade and Food Services Report, U.S. Census Bureau

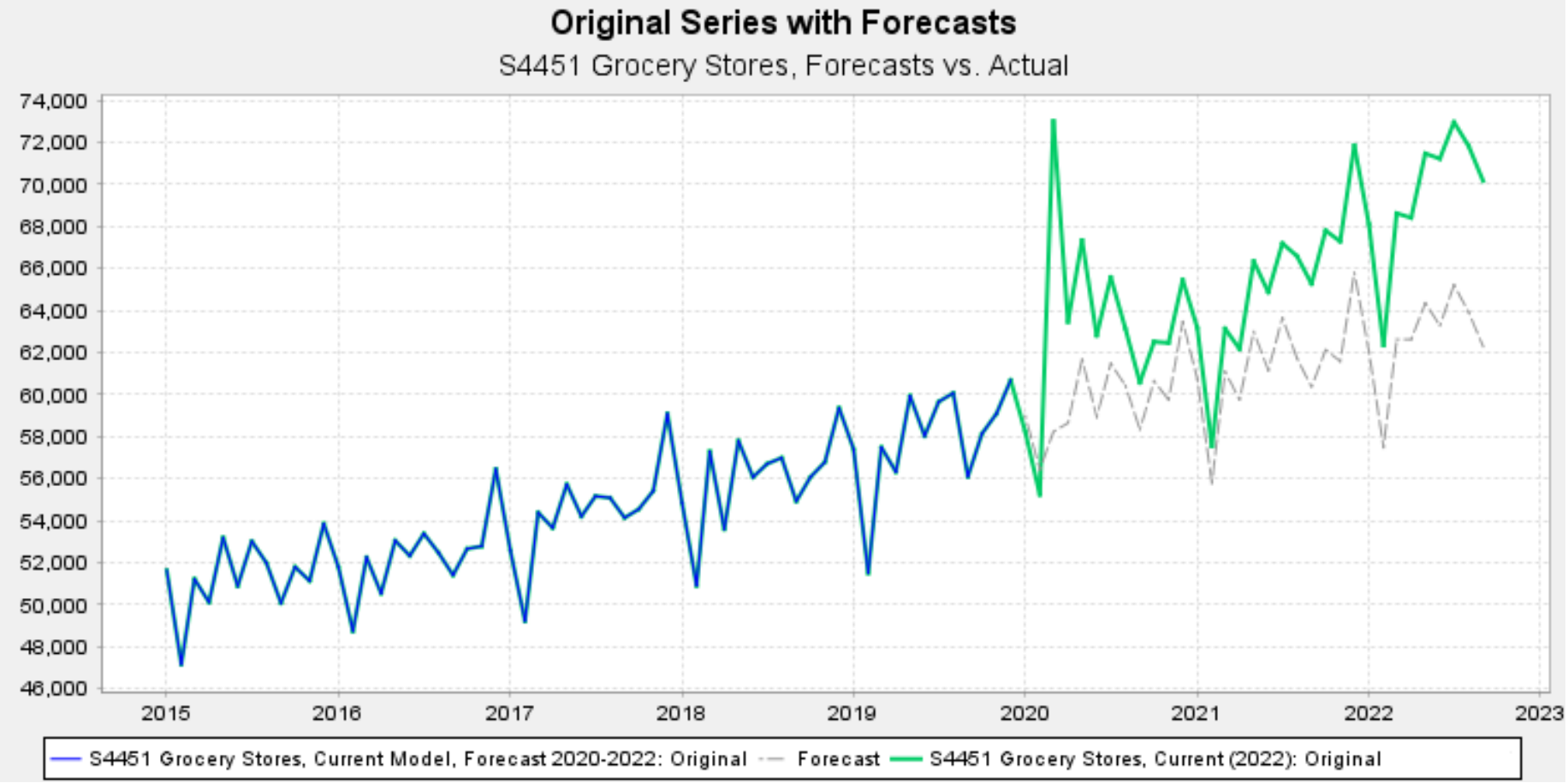
- Grocery Store Sales, NAICS 4451
  - Original, not seasonally adjusted time series is published
  - Forecasts are not official projections or estimates

Seasonal adjustment, post-pandemic
Grocery stores, very consistent



Source: Original time series from census.gov/retail

Seasonal adjustment post-pandemic
Forecasts from 2019 compared to actual estimates



Source: Original time series from census.gov/retail, forecasts generated from modeling

Overview of 2020-2022 seasonal adjustment of major Census Bureau surveys

Quarterly Services Survey (QSS)

- 135 seasonally adjusted series
  - 125 with at least one 2020-2022 outlier; 10 with no outliers
  - 30 with outliers covering a 1-2 quarter period
  - 85 with outliers covering 3+ quarters
  - ~15-20 which visually still look unusual
  - Many sectors had a large jump in value in 2021-2022, including education, truck transportation, some information
  - 63 with at least one 2020-2022 outlier with |t|>10

Number of QSS outliers

Quarter	AO	LS	TC
2020.1	48		
2020.2	116	2	2
2020.3	100		
2020.4	75		
2021.1	73		
2021.2	50		
2021.3	18		
2021.4	10		
2022.1	12		
2022.2	13		

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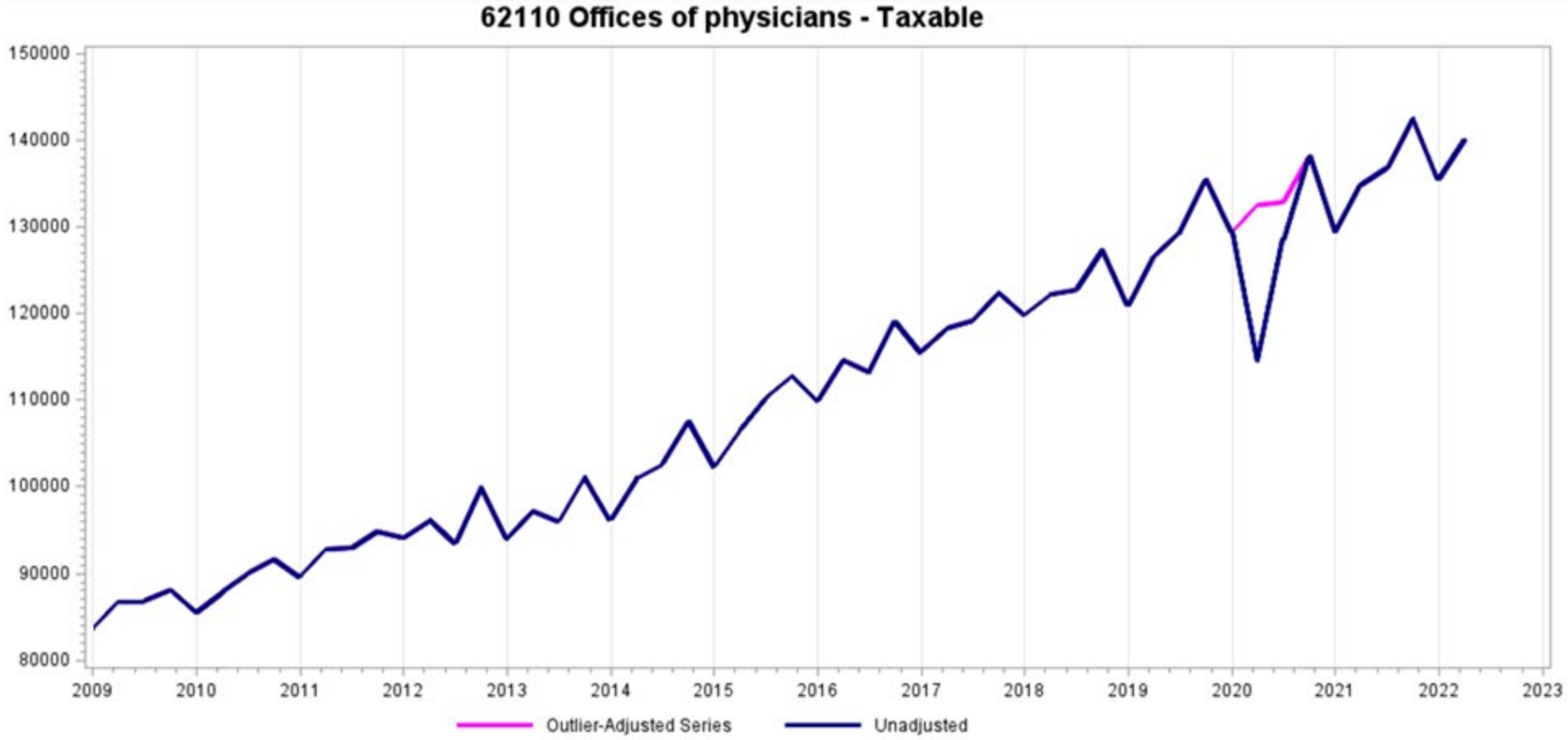
A QSS series with a short effect



Source: Original time series from census.gov/services, adjusted series generated from modeling

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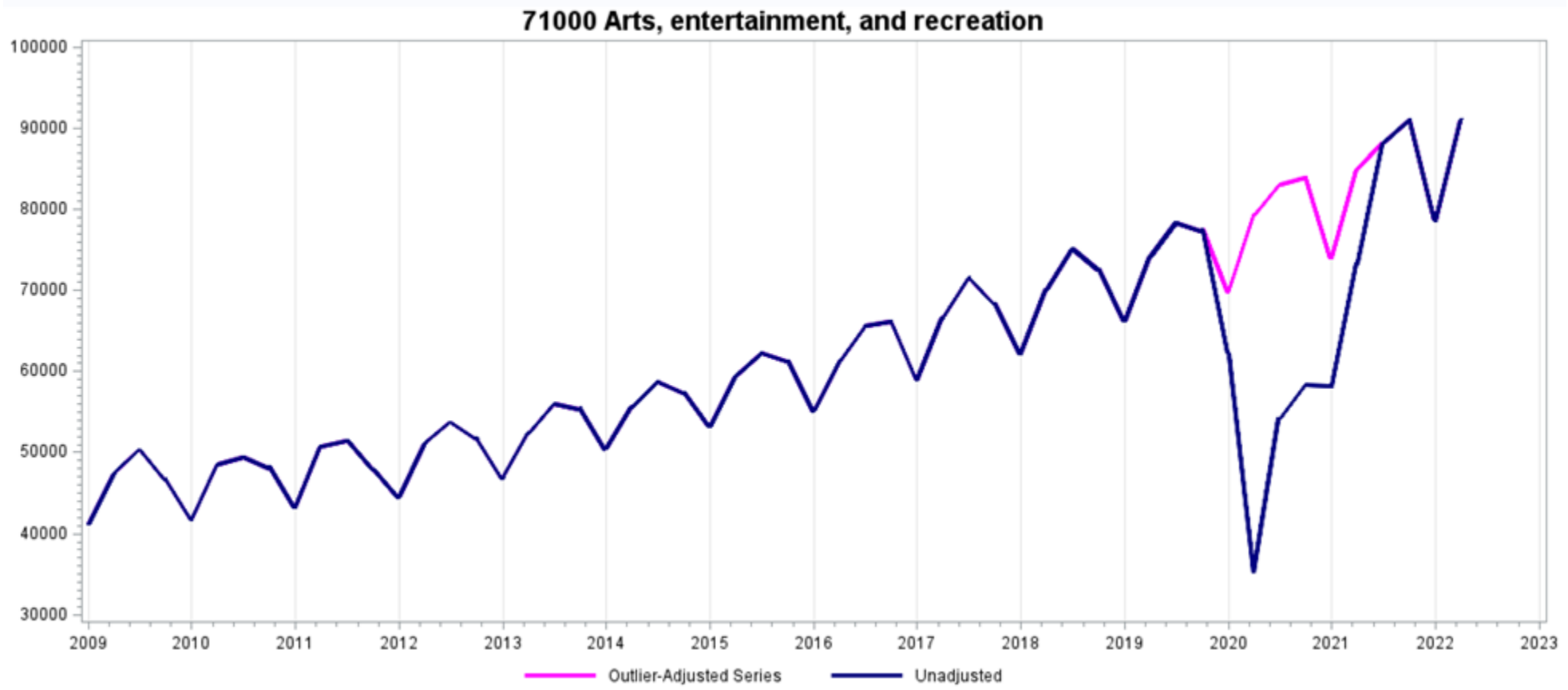
A QSS series with a long effect



Source: Original time series from census.gov/services, adjusted series generated from modeling

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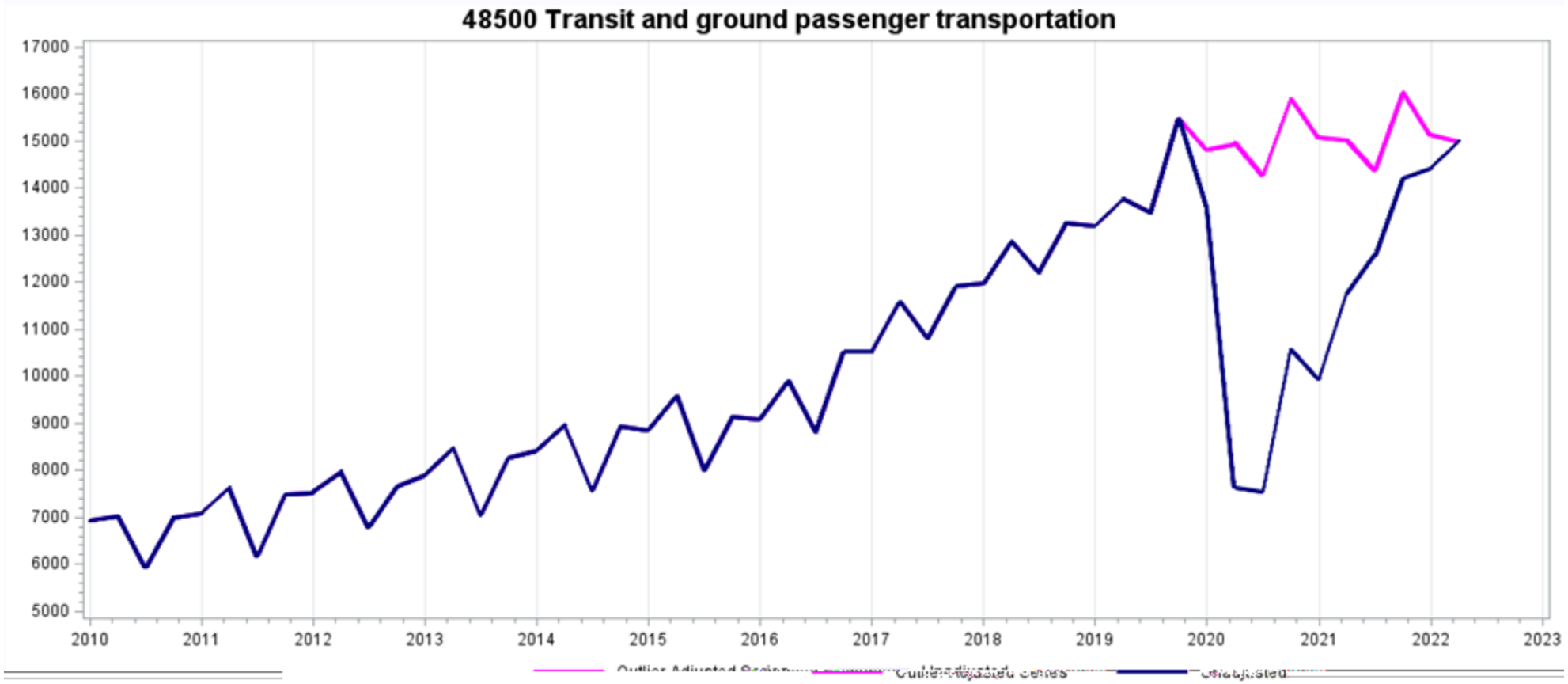
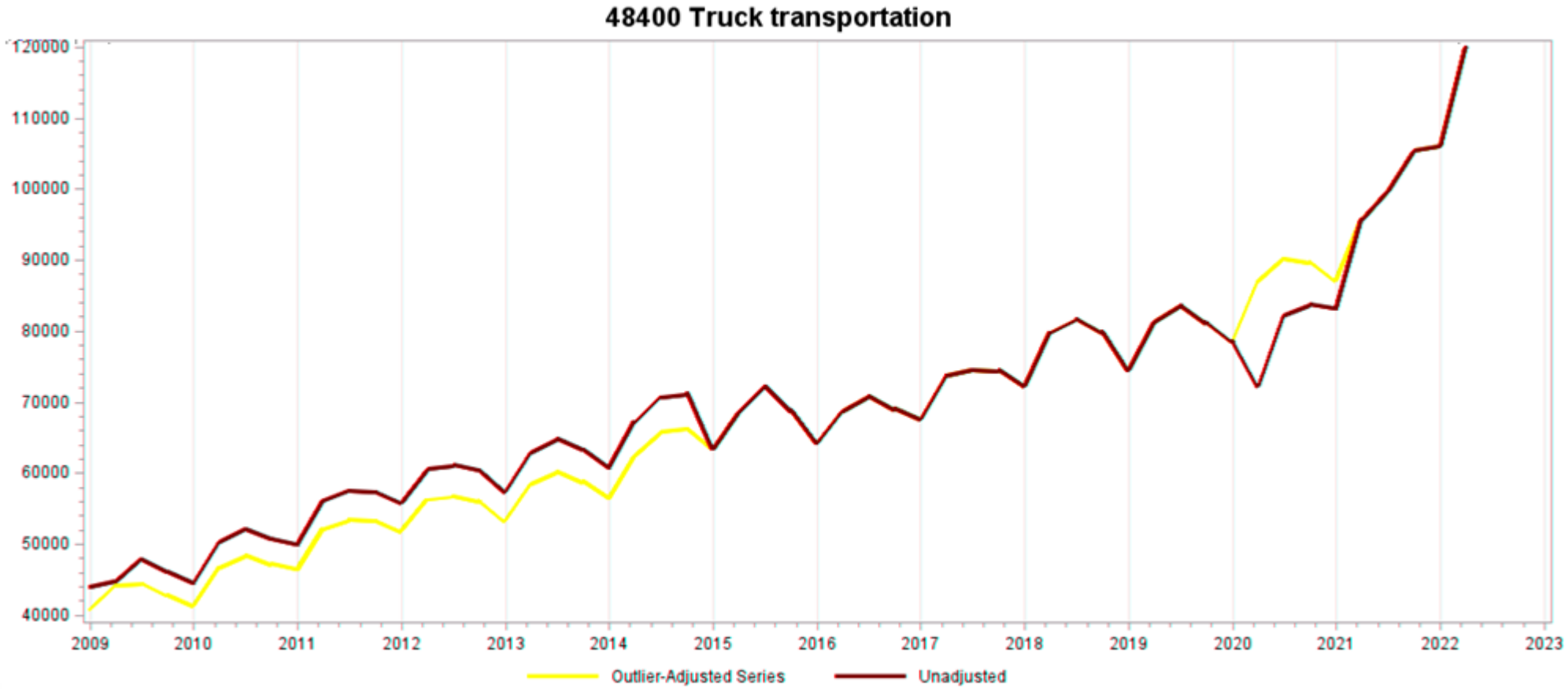
A QSS series with an effect that may still be continuing



Source: Original time series from census.gov/services, adjusted series generated from modeling

A QSS series exhibiting a rapid 2021-2022 value increase



Source: Original time series from census.gov/services, adjusted series generated from modeling

Monthly Retail Trade Survey (MRTS)

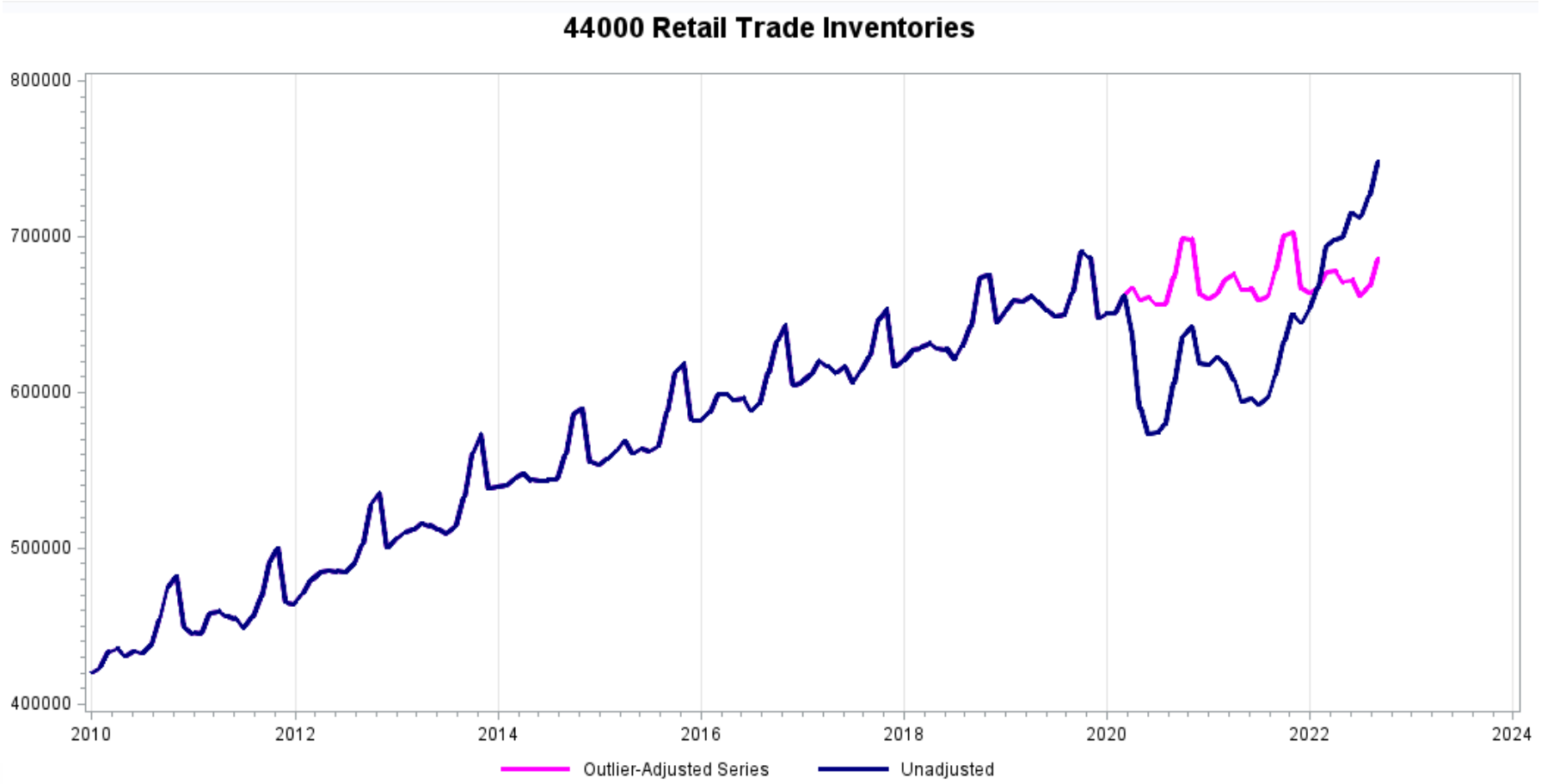
- 63 seasonally adjusted series, 17 inventory and 46 sales.
- Inventories: 8 had a longer effect and 9 no or a short 2020 effect. Many are now showing a strong increase in value; 12 are affected by 2022 outliers.
- Sales: Most series (41) had an effect >6 months in 2020. They've largely returned to normal; only 3 have any 2022 outliers.
- 41 series with |t|>10.

Number of MRTS outliers

Month	Number AO			Number LS			Number TC		
	2020	2021	2022	2020	2021	2022	2020	2021	2022
Jan	0	26	10	0	0	0	0	0	0
Feb	0	16	11	0	0	0	0	0	0
Mar	42	22	14	3	13	0	0	0	0
Apr	46	19	13	0	0	0	1	0	0
May	41	20	13	3	3	0	0	0	0
Jun	31	9	13	2	0	0	2	0	0
Jul	26	6	13	1	0	0	0	0	0
Aug	21	6	13	2	0	0	0	0	0
Sep	21	5	13	0	0	0	0	0	0
Oct	17	5	2	1	0		0	0	
Nov	16	5		0	0		0	0	
Dec	18	17		0	0		0	0	
Total	279	156	115	12	16	0	3	0	0

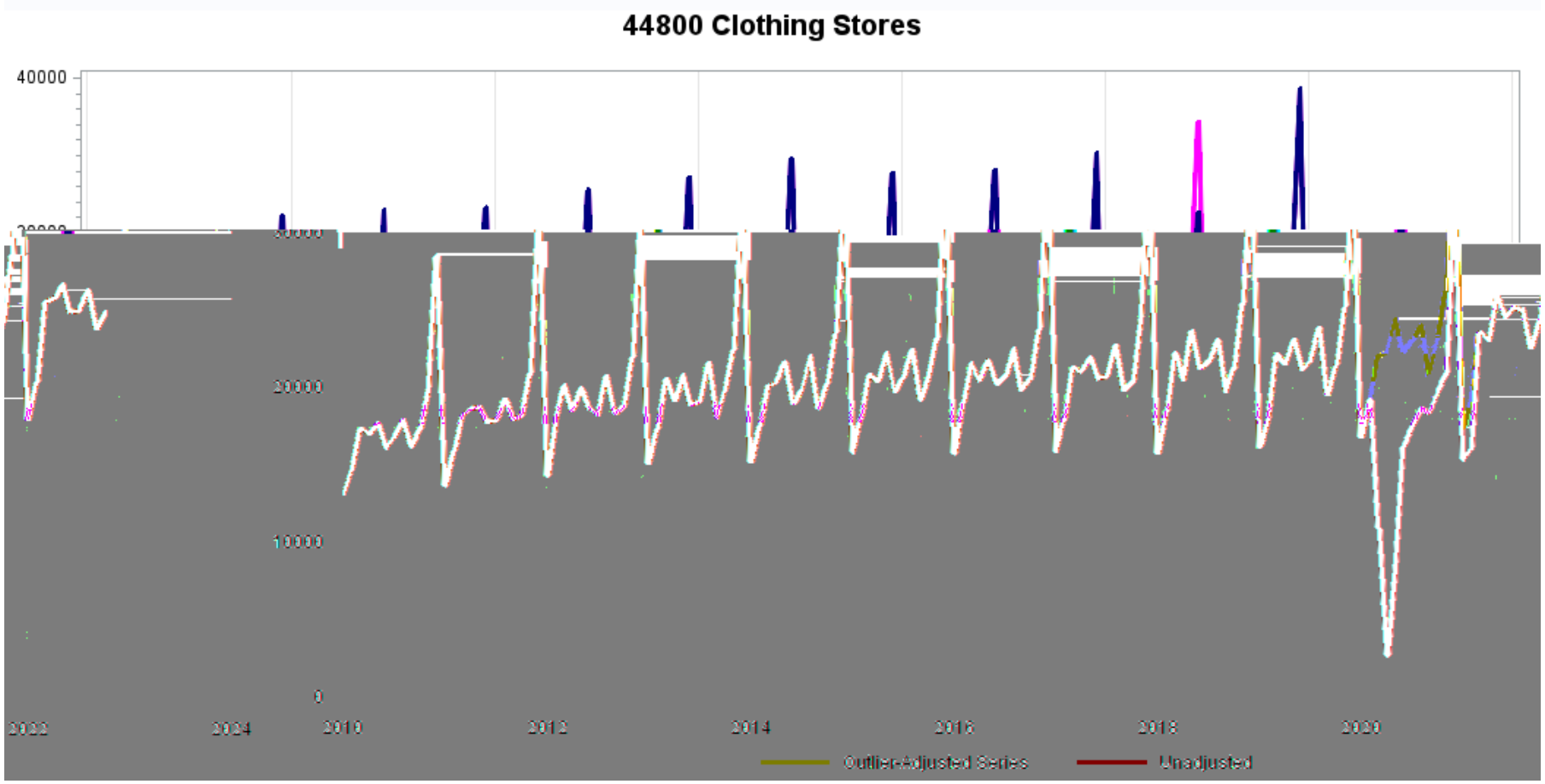
Additionally, 2 series have ramps, 2020.feb-may

MRTS inventory series with an ongoing effect



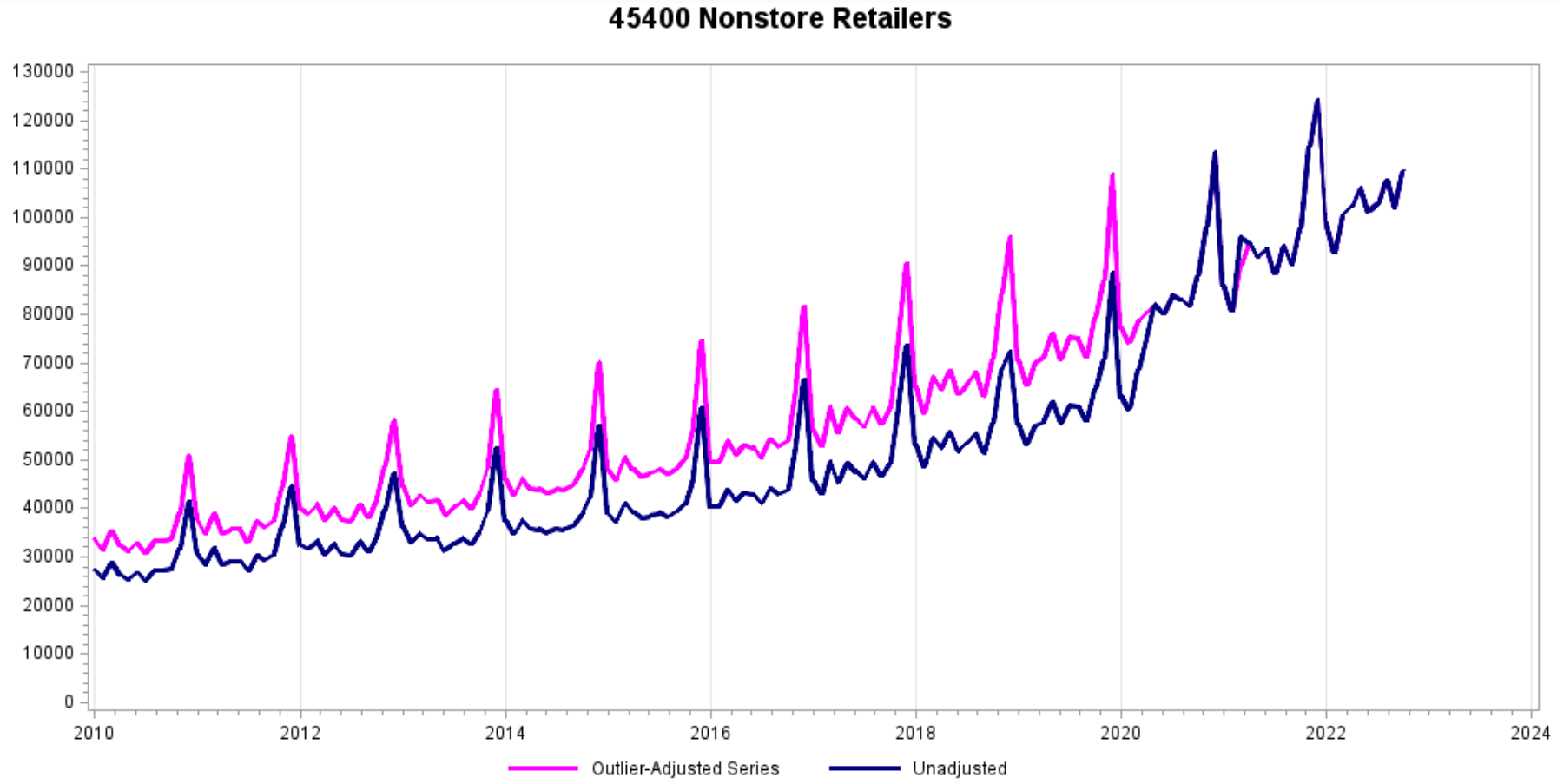
Source: Original time series from census.gov/retail, adjusted series generated from modeling

MRTS sales series that has returned to normal



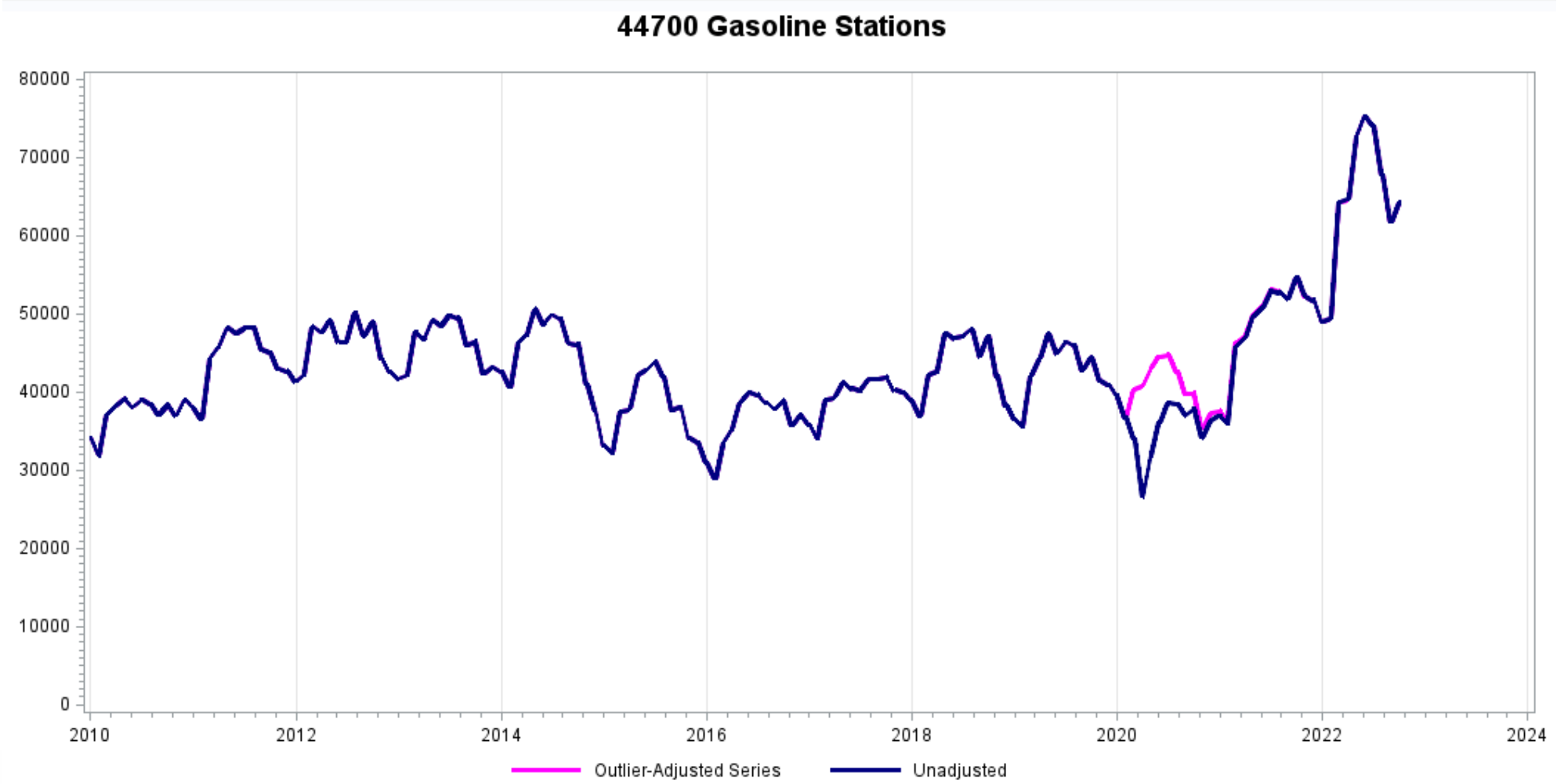
Source: Original time series from census.gov/retail, adjusted series generated from modeling

MRTS sales series with an early 2020 level shift



Source: Original time series from census.gov/retail, adjusted series generated from modeling

MRTS sales series with unusual 2022



Source: Original time series from census.gov/retail, adjusted series generated from modeling

Monthly Wholesale Trade Survey (MWTS)

- 22 sales and 22 inventories series
  - Inventories mostly had no or a short effect in 2020, but almost all series had a rapid increase in value in 2021-2022
  - Most sales series (~15) had an effect less than six months in 2020; 4 had a longer effect. 9 have a visible level change in 2021-2022.
  - 7 series had a |t|>10 – all sales series

Number of MWTS outliers

Month	Additive Outliers			Level Shifts		
	2020	2021	2022	2020	2021	2022
Jan	0	2	5	0	0	0
Feb	1	1	4	0	0	0
Mar	17	1	4	0	3	0
Apr	25	1	4	0	0	0
May	26	2	4	0	0	0
Jun	23	2	4	1	0	0
Jul	16	2	4	1	0	0
Aug	12	2	4	0	0	0
Sep	8	2	4	0	0	0
Oct	7	3		0	0	
Nov	6	4		0	0	
Dec	6	4		0	0	
Total	147	26	37	2	3	0

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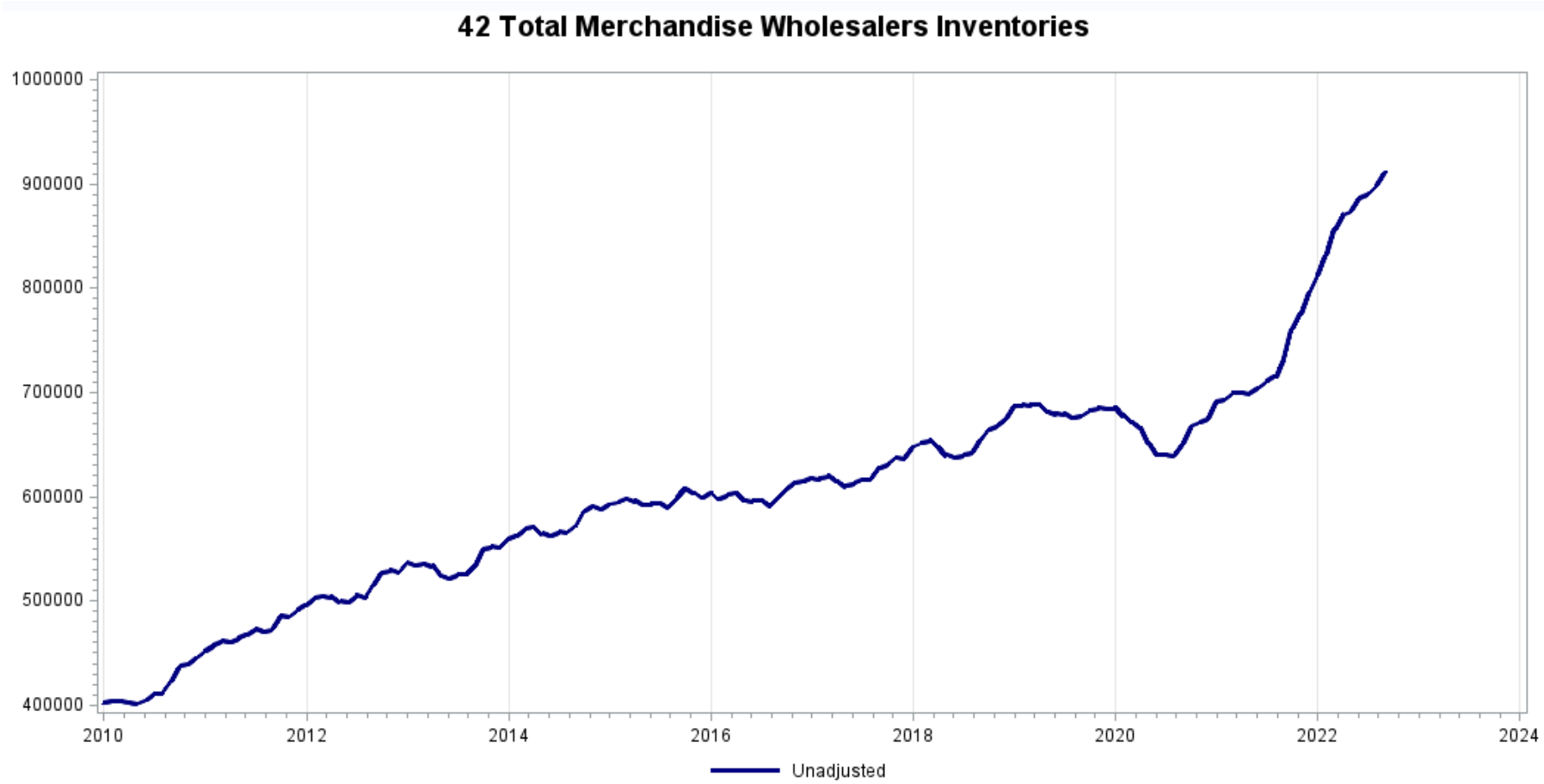
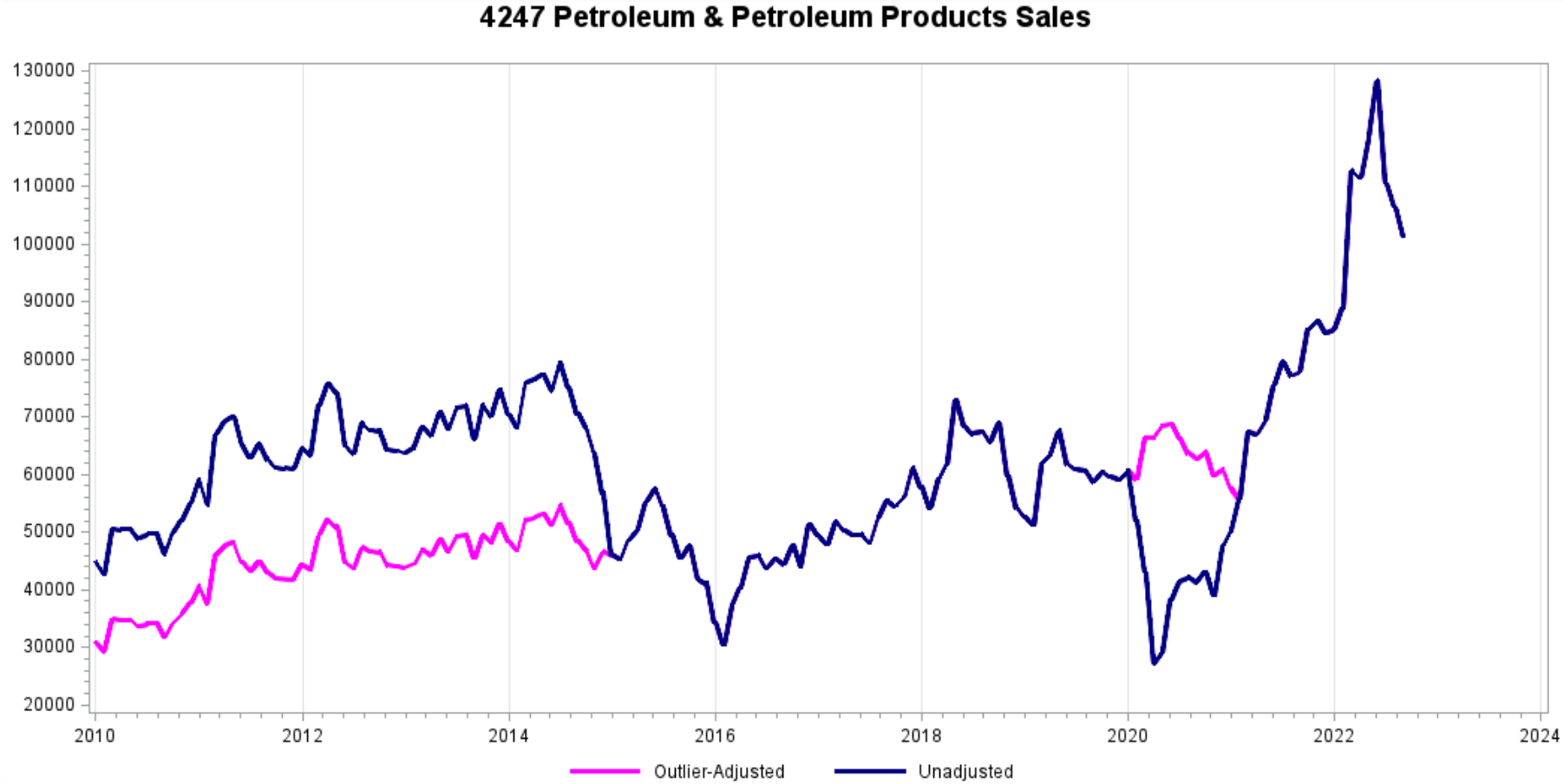
MWTS inventory series with 2021-2022 value increase



Source: Original time series from census.gov/wholesale, adjusted series generated from modeling

MWTS sales series with long initial effect and a 2021-2022 increase



Source: Original time series from census.gov/wholesale, adjusted series generated from modeling

Construction Spending

- 124 seasonally adjusted series
- Series are generally more volatile than those of other surveys and weren't treated as vigorously with outliers. 6 series had outliers in 2020-2022.

New research and methods development since the start of the pandemic

- Demetra Lytras wrote new code to collect model diagnostics and information to aid in annual review
- Eric Valentine wrote new code to generate temporary change regressors of different rates (how quickly the regressor returns to normal); in addition, preliminary results of his research suggest that for retail sales time series, a quicker rate might fit better than the default

Is the seasonal pattern changing?

- We can add change-of-regime seasonal dummy variables to the model to test for a change in seasonal pattern.
  - Because 2020 is generally messy and outliers will interfere with the results, we add them to series with 0 or 1 2021-22 outliers and start them in 2021

  - QSS: In 52 series, 11 have $p<0.05$.
  - MRTS: In 22 series, 10 had $p<0.05$
  - MWTS: In 40 series, 5 had $p<=0.05$ (all sales)

- These are very preliminary results; tested on just 1.5 years of data, it's impossible to tell whether it's a true pattern change or just the test reacting to an unusual 2021-2022.
- Visually, only a few series look like they might have a true seasonal pattern change.

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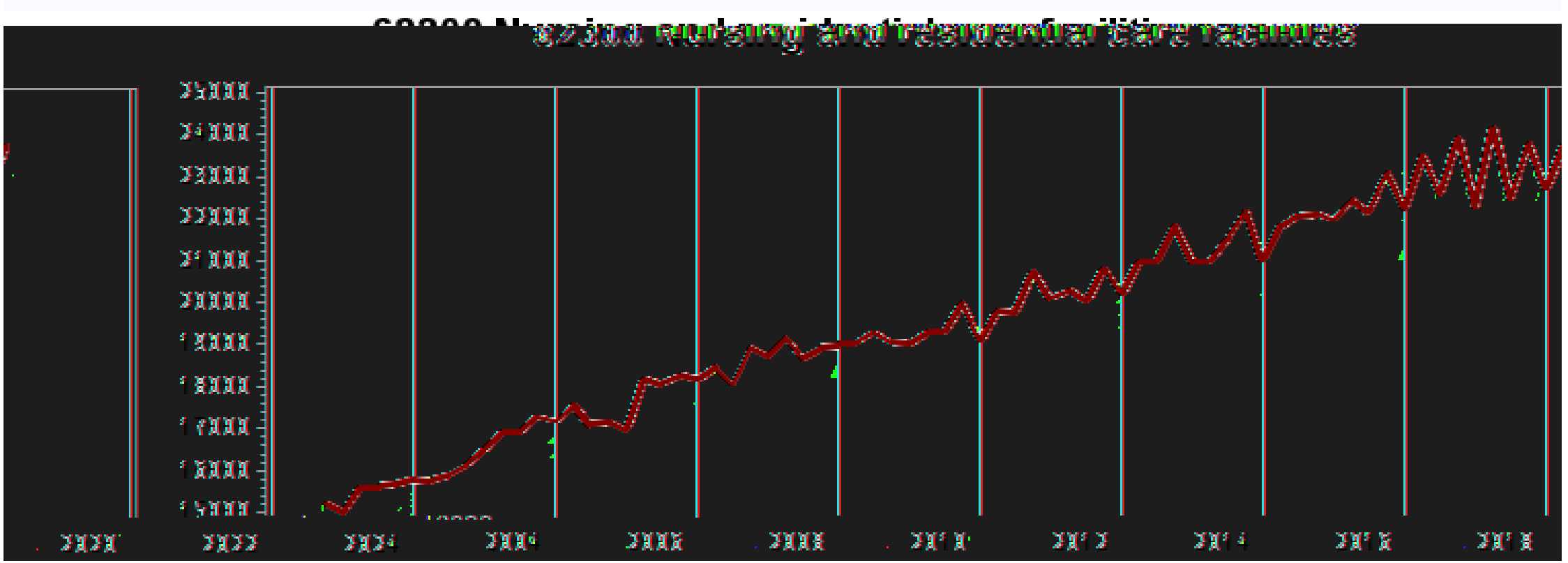
QSS series with a potential seasonal pattern change



Source: Original time series from census.gov/services

Thank you!

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