

Quarterly Services Survey Seasonal Adjustment Expansion

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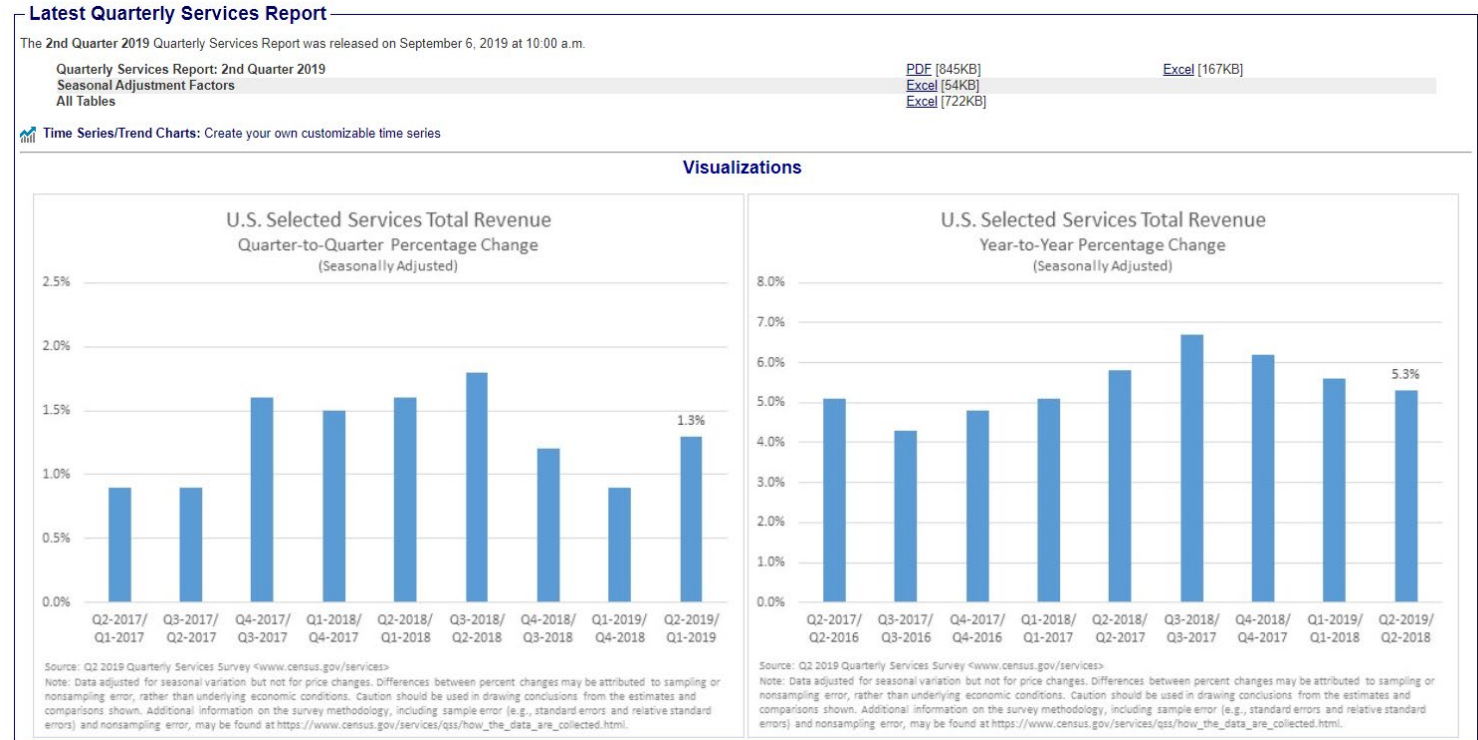
U.S. Census Bureau

Economic Statistical Methods Division

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Quarterly Services Survey (QSS)

- QSS is a principal economic indicator providing quarterly estimates of revenue, expenses, inpatient days, and discharges for selected service industries.
- Estimates were first published in September 2004 (not seasonally adjusted estimates).
- Estimates are published twice per quarter in the *Advance Quarterly Services Report* and *Quarterly Services Report*.
- Estimates are benchmarked annually to the Service Annual Survey (SAS).



Quarterly Services Survey (QSS)

NAICS	Kind of Business	Types of Data Collected
22	Utilities	Quarterly revenue
48-49	Transportation and Warehousing	Quarterly revenue
51	Information	Quarterly revenue; Revenue from government, household & business
52	Finance and Insurance	Quarterly revenue
53	Real Estate and Rental and Leasing	Quarterly revenue
54	Professional, Scientific and Technical Services	Quarterly revenue; Revenue from government, household & business
56	Administrative and Support and Waste Management and Remediation Services	Quarterly revenue; Revenue from government, household & business
61	Educational Services	Quarterly revenue & expenses
62	Health Care and Social Assistance	Quarterly revenue & expenses, inpatient days, total discharges
71	Arts, Entertainment, and Recreation	Quarterly revenue & expenses, admissions & non-admissions revenue
721	Accommodation	Quarterly revenue
81	Other Services (Except Public Administration)	Quarterly revenue & expenses

Quarterly Services Survey (QSS)

NAICS Sector/Subsector	Kind of Business	First NSA Published Quarter	
51	Information	2003Q4	
622	Hospitals	2004Q4	
623	Nursing and residential care facilities		
54	Professional, scientific, and technical services	2006Q3	
56	Administrative and support and waste management and remediation services		
484, 492, 493	Transportation (pt) and warehousing	2009Q1	
532	Rental and leasing services		
621	Ambulatory health care services		
624	Social assistance		
71	Arts, entertainment, and recreation		
81	Other services (except public administration)		
52	Finance and insurance		2009Q3
22	Utilities		2010Q1
481,483,485, 486,487,488	Selected industries in transportation		
533	Lessors of nonfinancial intangible assets (except copyrighted works)		
61	Educational services		
531	Real Estate	2012Q3	
721	Accommodation		
N/A	Selected Services Total	2015Q4	

History of Seasonal Adjustment in QSS

- Seasonally adjusted estimates were first published in 2008. As of 2017, 12 series were seasonally adjusted from NAICS 51, 54, 56, and subsector 622 (hospitals).
- As of 2018Q4, QSS published 26 new seasonally adjusted series including the Selected Services Total & series in NAICS 22, 48-49, 51 and 54.

Seasonal Adjustment Expansion Project

- Over 200 revenue and expense series were considered for expansion.
- Series were assigned to research phases based on the following priorities:
 - Direct adjustment of Services Total, complete adjustment of NAICS 51 & 54
 - Numerical NAICS order (except NAICS 61 & 721 due to size)
- Series were classified as seasonal, borderline seasonal, or not seasonal using a two-step review process.

Phase	NAICS
1	Selected Services Total, 51, 54
2	22, 48-49
3	52, 53
4	62, 561 (indirect)
5	71, 5111 (indirect)
6	81
7	61, 721

Use of X-13ARIMA-SEATS

- RegARIMA Model
 - Model calendar effects
 - Adjust for outliers
 - Forecast the series for seasonal adjustment purposes
- X11 Method
 - Perform the seasonal adjustment
- Diagnostics that help make adjustment decisions
 - Check for presence of seasonality in the original series
 - Determine adequacy of the model
 - Measure stability of the seasonal adjustment
 - Check for presence of residual seasonality in the adjusted series

Model Diagnostics

- F -test for seasonal regressors: $p < 0.05$ – seasonality present
- Initial model: Airline (0 1 1)(0 1 1)
 - Significance of model coefficients: θ – nonseasonal, Θ - seasonal
- Type of transformation: Multiplicative (Log) or Additive (None)
- Outliers: Auto-identified ($t \geq \text{critical value}$) and Potential (*within 0.5 of critical value*)
- Calendar effects: Easter and Trading Day coefficient
- Regression constant

Model Diagnostics

- Moving seasonality test
- Seasonal diagnostics
 - $M7 < 1$
 - F -statistic > 7
 - QS statistics
 - Original series: $p < 0.05$ – seasonality present
 - Seasonally adjusted series: $p \geq 0.05$ – no residual seasonality present
- Extreme values (full or partial)
- Seasonal filters: 3x3, 3x5, 3x9, x11default

Preliminary Review

- Analysis was performed using time series ending in 2017Q1.
- Model diagnostics were used to classify series as seasonal, borderline seasonal, or not seasonal.

New Series to Assess

Revenue Series

Sector	Seasonal	Borderline	Not Seasonal	Grand Total
22 – Utilities	4			4
48-49 – Transportation and warehousing	15		1	16
51 – Information	12	1		13
52 – Finance and insurance	4	2	8	14
53 – Real estate and rental and leasing	12	1		13
54 – Professional, scientific, and technical services	8		1	9
61 – Education services	3	1	1	5
62 – Health care and social assistance	33	4	5	42
71 – Arts, entertainment, and recreation	26			26
721 – Accommodation	4			4
81 – Other services	10	1	2	13
Services Total	1			1
Grand Total	132	10	18	160

Expense Series

Sector	seasonal	borderline	not seasonal	Grand Total
62 – Health care and social assistance	33	4	6	43
71 – Arts, entertainment, and recreation	6		1	7
81 – Other services	1			1
Grand Total	40	4	7	51

Additional Tracking

- Seasonal or borderline seasonal revenue series were tracked using the most recently published 8 quarters of data.
 - i.e. Currently 2019Q3, use 2017Q3-2019Q2 for testing
- The same diagnostics as used in preliminary review were evaluated.
- Expense series will be reviewed at a later date.

Additional Tracking

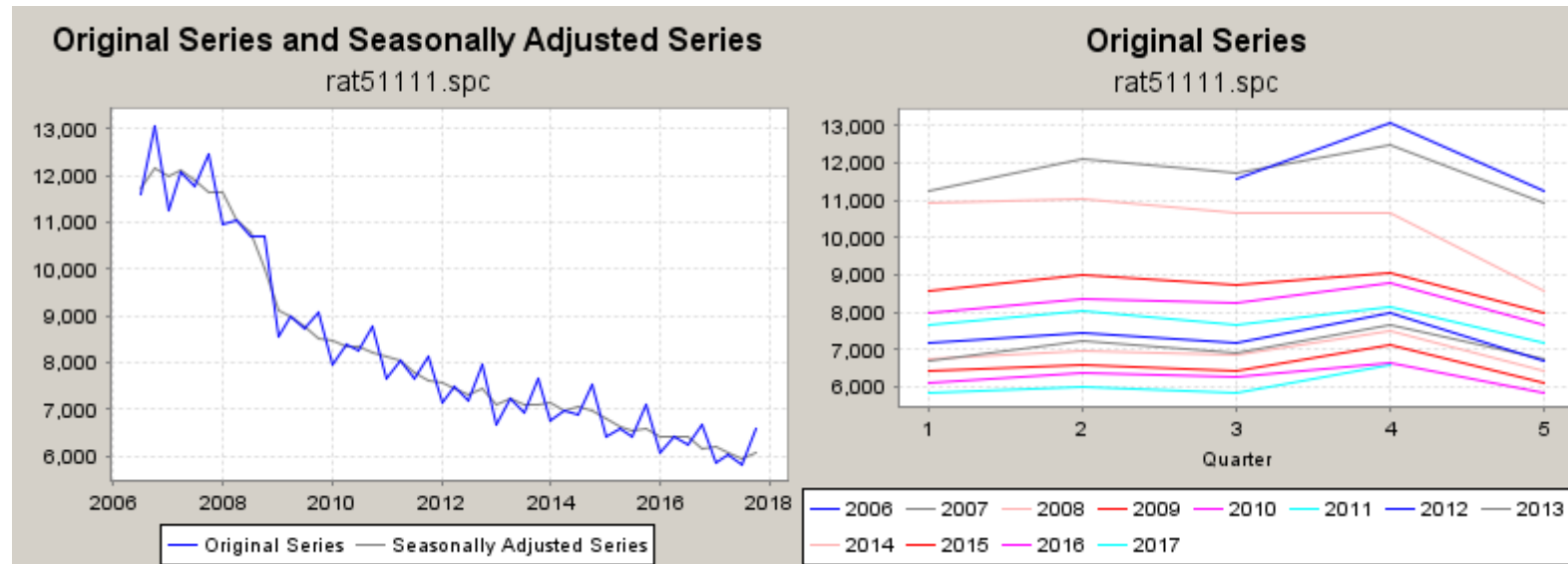
Series 51111 Data	Type of adjustment and transformation	Easter Effect	Outliers	Potential Outliers	Extreme Values	Constant in regression?	Is the series seasonal? (M7 Statistic F Statistic)	Is there residual seasonality?	Thetas	Trading Day	Moving Seasonality
Through 3 rd Quarter 2015	Mult/Log	Easter[8] t=0.24	None	LS2008.4(-3.14) LS2009.1(-3.09)	2009.1(29.0) 2012.4(44.0) 2013.1(49.8)	No t=0.47	Yes M7=0.150 F=232.524 QSp=0.0000	No QSp=1.000	$\theta=0.03007$ (0.14712) $\Theta=0.99901$ (0.15226)	td1 (0.72)	Not present at 5%
Through 4 th Quarter 2015	Mult/Log	Easter[8] t=0.24	None	None	2009.1(20.7) 2012.4(47.6) 2013.1(31.7)	No t=1.10	Yes M7=0.143 F=2248.807 QSp=0.0000	No QSp=1.000	$\theta=-0.03279$ (0.15610) $\Theta=0.86390$ (0.15007)	td1 (0.71)	Not present at 5%
• • •											
Through 2 nd Quarter 2017	Mult/Log	Easter[8] t=-0.10	None	LS2008.4 (-3.30) LS2009.1 (-3.24)	2009.1 (17.5) 2012.4 (36.7) 2013.1 (57.2)	No t=0.79	Yes M7=0.128 F=306.390 QSp=0.0000	No QSp=1.000	$\theta=-0.00553$ (0.13698) $\Theta=0.99824$ (0.11850)	td1 (1.20)	Not present at 5%

Additional Tracking

- Complete X-13 review of each individual series.
- Determine scenarios for possible indirect seasonal adjustments.
- Test each seasonal adjustment scenario using X-13.
- Provide final recommendations to Survey Analysts.

NAICS 51111 – Newspaper Publishers

Preliminary Review: Seasonal
Additional Tracking: Seasonal



NAICS 51111 – Newspaper Publishers

Recommendation: Support Adjustment

ARIMA Model: (0 1 1)(0 1 1)

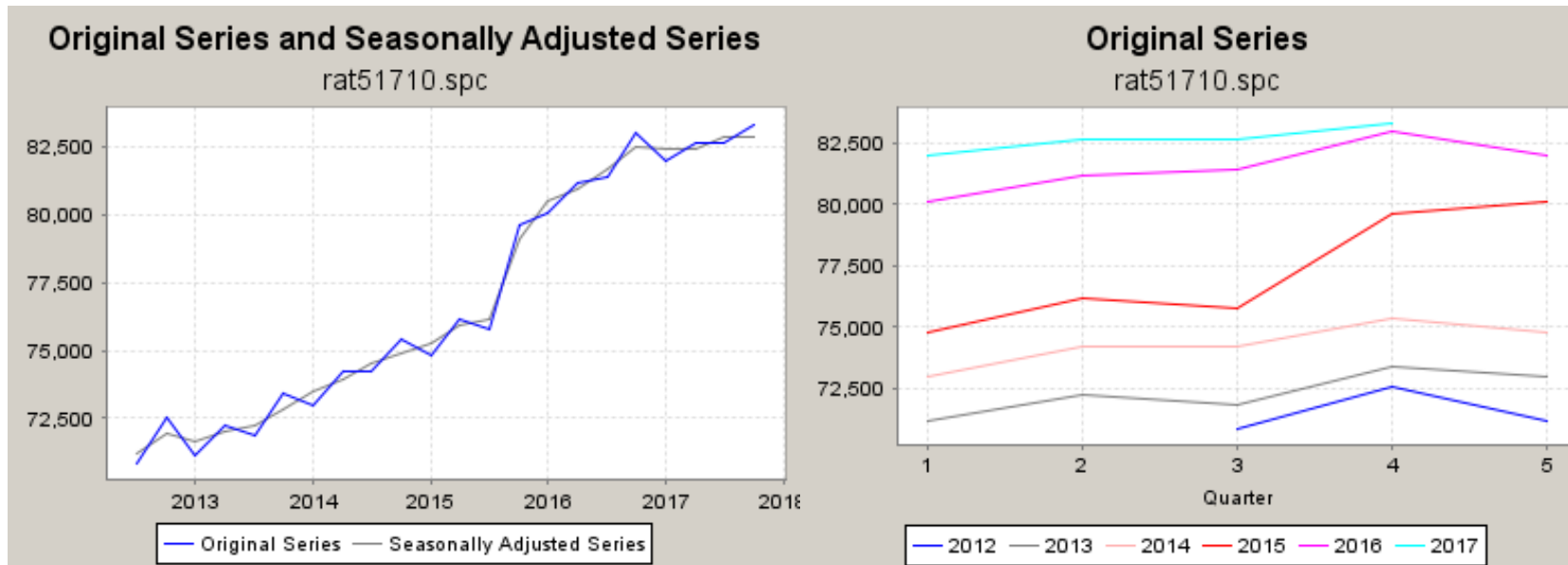
Seasonal Filter: x11default

Notes: LS2008.4 ($t=-3.16$) and LS2009.1($t=-3.13$) are potential outliers as of 2017Q4

NAICS 5171 – Wired Telecommunications Carriers

Preliminary Review: Seasonal

Additional Tracking: Continue to Monitor



NAICS 5171 – Wired Telecommunications Carriers

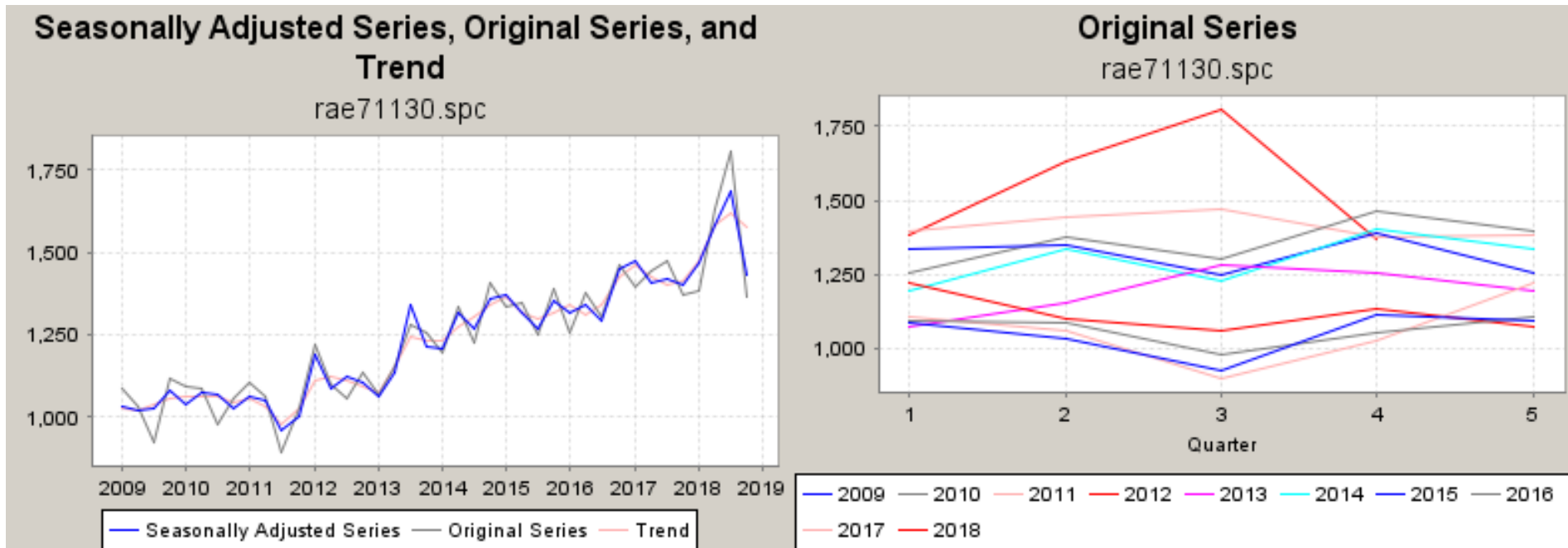
Recommendation: Seasonal, Continue to monitor

Notes: The change in the seasonal pattern of the series should continue to be monitored. LS2015.4 (t=5.51) is an outlier, and the potential outliers are gone as of 2017Q4.

NAICS 7113E - Promoters of Performing Arts, Sports, and Similar Events

Preliminary Review: Seasonal

Additional Tracking: Not Seasonal



NAICS 7113E - Promoters of Performing Arts, Sports, and Similar Events

- Recommendation: Not seasonal. Do not support adjustment.
 - Preliminary Diagnostics
 - 2017Q1: M7=0.642, F=11.5, QS (original) $p=0.00$
 - Additional Tracking Diagnostics
 - 2018Q4: M7=2.325, F=1.242, QS (original) $p=0.460$
 - 2019Q1: M7=2.303, F=1.063, QS (original) $p=0.166$
 - The year-over-year graph lacks a seasonal pattern starting in 2017.

Indirect Adjustment of NAICS 22

$$22 = 2211 + 2212 + 2213$$

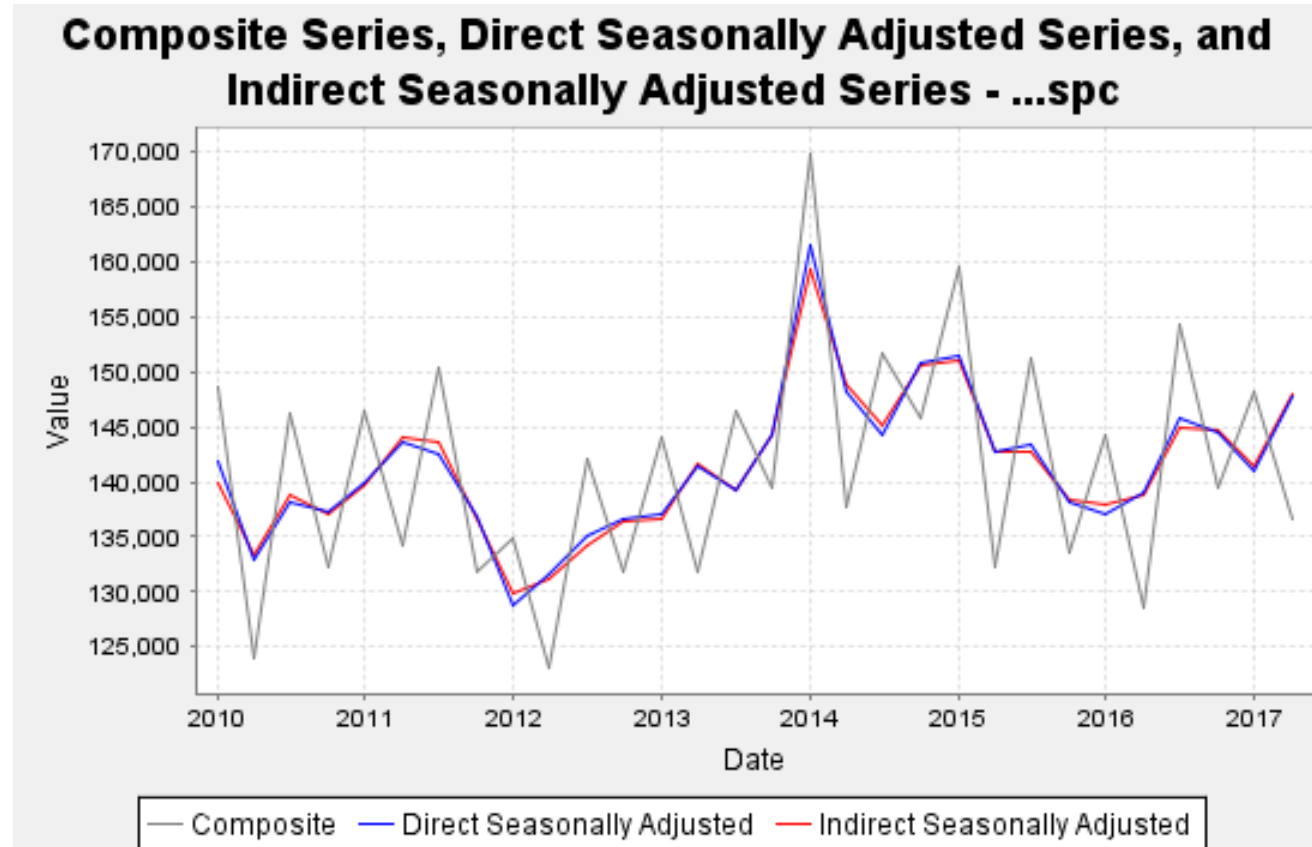
- NAICS 22 and industry groups 2211, 2212 & 2213, have the same span and were classified as seasonal during both stages of review.
- QS (indirect): $p=0.733$

Composition of NAICS 22's Quarterly Revenue Total
(Computed using NSA data for 2017Q2)

NAICS	Dollar Volume (In millions of dollars)	Percentage of NAICS 22
22	\$136,579	
2211	\$112,487	82.36%
2212	\$20,414	14.95%
2213	\$3,678	2.69%

Source: <http://www2.census.gov/services/qss/2017/qssq2-17pr.pdf>

Indirect Adjustment of NAICS 22



Current Status

- Phases 1 & 2 have been published since the preliminary 2018Q4 release.
- Phases 3-5, comprised of NAICS 52, 53, 62, 71, subsector 561, and industry group 5111, will be published in the March 2020 release of 2019Q4 estimates.
- This will increase the number of seasonally adjusted series from 38 to 100.

References

Quarterly Services. (n.d.). Retrieved November 15, 2019, from <https://www.census.gov/services/index.html>

Lytras, D. P., Feldpausch, R. M., & Bell, W. R. (n.d.). Determining Seasonality: A Comparison of Diagnostics From X-12-ARIMA. Retrieved from <https://www.census.gov/ts/papers/ices2007dpl.pdf>

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Questions?

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