NISRA
Northern Ireland Statistics and Research Agency
Gníomhaireacht Thuaisceart Éireann um Staitistiocí agus Taighde

Northern Ireland Quarterly Index of Services
Impact of Seasonal Adjustment Review

Theme: Economy
Date: 16 June 2022

Introduction

This paper summarises the impact of the periodic Seasonal Adjustment Review on the **Northern Ireland Index Of Services (IOS)** estimates. This review was carried out in Quarter 1 2022. This paper provides background information on the IOS, descriptions of the revisions that have been made to seasonal adjustment and the impact of these revisions. It is normal practice for economic estimates to be revised. IOS data are provisional and subject to **revision** for a period of four quarters from the publication date.

The quarterly Index of Services (IOS) provides a timely indicator of growth in the output of the private sector services industries in Northern Ireland. Output estimates are calculated from the IOS aspect of the Quarterly Business Survey (QBS). The IOS has a sample size of approximately 3,600 businesses, covering all private service sector businesses with 100 or more employees and a representative sample of smaller businesses. The sample frame for IOS is the Inter Departmental Business Register (IDBR), a register of all businesses registered for VAT and/or PAYE. **More information on the IOS methodology can be found on the NISRA website**.

A Seasonal Adjustment Review for IOS was carried out in May 2022, with the time series primarily reviewed by Mark Hogan and Sam Jukes of the **UK Office for National Statistics (ONS)**. The aim of the review was to ensure that the seasonal adjustment model utilised in each time series was appropriate and working well. The current IOS seasonal adjustment model had been determined in a previous ONS review in March 2021.

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Review Objectives

Economic output data can be affected by events throughout the year given that some work may be seasonal (for example, retailers may generate greater levels of turnover during the Christmas period or home heating oil suppliers may generate more turnover in winter). Output estimates from IOS are seasonally adjusted to account for such seasonal trends. Over time these seasonal patterns can change which necessitates periodic reviews of existing seasonal adjustment models.

The six quarterly series reviewed are shown in Figure 1. The name is a code that is used to refer to each series throughout this report, consistent with the names used in the previous review for the same series. The businesses which make up each series are identified by their Standard Industrial Classification (SIC) code which classifies business establishments and other statistical units by the type of economic activity in which they are engaged.

Figure 1 Series Reviewed May 2022

Series Name	Description
GI	Wholesale and retail trade; repair of motor vehicles and motorcycles; accommodation and food service activities
HJ	Transport, storage, information & communication
KLMN	Business services and finance
PQRS	Other services
RSI	Retail Sales Index
IOS	Index of Services

Any exact additive relations that hold between series before seasonal adjustment are not guaranteed to be preserved between the seasonally adjusted series. Such relations, however, will still hold approximately. The seasonal adjustment of each series was reviewed by ONS using X-13ARIMA-SEATS. Each review included:

- Assessment of whether the series is seasonal. Analysis is complicated by regular effects associated with the time of the year and the arrangement of the calendar that obscure movements. For example, retail sales rise each December due to Christmas and this may obscure underlying movements in the retail sales trend. The purpose of seasonal adjustment is to remove variation associated with the time of the year and the arrangement of the calendar. This helps users to interpret movement in the series between consecutive time periods.
- Choosing the appropriate decomposition type, that is, additive or multiplicative. In a multiplicative decomposition, the seasonal effects change proportionately with the trend. If the trend rises, the seasonal effects increase in magnitude, while if the trend moves downward the seasonal effects diminish. In an additive decomposition the seasonal effects remain broadly constant regardless of which direction the trend is moving in. In practice most economic time series exhibit a multiplicative relationship and hence the multiplicative decomposition often provides the best fit.
- Calculating prior adjustments to be made to the series before seasonal adjustment. For example: temporary prior adjustments for outliers and level shifts; and permanent prior adjustments for trading days, Easter effects and seasonal breaks.

- Selecting the ARIMA forecasting model. The purpose of ARIMA modelling is to identify systematic structural features in the history of the series. We assume that these features will continue to be present in the future and will use them to forecast future values. The ARIMA method provides a wide range of possible models, which have been found very effective in modelling typical socio-economic series showing trends, seasonality and business cycle effects.
- Deciding the lengths of the seasonal and trend moving averages. Seasonal moving averages are weighted arithmetic averages applied to each quarter over all the years in the series i.e. a particular seasonal moving average is applied to each column of data. They are used by the X-13ARIMA-SEATS program to estimate the seasonal component of the series. The trend moving averages are weighted arithmetic averages of data along consecutive quarters. In general 9-, 13- or 23-term averages are used for monthly data and a 5- or 7-term for quarterly data.
- Reviewing X-13ARIMA-SEATS diagnostics, both quantitative and visual. The quality of a statistical output should be determined by its performance against a range of attributes that together can be used to assess whether an output meets users' quality criteria.

The first stage of a review is a "default" run where all the parameters choices (decomposition, ARIMA model, outliers, seasonal and trend moving averages) are made automatically by X13ARIMA-SEATS. The outcome from the default run is then refined with the over-riding aim being to fit the simplest appropriate adjustment. The end result is then compared with the choices made in any previous review. A decision to alter previous recommendations, or to introduce complications, must be supported by evidence and reasonable argument. User-defined files for prior adjustments (rmx and ppp files) from the previous review were tested for significance and updated where necessary e.g. if transformation type for the series has changed.

This robust approach is taken to avoid uninformative revisions caused by minor changes to seasonal adjustment settings, changes that could easily revert back in the next review. A detailed description of the existing and recommended SA series can be found in Annex A.

Impact Of Revisions

From the date of the last review four quarters of additional data have been added for analysis, with the data series spanning from Quarter 1 2005 to Quarter 4 2021. There have been revisions to all data that were previously reviewed due to updates in the GVA estimates used and an **index rebase to 2019**.

Bearing this in mind Figure 2 below shows the absolute difference between the current SA model data and the revised SA model data expressed as a proportion, such that:

Absolute Revision = |yT – yt|/yt where yT = value from the current review and yt = value from the previous review.

The data changes from this review are reflected predominantly in shifting the level of the series while the patterns are generally preserved. Figure 2 shows that the impact of the revisions is small in all the reviewed series. The graphical comparisons can be seen in Annex B.

Figure 2 Series Absolute Revisions, May 2022

Series Name	Full Span Mean Absolute Revision	Last Three Years Mean Absolute Revision	Final Year Mean Absolute Revision	Latest Data Point Absolute Revision
GI	0.004	0.017	0.022	0.004
HJ	0.000	0.000	0.000	0.000
KLMN	0.003	0.003	0.005	0.009
PQRS	0.009	0.022	0.031	0.023
RSI	0.004	0.000	0.000	0.000
IOS	0.003	0.009	0.012	0.008

Analysis

The recommended seasonal adjustment is shown in Annex A. Only the GI and IOS series have revised models, which is reflected in the higher absolute revision value for that series in Figure 2 when compared to the other series. In the case of the PQRS series, a logistic transformation of the data is no longer required. As a result of the impact of Coronavirus many of the series now have additive outliers during 2020 and 2021. An additive outlier is a data point which falls out of the general pattern of the trend and seasonal component. Although an outlier may be caused by a random effect, that is an extreme irregular point, it may have an identifiable cause such as a strike, bad weather or a pandemic. Level shifts have been added to the KLMN model from Quarter 1 2021 and, for the IOS model, revised from Quarter 1 2021 to Quarter 2 2021. A level shift is an abrupt but sustained change in the underlying level of the time series. The annual seasonal pattern is not changed by a level shift.

The revised SA models will be introduced in the IOS Quarter 1 2022 publication results. Seasonal adjustment models and parameters will be reviewed regularly with the starting point for subsequent reviews being the revised SA models outlined in Annex A.

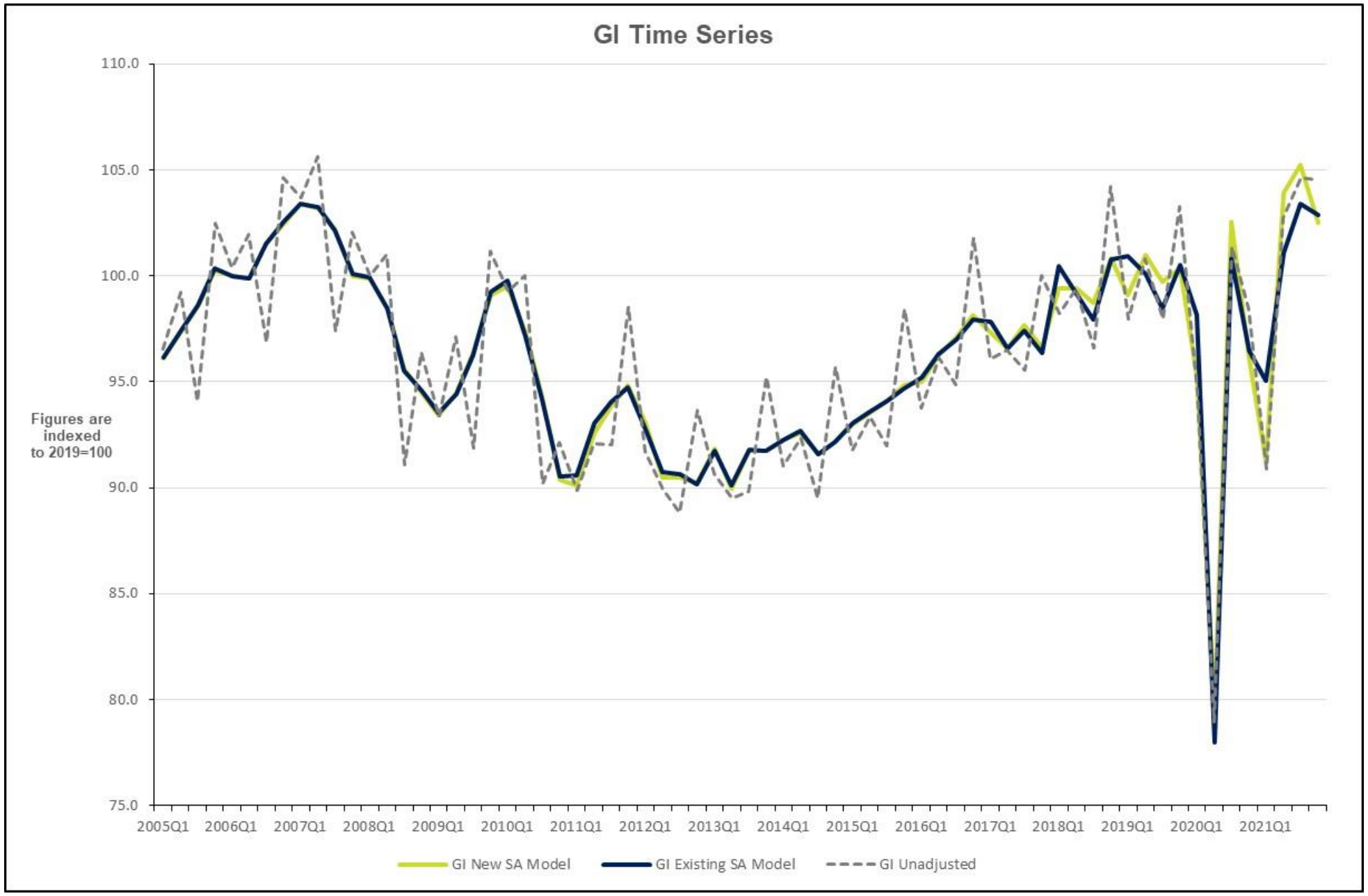
Revisions to the seasonally adjusted estimates will be made in accordance with the **IOS published policy on revisions**, informed by the **ESS Guidelines on Seasonal Adjustment**.

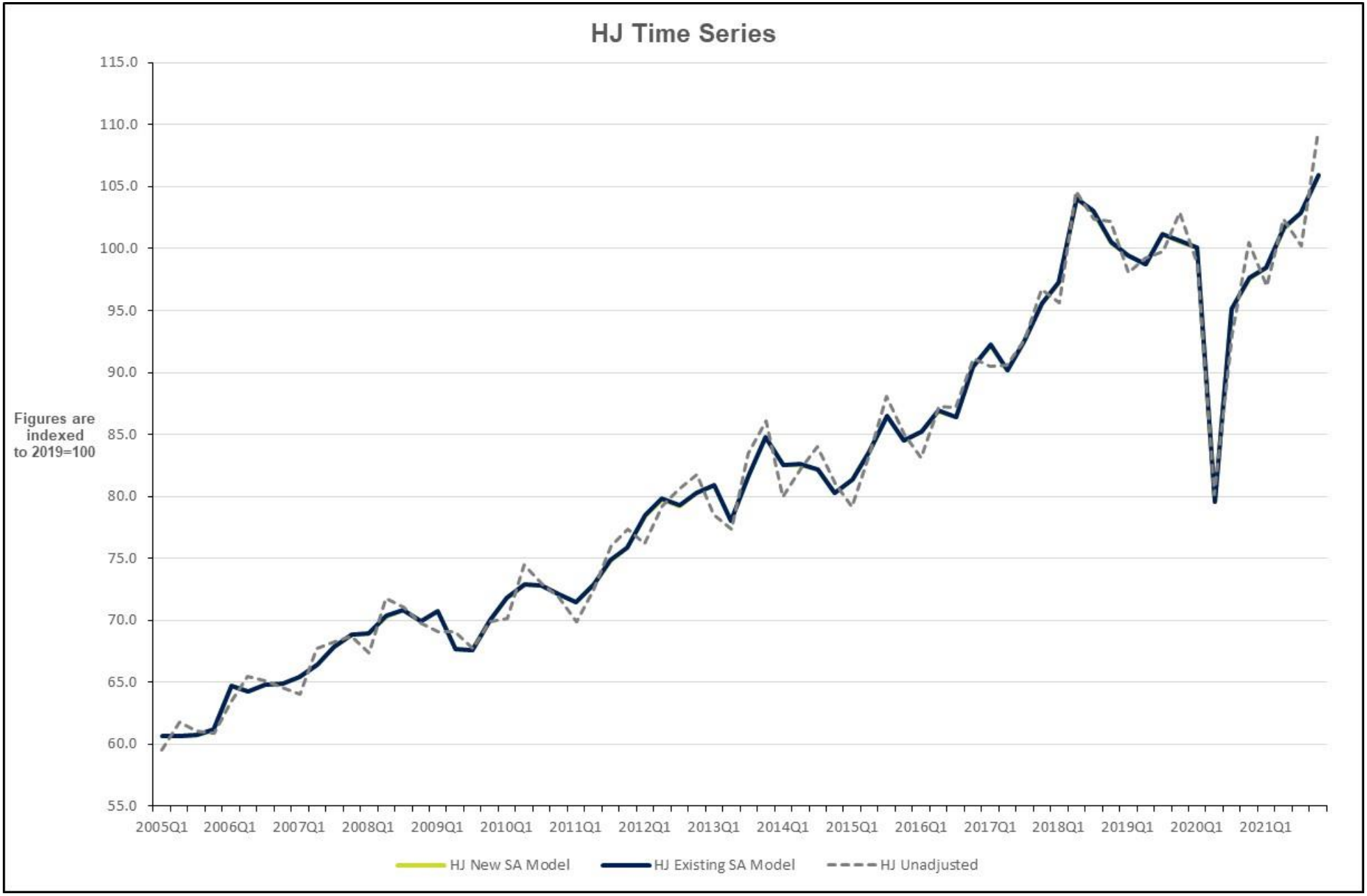
Annex A Seasonal Adjustment Models

	Current Seasonal Adjustment Model Used					Revised Seasonal Adjustment Model				
Series	**Transform**	**Model**	**TMA[1]**	**SMA[2]**	**Regressors**	**Transform**	**Model**	**TMA[1]**	**SMA[2]**	**Regressors**
GI	Log	(0,1,2)(1,1,1)	5	(3x3)	AO2020.1 & AO2020.2	Log	(0,1,1)(0,1,1)	5	(3x3)	AO2020.1, AO2020.2, AO2020.4, AO2021.1
HJ	Log	(0,1,1)(1,1,1)	5	(3x3)	AO2020.2	Log	(0,1,1)(1,1,1)	5	(3x3)	AO2020.2
KLMN	Log	(0,1,1)(0,1,1)	5	(3x3)	LS2008.4 & AO2020.2	Log	(0,1,1)(0,1,1)	5	(3x3)	LS2008.4, LS2020.1, AO2020.2 & LS2021.1
PQRS	Log	(1,0,0)(0,1,1)	5	(3x3)	AO2006.2, LS2020.1 & AO2020.2	None	(1,0,0)(0,1,1)	5	(3x3)	AO2006.2, AO2014.4,AO2014.4, LS2020.1, AO2020.2, AO2021.1
RSI	Log	(0,0,1)(1,1,0)	5	(3x3)	AO2006.2, LS2020.1 & AO2020.2	Log	(0,0,1)(1,1,0)	5	(3x3)	
IOS	Log	(2,1,0)(0,1,1)	5	(3x3)	LS2020.1 & AO2020.2	Log	(0,1,1)(0,1,1)	5	(3x3)	AO2020.1, AO2020.2 & LS2021.2

[1] TMA, Trend Moving Average
[2] SMA, Seasonal Moving Average

Annex B Seasonal Adjustment Time Series Comparison

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2010Q1
2011Q1
2012Q1
2013Q1
2014Q1
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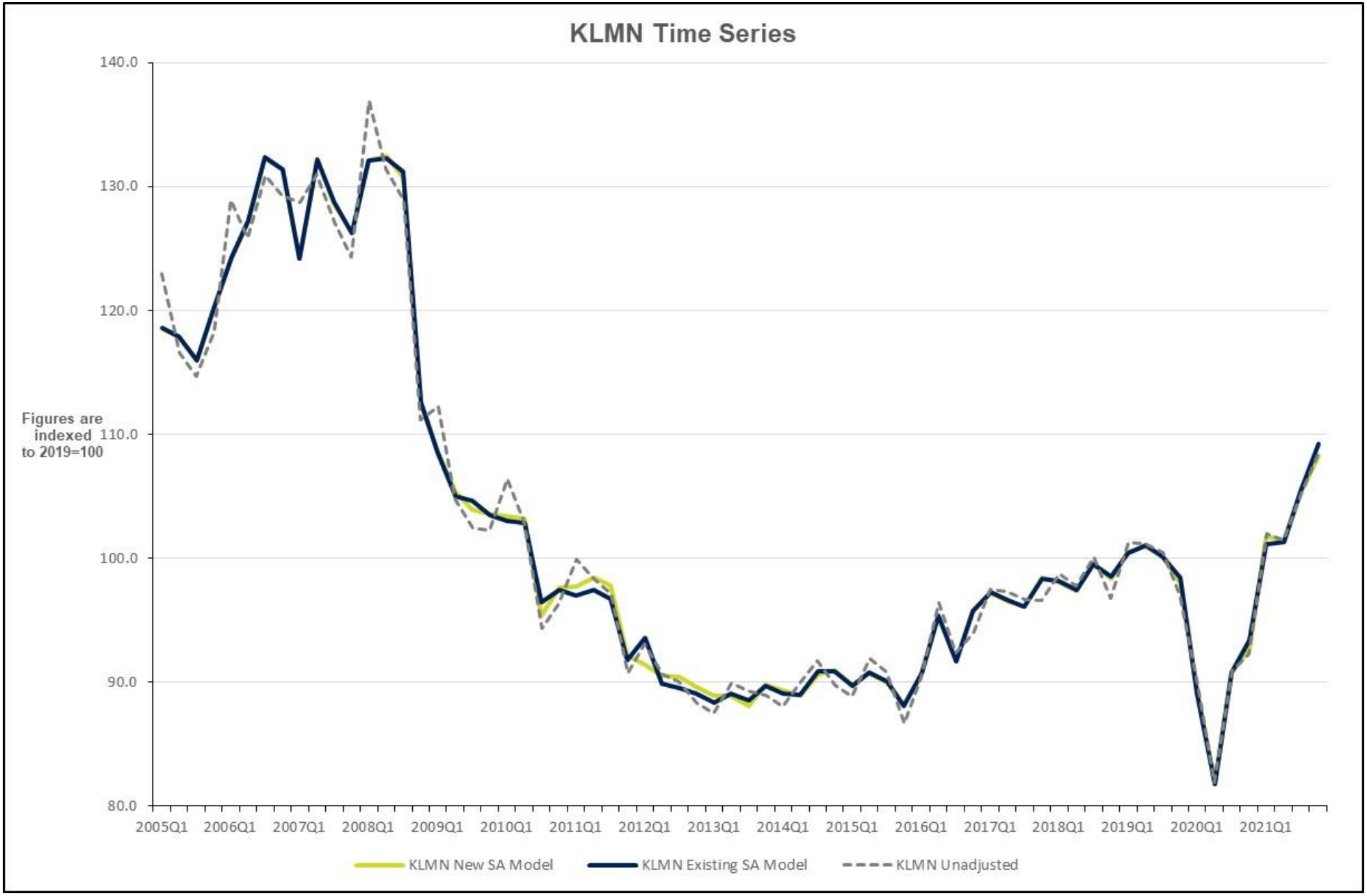
2016Q1
2017Q1
2018Q1
2019Q1
2020Q1
2021Q1
HJ New SA Model
HJ Existing SA Model
HJ Unadjusted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2011Q1
2012Q1
2013Q1
2014Q1
2015Q1
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2018Q1
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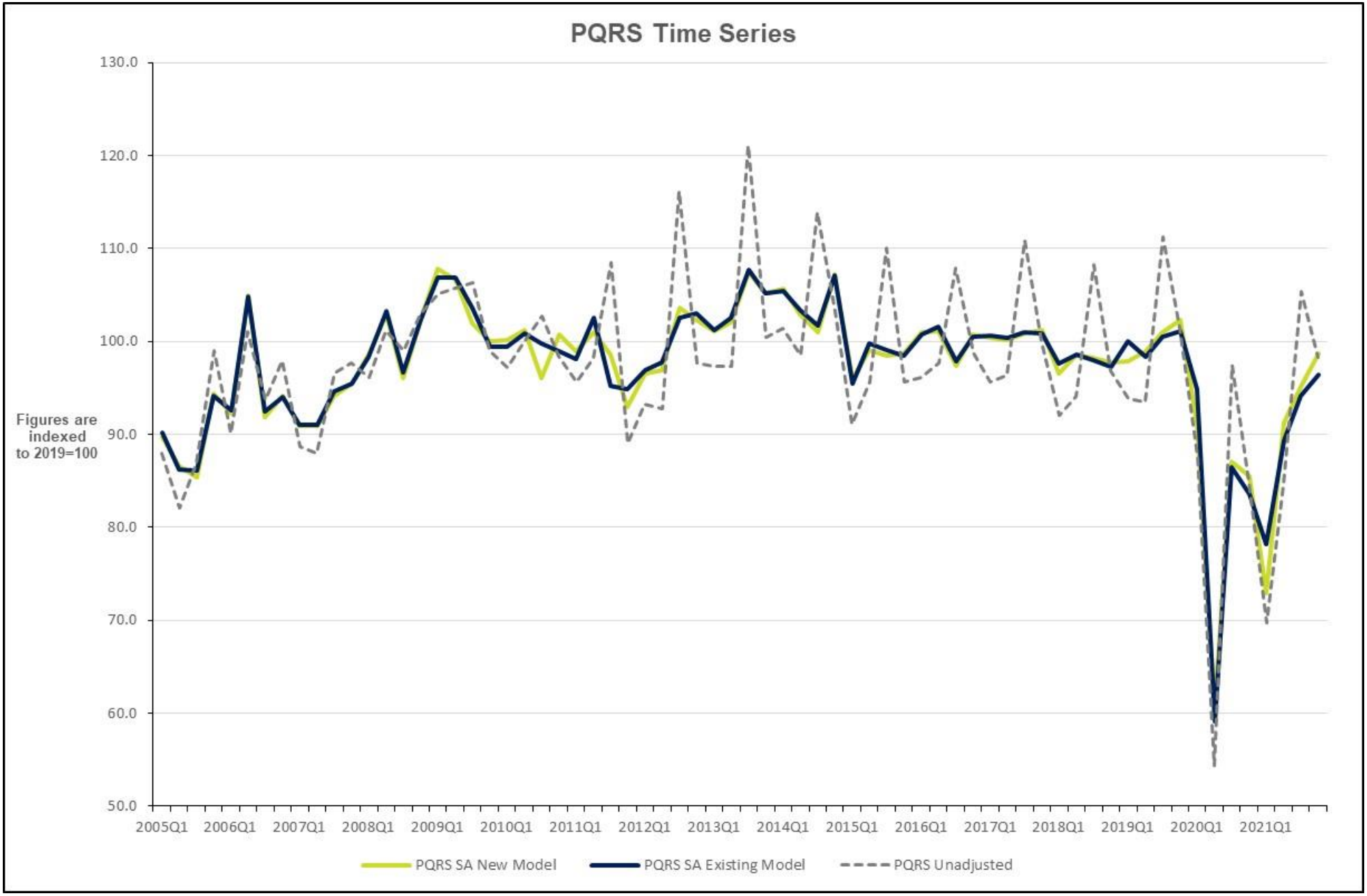
2020Q1
2021Q1
KLMN New SA Model
KLMN Existing SA Model
KLMN Unadjusted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70.0
60.0
50.0
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2008Q1
2009Q1
2010Q1
2011Q1
2012Q1
2013Q1
2014Q1
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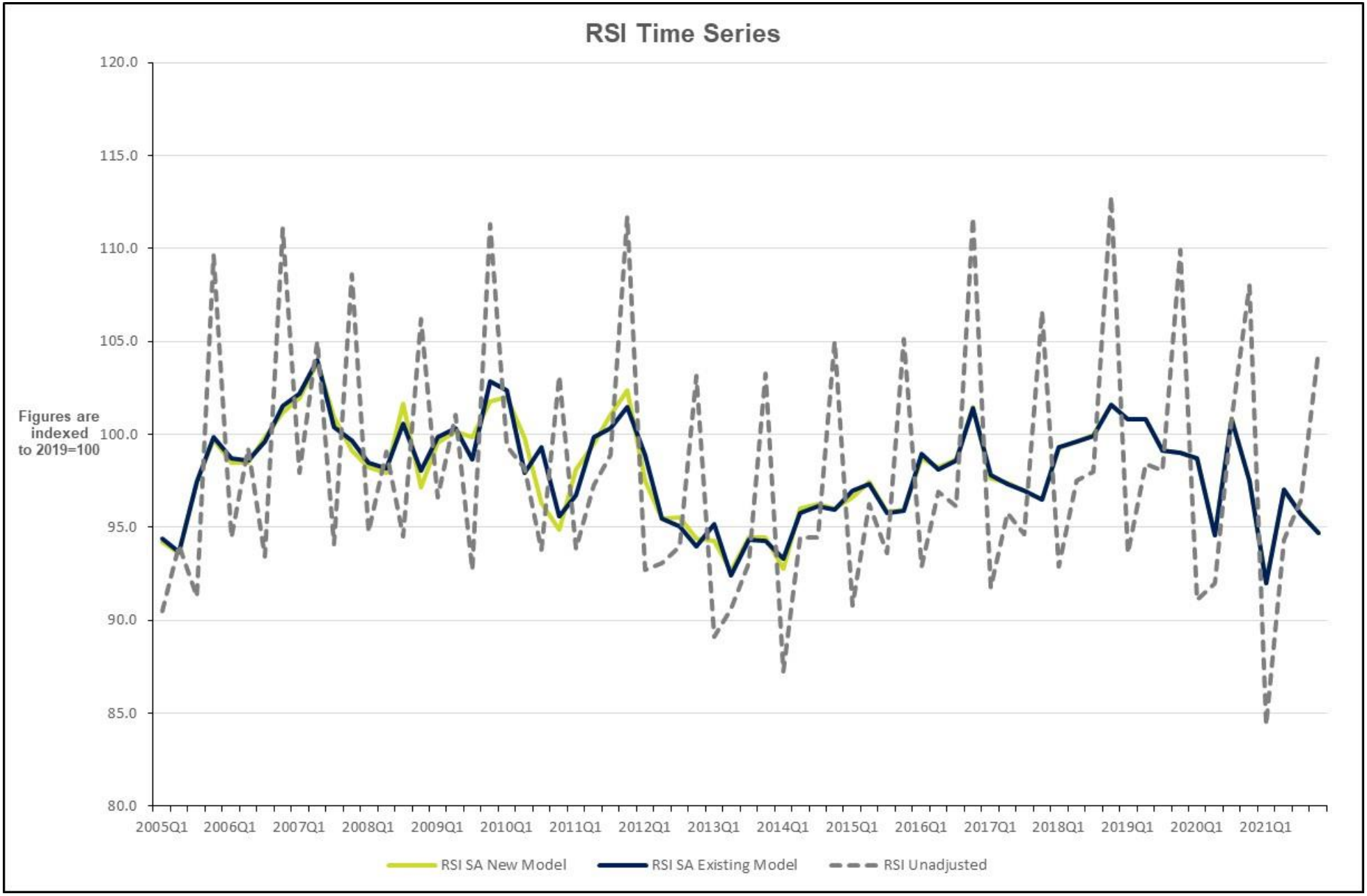
2016Q1
2017Q1
2018Q1
2019Q1
2020Q1
2021Q1
PQRS SA New Model
PQRS SA Existing Model
PQRS Unadjusted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2010Q1
2011Q1
2012Q1
2013Q1
2014Q1
2015Q1
2016Q1
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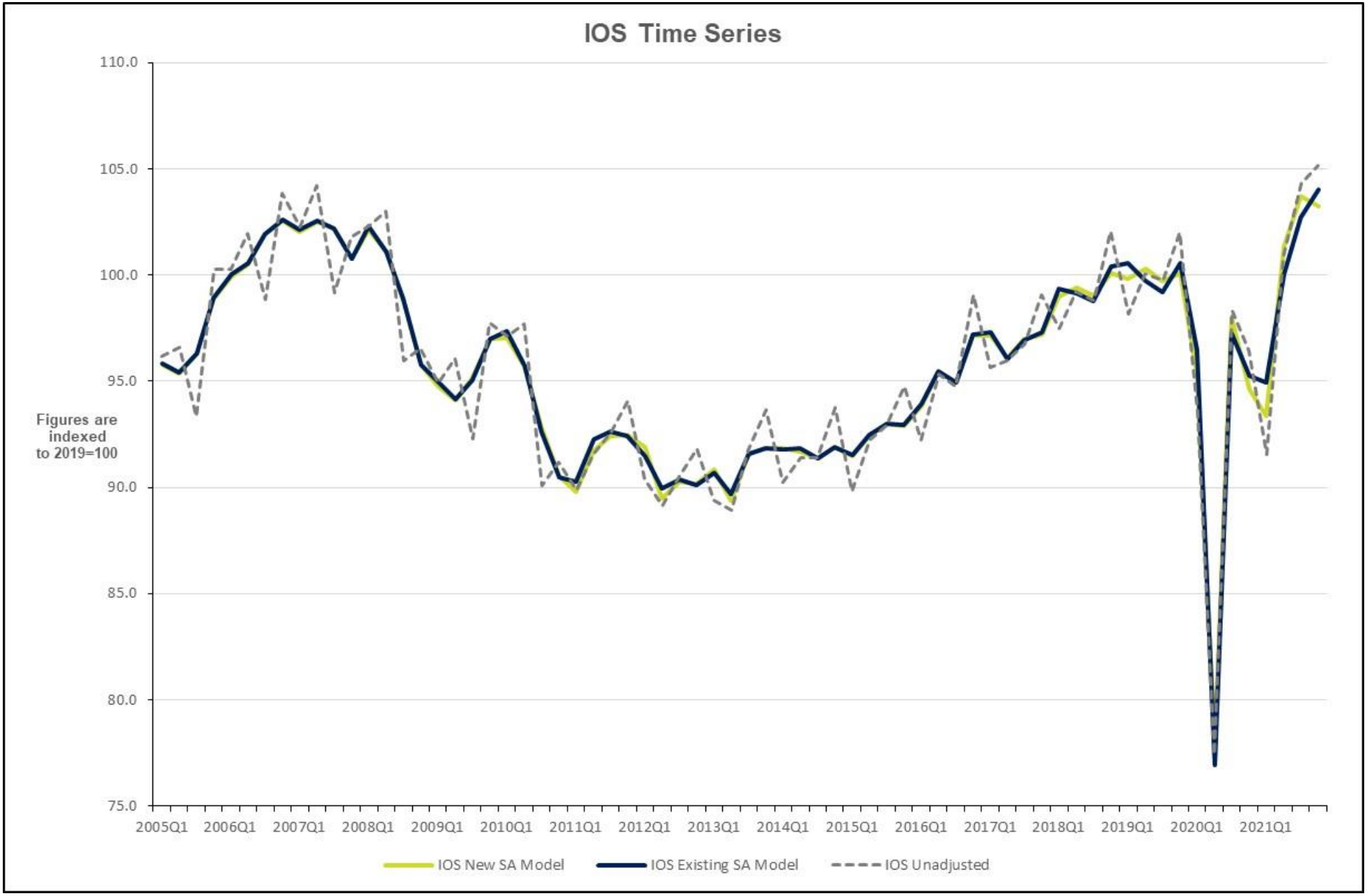
2019Q1
2020Q1
2021Q1
RSI SA New Model
RSI SA Existing Model
RSI Unadjusted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85.0
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2015Q1
2016Q1
2017Q1
2018Q1
2019Q1
2020Q1
2021Q1
IOS New SA Model
IOS Existing SA Model
IOS Unadjusted