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: 17 June 2021

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 2021. 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 3,400 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 March 2021, with the time series reviewed by Sam Jukes and Julianne Haarmann 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 November 2018.

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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 5 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 March 2021

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
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. A multiplicative decomposition cannot be used in its most basic form if any zero or negative values appear in the time series, however it could be used with the temporary addition of a constant value to the time series
- 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 9 quarters of additional data have been added for analysis, with the data series spanning from Q1 2005 to Q4 2020. There have been revisions to all data that were previously reviewed due to updates in the GVA estimates used and an **index rebase to 2018**.

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, March 2021

Series Name	Full Span Mean Absolute Revision	Last Three Years Mean Absolute Revision	Final Year Mean Absolute Revision	Latest Data Point Absolute Revision
GI	0.011	0.014	0.024	0.041
HJ	0.003	0.011	0.016	0.022
KLMN	0.002	0.006	0.008	0.013
PQRS	0.016	0.022	0.022	0.050
IOS	0.004	0.012	0.017	0.033

Analysis

The recommended seasonal adjustment is shown in Annex A. Only the PQRS series has a revised model which is reflected in the higher absolute revision value for that series in Figure 2 when compared to the other series. As a result of the impact of Coronavirus many of the series now have additive outliers during 2020. 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 IOS and PQRS models from Q1 2020. 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 Q1 2021 publication results. Seasonal adjustment models and parameters will be reviewed annually with the starting point for subsequent reviews being the revised SA models outlined in Annex A. This review will take place after IOS Q4 results have been published and will be implemented for the Quarter 1 results and subsequent publications

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**.

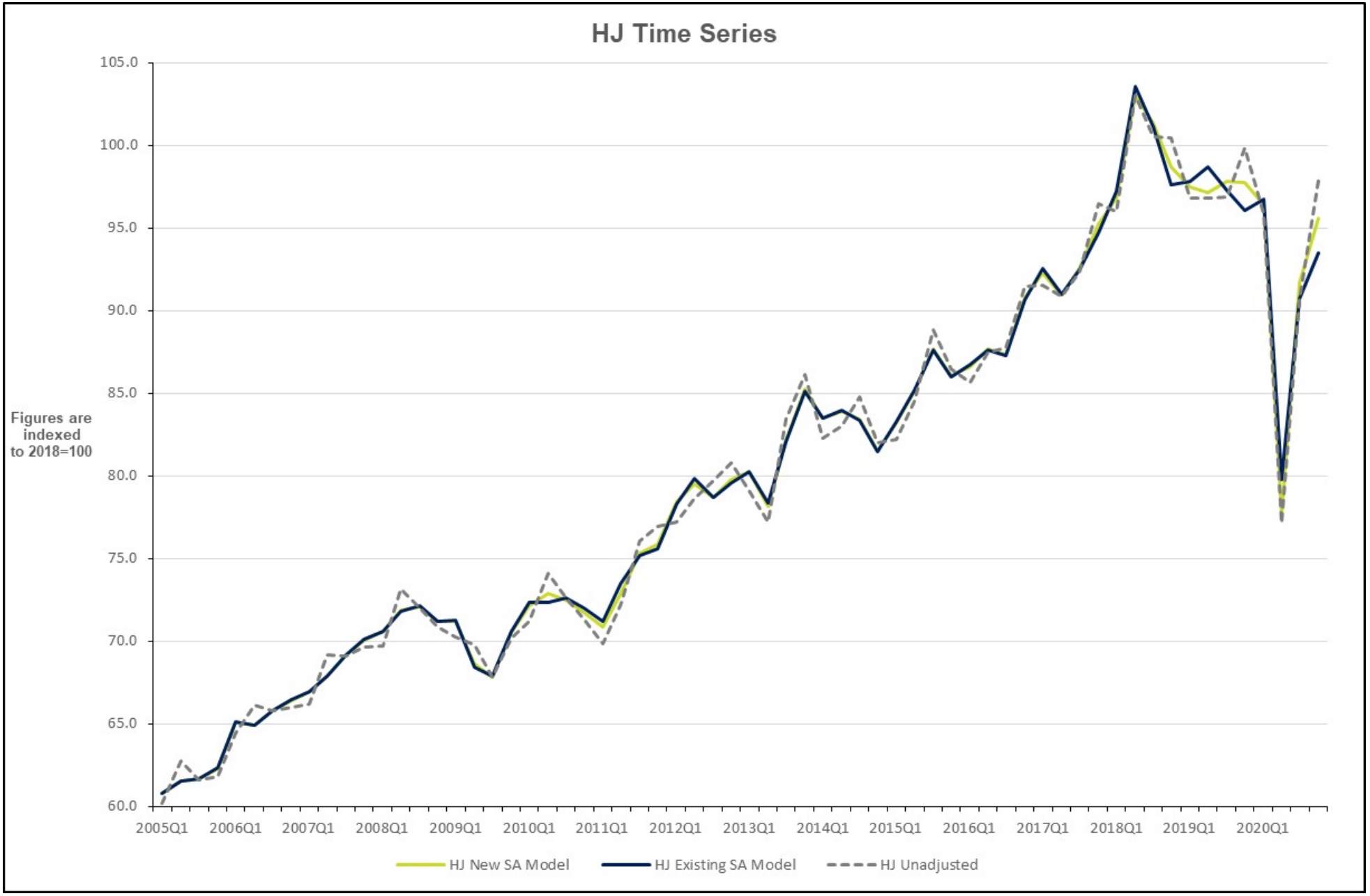
Annex A Seasonal Adjustment Models

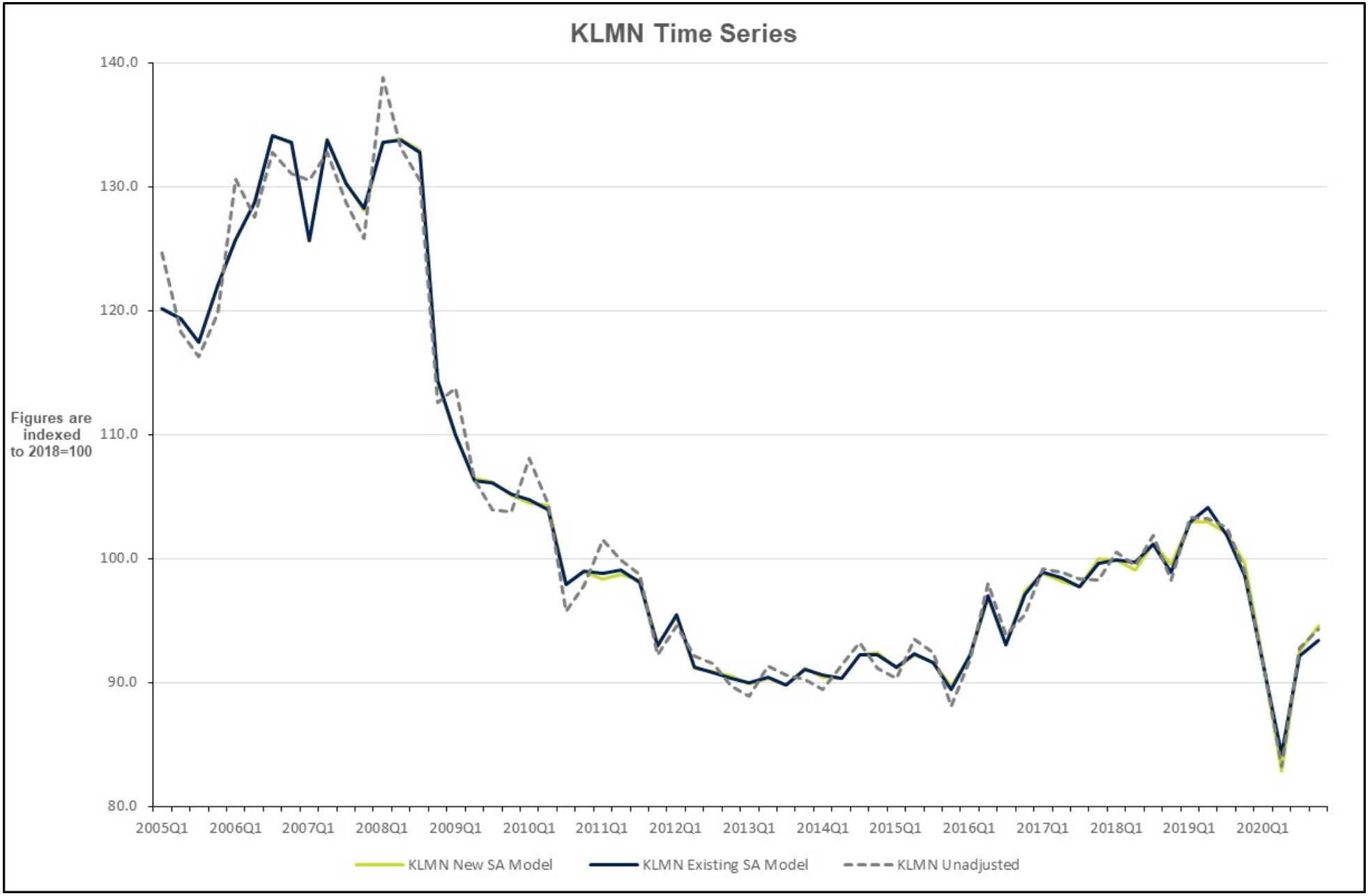
	Current Seasonal Adjustment Model Used						Revised Seasonal Adjustment Model						
Series	**Transform**	**Model**	**TMA[1]**	**SMA[2]**	**Regressors**	**Seasonal**	**Transform**	**Model**	**TMA[1]**	**SMA[2]**	**Regressors**	**Seasonal**	**Seasonal Break**
GI	Log	(0,1,2)(1,1,1)	5	(3x3)		Y	Log	(0,1,2)(1,1,1)	5	(3x3)	AO2020.1 & AO2020.2	Y	Y
HJ	Log	(0,1,1)(1,1,1)	5	(3x3)		Y	Log	(0,1,1)(1,1,1)	5	(3x3)	AO2020.2	Y	Y
KLMN	Log	(0,1,1)(0,1,1)	5	(3x3)	LS2008.4	Y	Log	(0,1,1)(0,1,1)	5	(3x3)	LS2008.4 & AO2020.2	Y	Y
PQRS	Log	(0,1,2)(0,1,1)	7	(3x5)		Since 2011.2	Log	(1,0,0)(0,1,1)	5	(3x3)	AO2006.2, LS2020.1 & AO2020.2	Y	Y
IOS	Log	(2,1,0)(0,1,1)	5	(3x3)		Y	Log	(2,1,0)(0,1,1)	5	(3x3)	LS2020.1 & AO2020.2	Y	Y

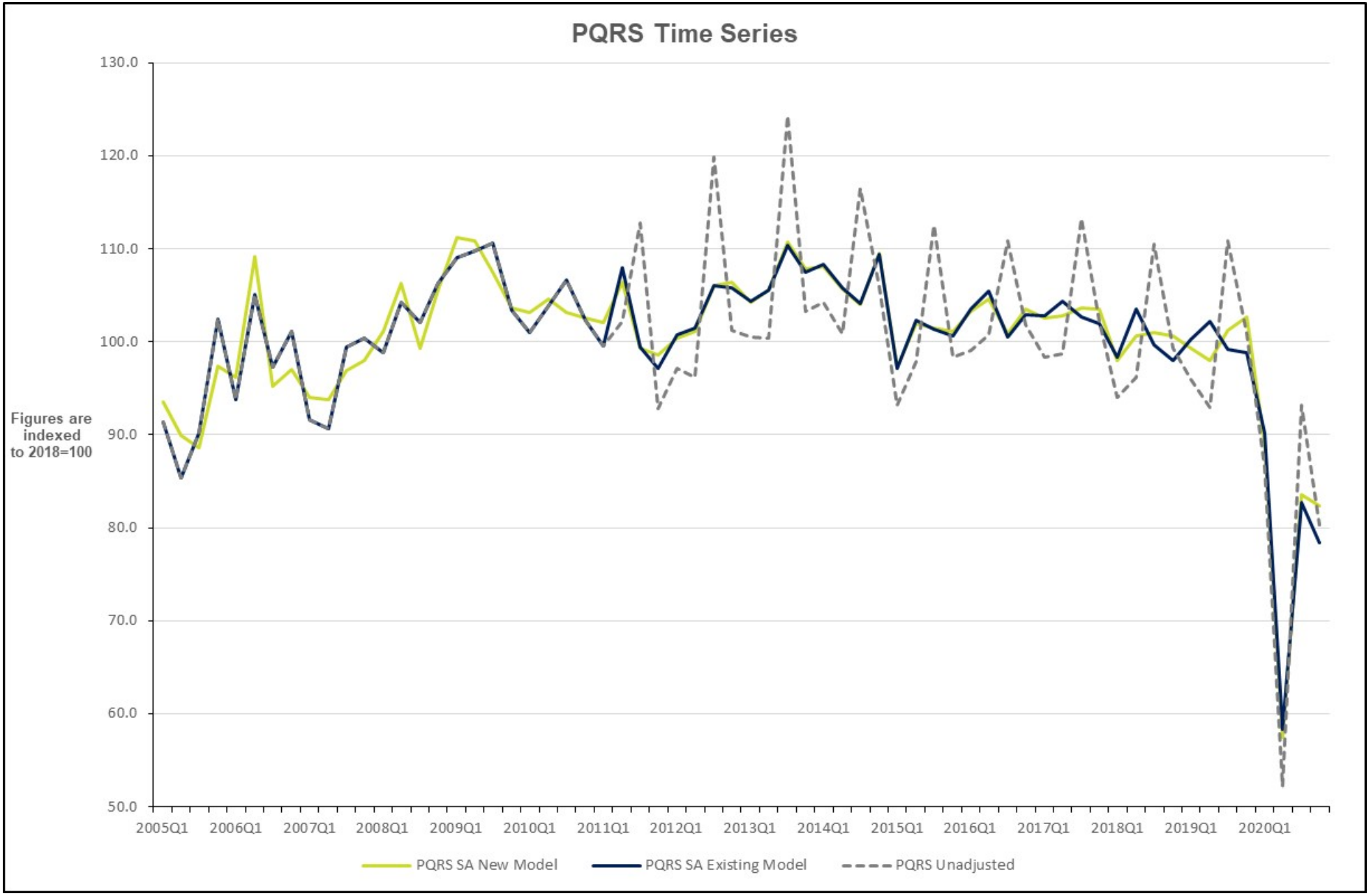
[1] TMA, Trend Moving Average
[2] SMA, Seasonal Moving Average

Annex B Seasonal Adjustment Time Series Comparison


GI Time Series
Figures are indexed to 2018=100
105.0
100.0
95.0
90.0
85.0
80.0
75.0
2005Q1
2006Q1
2007Q1
2008Q1
2009Q1
2010Q1
2011Q1
2012Q1
2013Q1
2014Q1
2015Q1
2016Q1
2017Q1
2018Q1
2019Q1
2020Q1
GI New SA Model
GI Existing SA Model
GI Unadjusted


HJ Time Series
105.0
100.0
95.0
90.0
85.0
80.0
75.0
70.0
65.0
60.0
Figures are indexed to 2018=100
2005Q1
2006Q1
2007Q1
2008Q1
2009Q1
2010Q1
2011Q1
2012Q1
2013Q1
2014Q1
2015Q1
2016Q1
2017Q1
2018Q1
2019Q1
2020Q1
HJ New SA Model
HJ Existing SA Model
HJ Unadjusted


KLMN Time Series
Figures are indexed to 2018=100
140.0
130.0
120.0
110.0
100.0
90.0
80.0
2005Q1
2006Q1
2007Q1
2008Q1
2009Q1
2010Q1
2011Q1
2012Q1
2013Q1
2014Q1
2015Q1
2016Q1
2017Q1
2018Q1
2019Q1
2020Q1
KLMN New SA Model
KLMN Existing SA Model
KLMN Unadjusted


PQRS Time Series
Figures are indexed to 2018=100
130.0
120.0
110.0
100.0
90.0
80.0
70.0
60.0
50.0
2005Q1
2006Q1
2007Q1
2008Q1
2009Q1
2010Q1
2011Q1
2012Q1
2013Q1
2014Q1
2015Q1
2016Q1
2017Q1
2018Q1
2019Q1
2020Q1
PQRS SA New Model
PQRS SA Existing Model
PQRS Unadjusted