

Northern Ireland Quarterly Index of Production

Impact of Seasonal Adjustment Review

Theme: Economy

Date: 14 September 2023

Introduction

This paper summarises the impact of the periodic Seasonal Adjustment Review on the [Northern Ireland Index of Production \(IOP\)](#) estimates. This review was carried out in Quarter 2 2023. This paper provides background information on the IOP, 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. IOP data are provisional and subject to [revision](#) for a period of four quarters from the publication date.

The quarterly Index of Production (IOP) provides a timely indicator of growth in the output of the production industries in Northern Ireland. This is defined as Standard Industrial Classification (SIC) 2007 sections B, C, D and E. Output estimates are calculated from the IOP aspect of the Quarterly Business Survey (QBS). The IOP has a sample size of approximately 1,200 businesses covering all relevant companies employing 40 or more employees and those employing 0 to 39 employees and having a turnover of £10 million or more, along with a representative sample of smaller businesses. The sample frame for IOP is the Inter Departmental Business Register (IDBR), a register of all businesses registered for VAT and/or PAYE. [More information on the IOP methodology can be found on the NISRA website.](#)

A Seasonal Adjustment Review for IOP was carried out in July 2023, with the time series primarily reviewed by Mark Hogan 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 IOP seasonal adjustment model had been determined in a previous ONS review in March 2022.

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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 IOP 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 20 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 July 2023

Series Name	Description
IOP	Overall Index of Production
ALLC	Manufacturing sector (SIC07 Section C) Sector
E	Water supply, sewerage, and waste management (Inc. recycling) (SIC07 Section E) Sector
ALLD	Electricity, gas, steam and air conditioning supply (SIC07 Section D) Sector
B	Mining and quarrying (SIC07 Section B) Sector
ENG	Engineering and allied industries, Manufacturing Subsector
TOTOTHER	Total Other manufacturing, Manufacturing Subsector
CA	Food products, beverages and tobacco, Manufacturing Subsector
CH	Basic and fabricated metal products, Manufacturing Subsector
CECF	Manufacturing of chemical and pharmaceutical products, Manufacturing Subsector
CB	Textiles, leather and related products, Manufacturing Subsector
Consumer	Consumer goods are the final goods produced by industry which are intended for purchase by private consumers. These goods are consumed by market rather than used in the production of another good and are therefore closely linked to consumer demand and the factors which influence this.
Intermediate	Intermediate goods are those purchased by the industry as inputs into the final production of goods. This category would include materials (for example, cement, rubber, plastic, chemicals and electronics) which will ultimately be used to produce a good for consumption.
Investment	Investment goods (capital goods) are goods which enable production. For example, plant, equipment and inventories used to produce goods for consumption. Investment increases if business wish to expand or upgrade existing equipment.
CC	Wood & paper products & printing & reproduction of recorded media
CDCM	Other manufacturing
CG	Rubber plastic & non-metallic mineral products
CICJ	Computer, electronic, electrical & optical products
CK	Machinery and equipment n.e.c
CL	Transport equipment

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 five quarters of additional data have been added for analysis, with the data series spanning from Quarter 1 2005 to Quarter 1 2023. 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 = $|y_T - y_t|/y_t$ where y_T = value from the current review and y_t = 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 Mean Absolute Revision, Reviewed July 2023

Series Name	Full Span Mean Absolute Revision	Last Three Years Mean Absolute Revision	Final Year Mean Absolute Revision	Latest Data Point Absolute Revision
IOP	0.003	0.003	0.002	0.001
ALLC	0.003	0.002	0.001	0.000
E	0.003	0.002	0.002	0.004
ALLD	0.002	0.003	0.005	0.011
B	0.004	0.010	0.009	0.006
ENG	0.004	0.003	0.003	0.002
TOTOTHER	0.001	0.001	0.001	0.002
CA	0.002	0.002	0.001	0.003
CH	0.012	0.007	0.006	0.005
CECF	0.014	0.023	0.022	0.018
CB	0.008	0.004	0.001	0.001
Consumer	0.002	0.001	0.002	0.003
Intermediate	0.005	0.005	0.008	0.002
Investment	0.008	0.017	0.017	0.013
CC	0.000	0.000	0.000	0.000
CDCM	0.009	0.018	0.019	0.039
CG	0.003	0.004	0.003	0.004
CICJ	0.005	0.003	0.003	0.006
CK	0.006	0.010	0.007	0.013
CL	0.014	0.029	0.021	0.037

Analysis

The recommended seasonal adjustment is shown in Annex A. Five of the series have a new model (ALLD, CECF, CICJ, Intermediate and Investment) which is reflected, in part, in the higher absolute revision value for those series in Figure 2. 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 during 2020 and 2021 for three of the series have been added, although the majority of level shifts apply to periods identified in the previous review in 2022. 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. Similarly ramp regressors (Rp) have been identified in 13 of the series which contrasts to 10 in the 2022 review. A ramp is a type of outlier used when a trend is changing too quickly to be considered a natural movement of the trend itself yet is not an instant change where a LS would be a better option. The decision to use them is usually based on whether a sharp change in trend level causes problems for the quality of the seasonal adjustment which proved to be the case.

The revised SA models will be introduced in the IOP Q2 2023 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 [IOP published policy on revisions](#), informed by the [ESS Guidelines on Seasonal Adjustment](#).

Annex A Seasonal Adjustment Models

Series	Current Seasonal Adjustment Model Used					Revised Seasonal Adjustment Model				
	Transform	Model	TMA ¹	SMA ²	Regressors	Transform	Model	TMA ¹	SMA ²	Regressors
IOP	Log	(2 1 0)(0 1 1)	5	(3x3)	Rp2008.2-2009.2, LS2012.2, Rp2017.1-2017.3, LS2020.1 & AO2020.2	Log	(2 1 0)(0 1 1)	5	(3x9)	Rp2008.2-2009.2, LS2012.2, Rp2017.1-2017.3, LS2020.1 & AO2020.2
ALLC	Log	(0 1 1)(0 1 1)	5	(3x3)	Easter[1], Rp2008.2-2008.4, Rp2017.1-2017.3 & AO2020.2	Log	(0 1 1)(0 1 1)	5	(3x9)	Easter[1], Rp2008.2-2008.4, Rp2017.1-2017.3 & AO2020.2
E	Log	(0 1 1)(0 1 1)	5	(3x5)	AO2020.2, AO2020.3	Log	(0 1 1)(0 1 1)	5	(3x5)	AO2020.2, AO2020.3
ALLD	Log	(2 1 0)(0 1 1)	5	(3x3)	TC2005.2, LS2008.1 & TC2020.2	Log	(1 0 1)(0 1 1)	5	(3x3)	AO2005.2, LS2008.1 & TC2020.2
B	None	(2 0 0)(0 1 1)	5	(3x5)	LS2020.3, AO2020.4	None	(2 0 0)(0 1 1)	5	(3x5)	LS2020.3 & LS2021.1
ENG	Log	(0 1 1)(0 1 1)	5	(3x5)	Rp2008.3-2009.2, Rp2009.4-2010.3 & AO2020.2	Log	(0 1 1)(0 1 1)	5	(3x9)	Rp2008.3-2009.2 & AO2020.2
TOTOTHER	Log	(0 1 0)(0 1 1)	5	(3x5)	Easter[8], td1coef, Rp2008.2-2009.1, LS2011.4, AO2013.3, LS2018.4, AO2020.2 & LS2021.1	Log	(0 1 0)(0 1 1)	5	(3x5)	Rp2008.2-2009.2, AO2013.3, LS2018.4, AO2020.2 & LS2021.1
CA	Log	(0 1 1)(0 1 1)	7	(3x5)	AO2005.3, AO2005.4 & Rp2017.1-2017.3	Log	(0 1 1)(0 1 1)	7	(3x9)	AO2005.3, AO2005.4 & Rp2017.1-2017.3
CH	Log	(0 1 1)(0 1 1)	5	3x9	Rp2008.2-2008.4, AO2020.2	Log	(0 1 1)(0 1 1)	5	3x9	E1, Rp2008.2-2008.4 & AO2020.2
CECF	Log	(3 0 1)(0 0 1)	5	(3x5)	AO2018.4, LS2020.2 & AO2020.4	Seasonal Adjustment Removed				
CB	Log	(0 1 1)(0 1 1)	7	(3x5)	LS2019.1, AO2020.3	Log	(0 1 1)(0 1 1)	7	(3x9)	LS2019.1 & AO2020.3
Consumer	Log	(0 1 1)(0 1 1)	5	(3x5)	AO2005.3, AO2005.4, Rp2017.1-2017.3 & AO2020.2	Log	(0 1 1)(0 1 1)	5	(3x3)	AO2005.3, AO2005.4, Rp2017.1-2017.3 & AO2020.2
Intermediate	Log	(0 1 1)(0 1 1)	5	(3x3)	LS2009.2, AO2020.2	Log	(0 1 1)(2 1 2)	5	(3x5)	Rp2008.4-2009.2 & AO2020.2
Investment	None	(0 1 0)(0 1 1)	5	(3x5)	LS2009.1, AO2020.2	None	(3 1 1)(0 1 1)	5	(3x5)	Rp2008.4-2009.2 & AO2020.2
CC	Log	(0 1 1)(0 1 1)	5	(3x5)	Rp2008.2-2009.1, Rp2020.4-2021.2 & AO2020.2	No Change				
CDCM	Log	(2 1 2)(0 1 1)	5	(3x3)	AO2020.2	Log	(2 1 2)(0 1 1)	5	(3x9)	AO2020.2 & AO2023.1

¹ TMA, Trend Moving Average

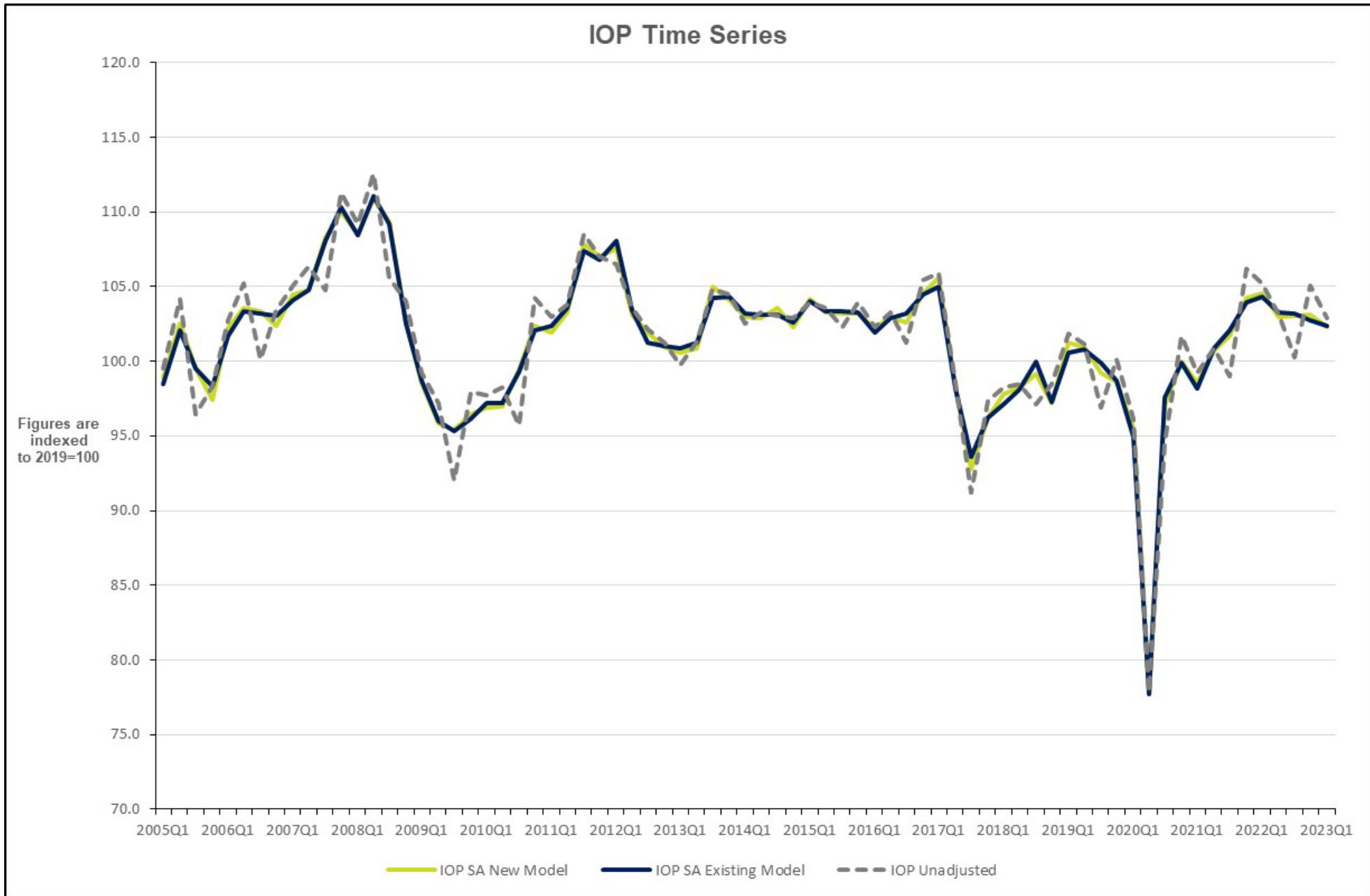
² SMA, Seasonal Moving Average

Series	Current Seasonal Adjustment Model Used					Revised Seasonal Adjustment Model				
	Transform	Model	TMA ¹	SMA ²	Regressors	Transform	Model	TMA ¹	SMA ²	Regressors
CG	Log	(1 0 0)(0 1 1)	5	(3x5)	Easter[8], Rp2008.2-2009.1, Rp2012.1-2012.3, LS2013.2, Rp2018.3-2019.1 & AO2020.2	Log	(1 0 0)(0 1 1)	5	(3x5)	Rp2008.2-2009.1, Rp2018.3-2019.1, AO2020.2 & LS2020.3
CICJ	Log	(0 1 2)(0 1 1)	5	(3x3)	Easter[1], LS2009.2, LS2010.1, LS2012.4, LS2009.1, AO2011.4, LS2015.4, AO2020.2 & AO2020.4	Log	(0 1 1)(0 1 1)	5	(3x9)	LS2009.1, LS2009.2, LS2010.1, AO2011.4, LS2012.4, LS2015.4, AO2020.2 & AO2020.4
CK	None	(0 1 1)(0 1 1)	5	(3x5)	Rp2008.2-2009.1, LS2010.3, LS2012.3, LS2013.3, LS2015.4, LS2020.1 & AO2020.2	None	(0 1 1)(0 1 1)	5	(3x5)	Rp2008.2-2009.1 & AO2020.2
CL	None	(0 1 1)(0 1 1)	5	(3x5)	AO2006.1, AO2011.3, AO2018.4, LS2020.1, AO2020.2 & AO2021.1	None	(0 1 1)(0 1 1)	5	(3x9)	LS2020.2 & AO2020.3

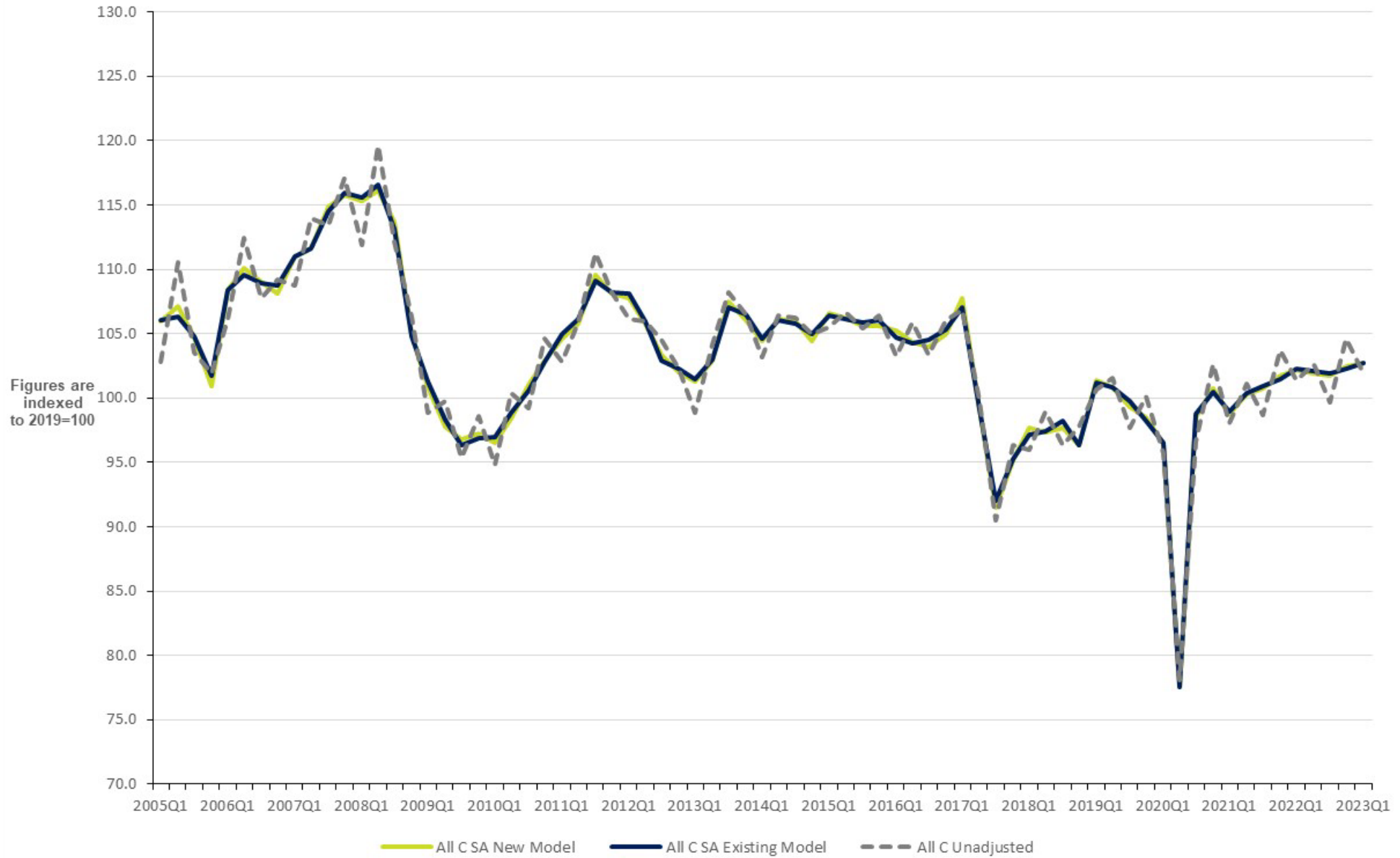
¹ TMA, Trend Moving Average

² SMA, Seasonal Moving Average

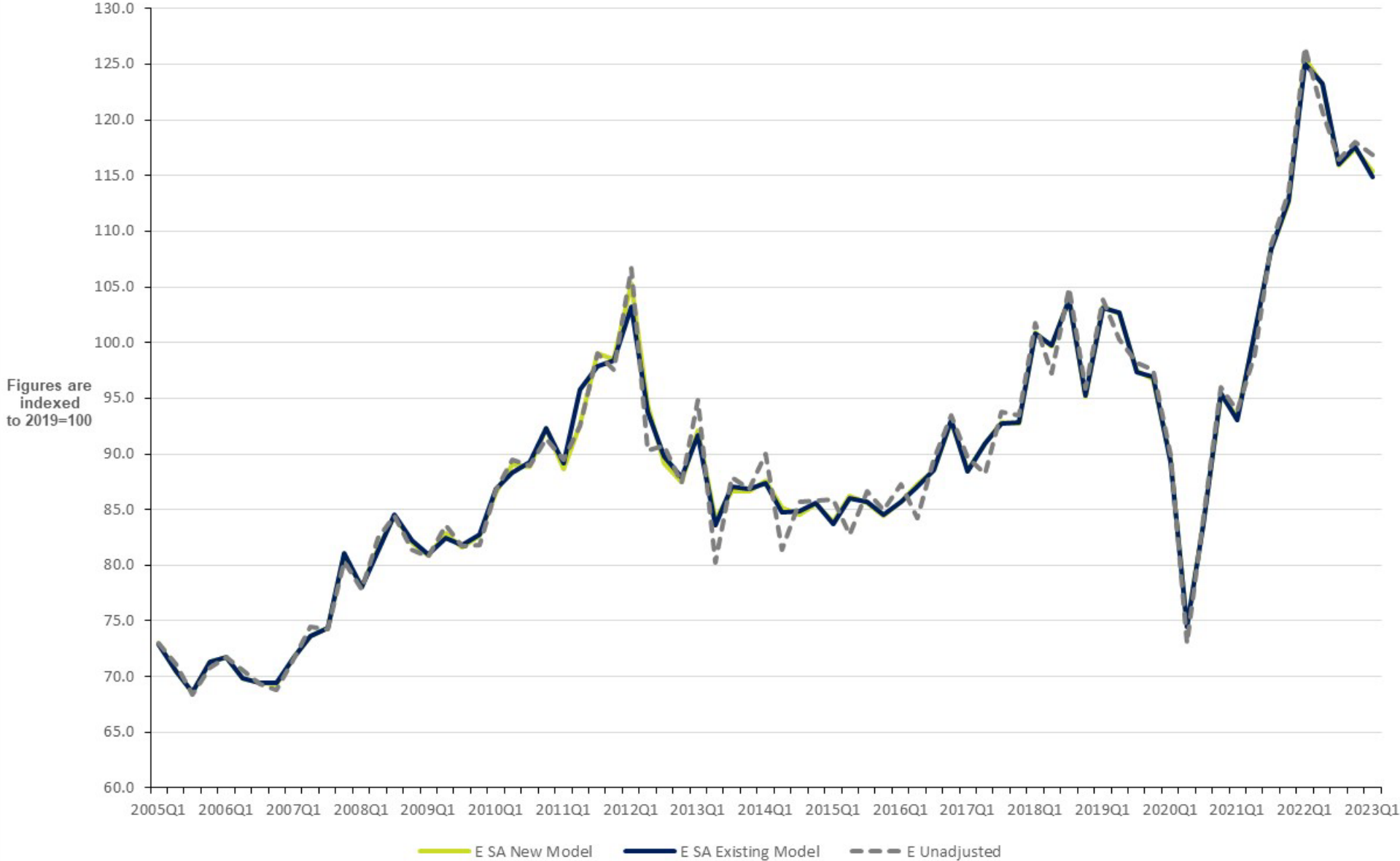
Annex B Seasonal Adjustment Time Series Comparison



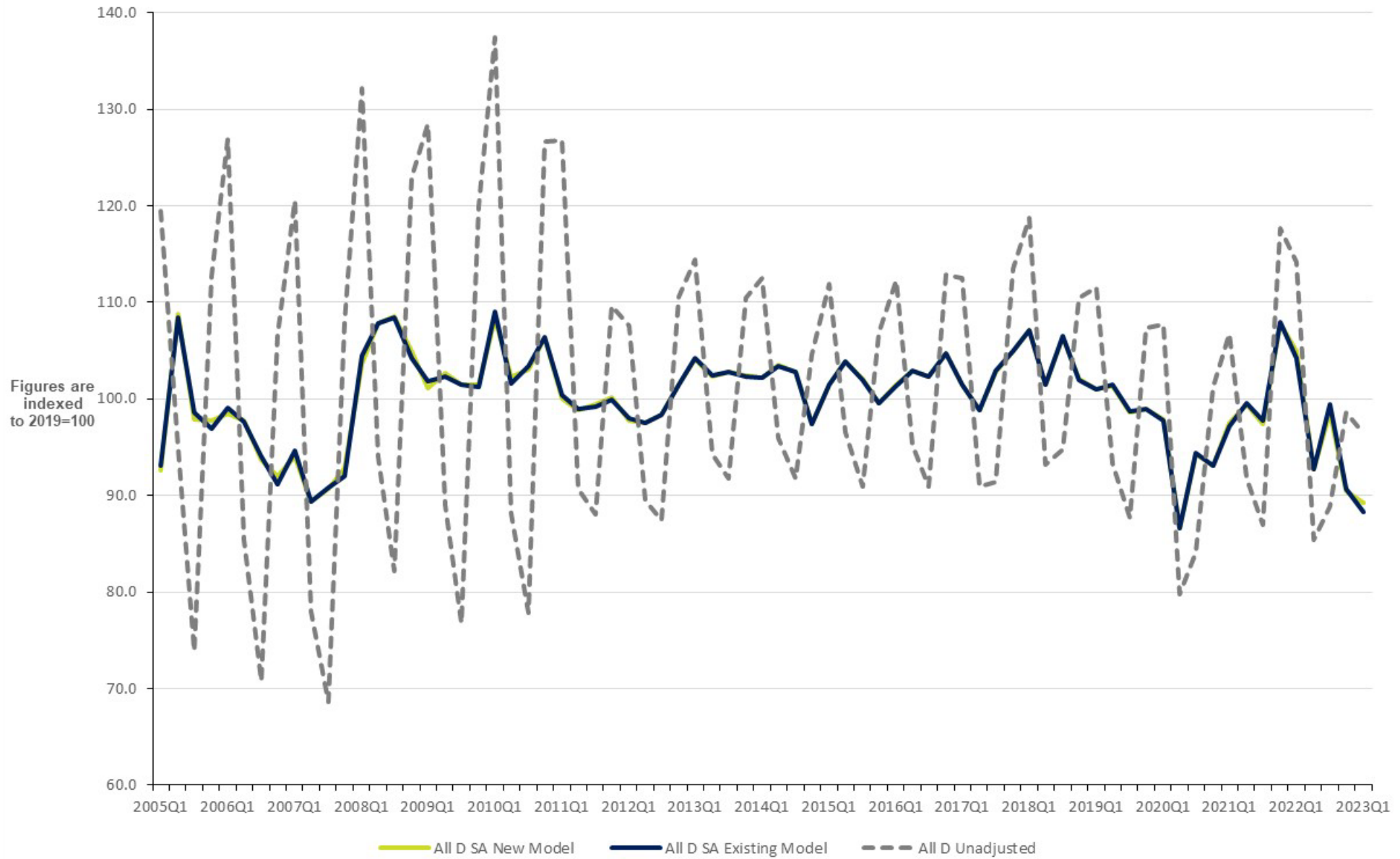
AIC Time Series



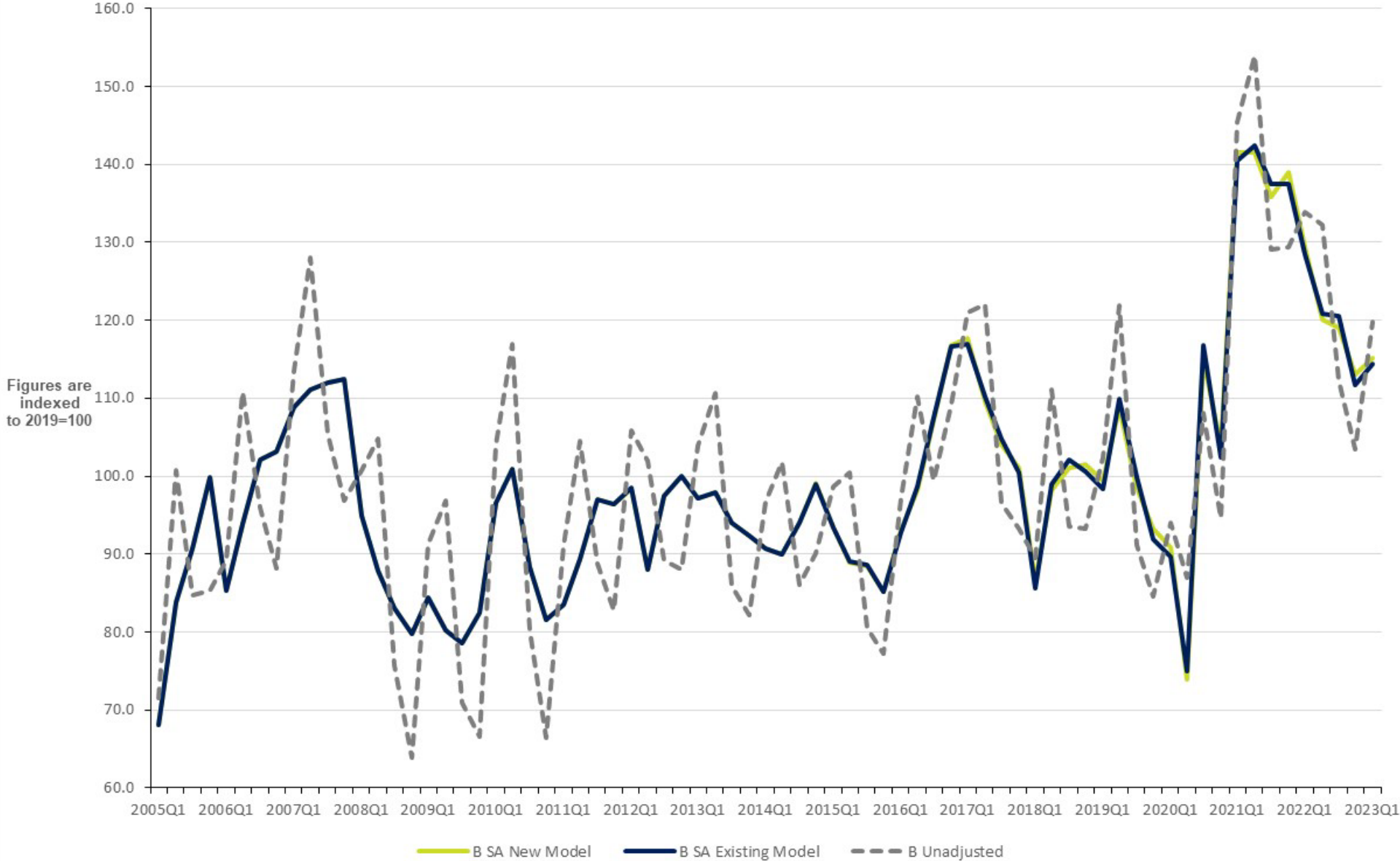
E Time Series



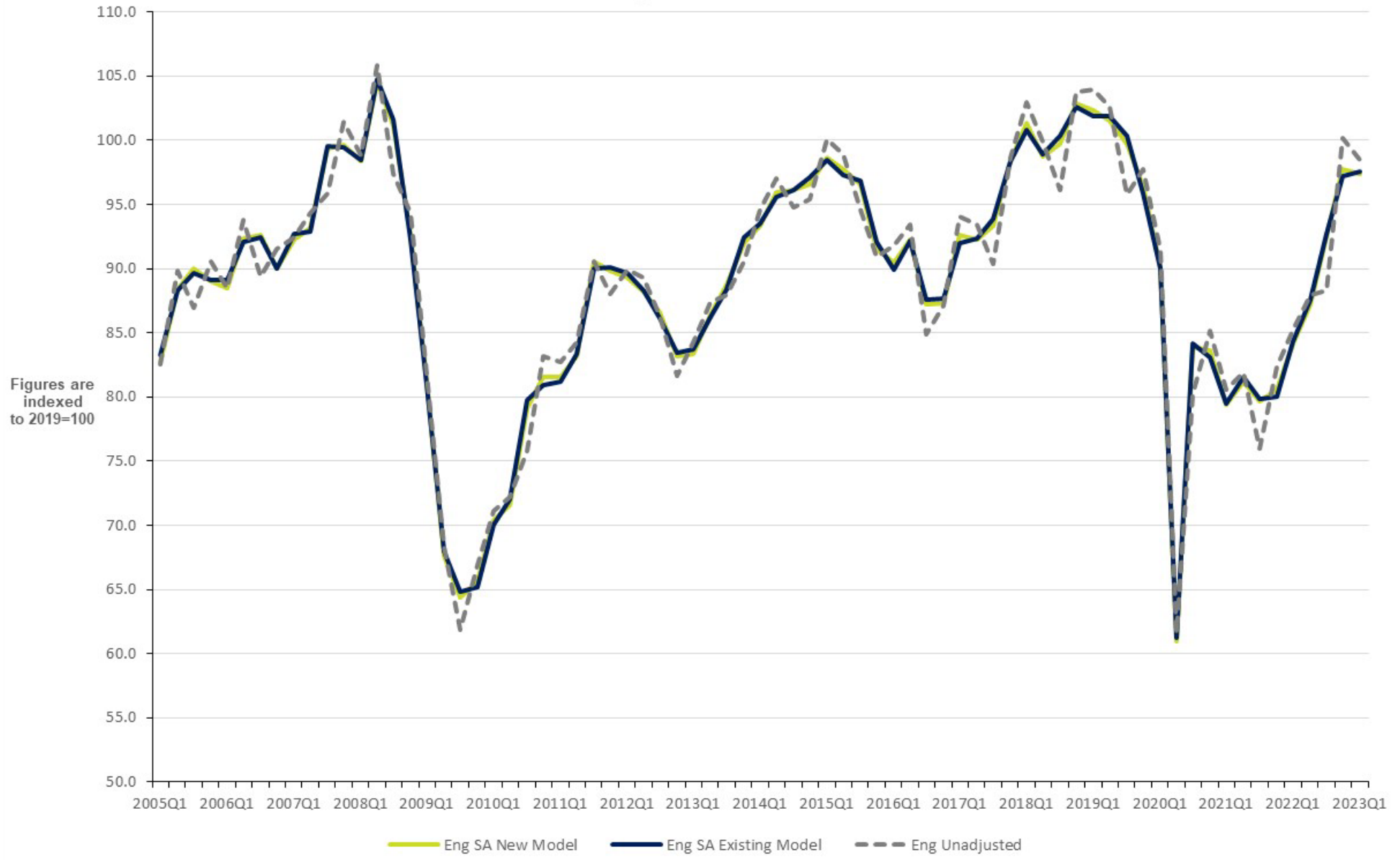
AIID Time Series



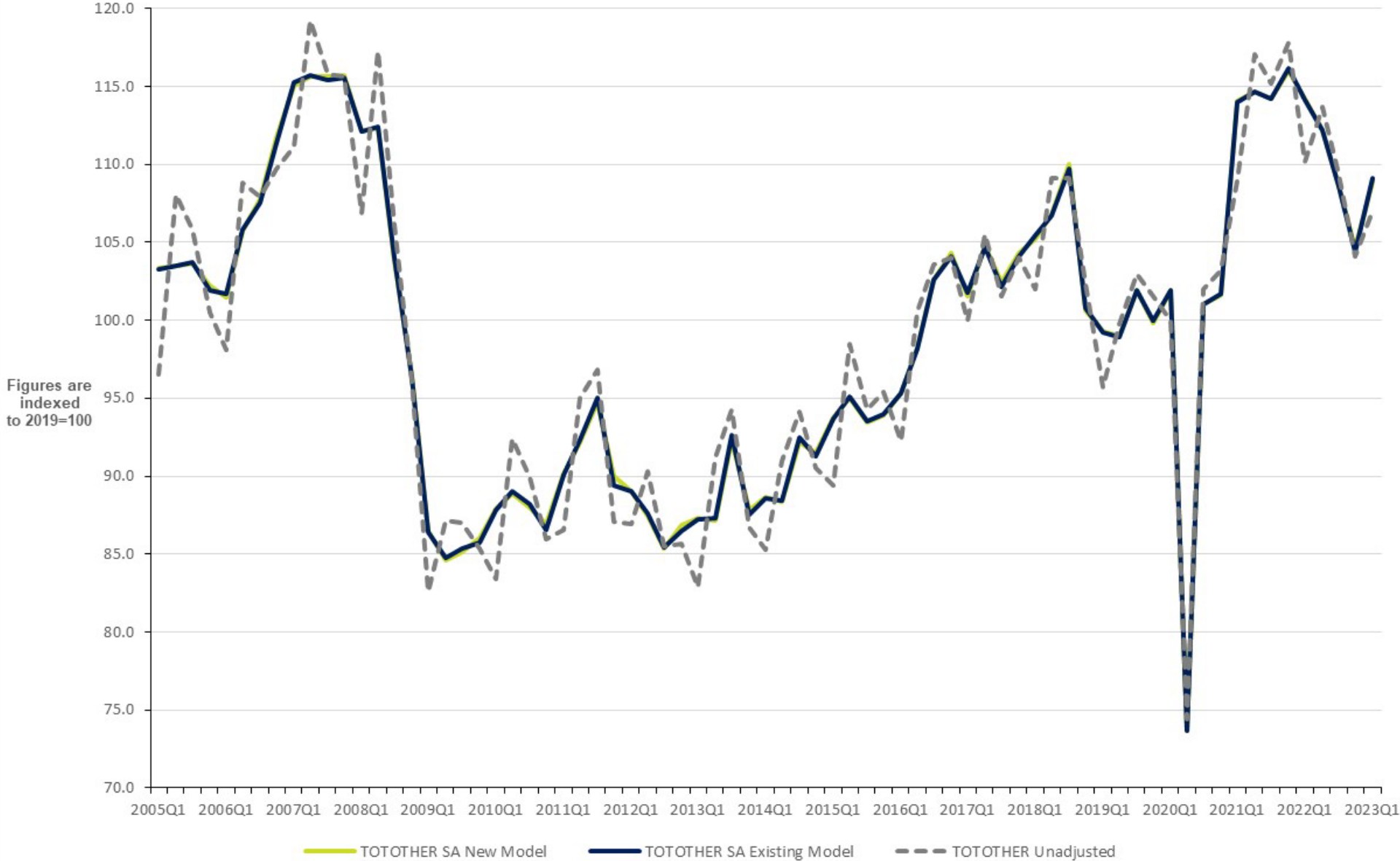
B Time Series



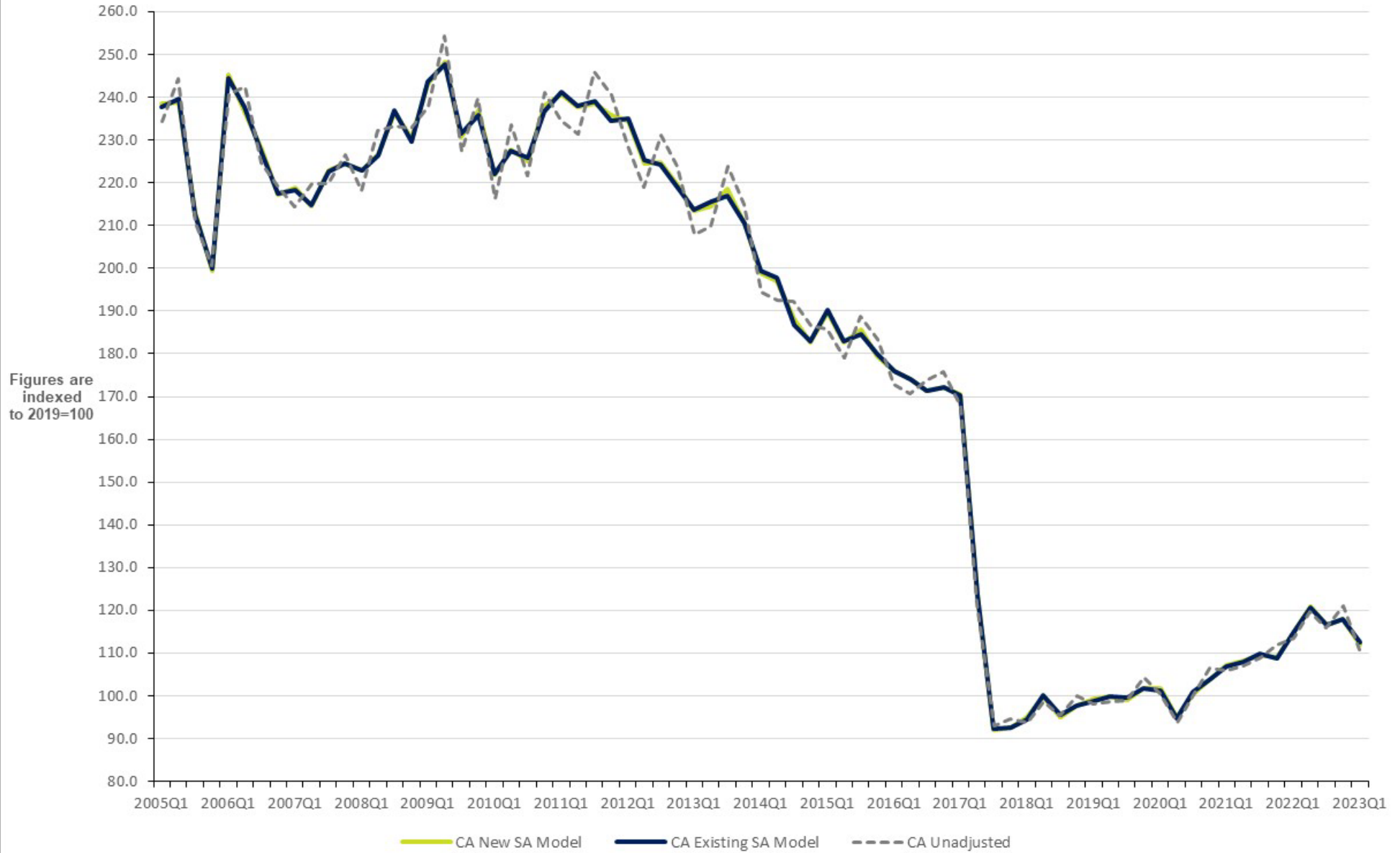
Eng Time Series



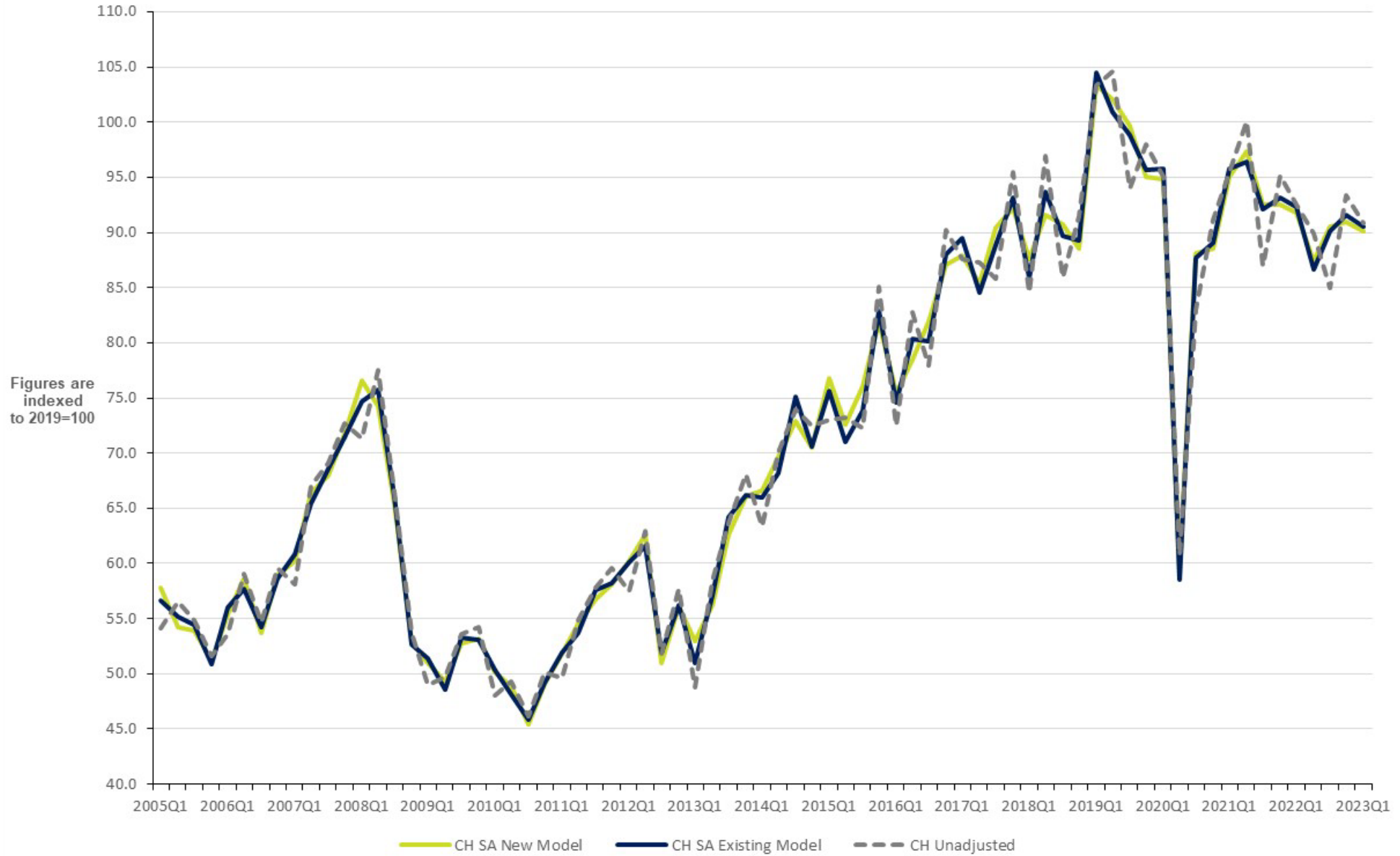
TOTOTHER Time Series



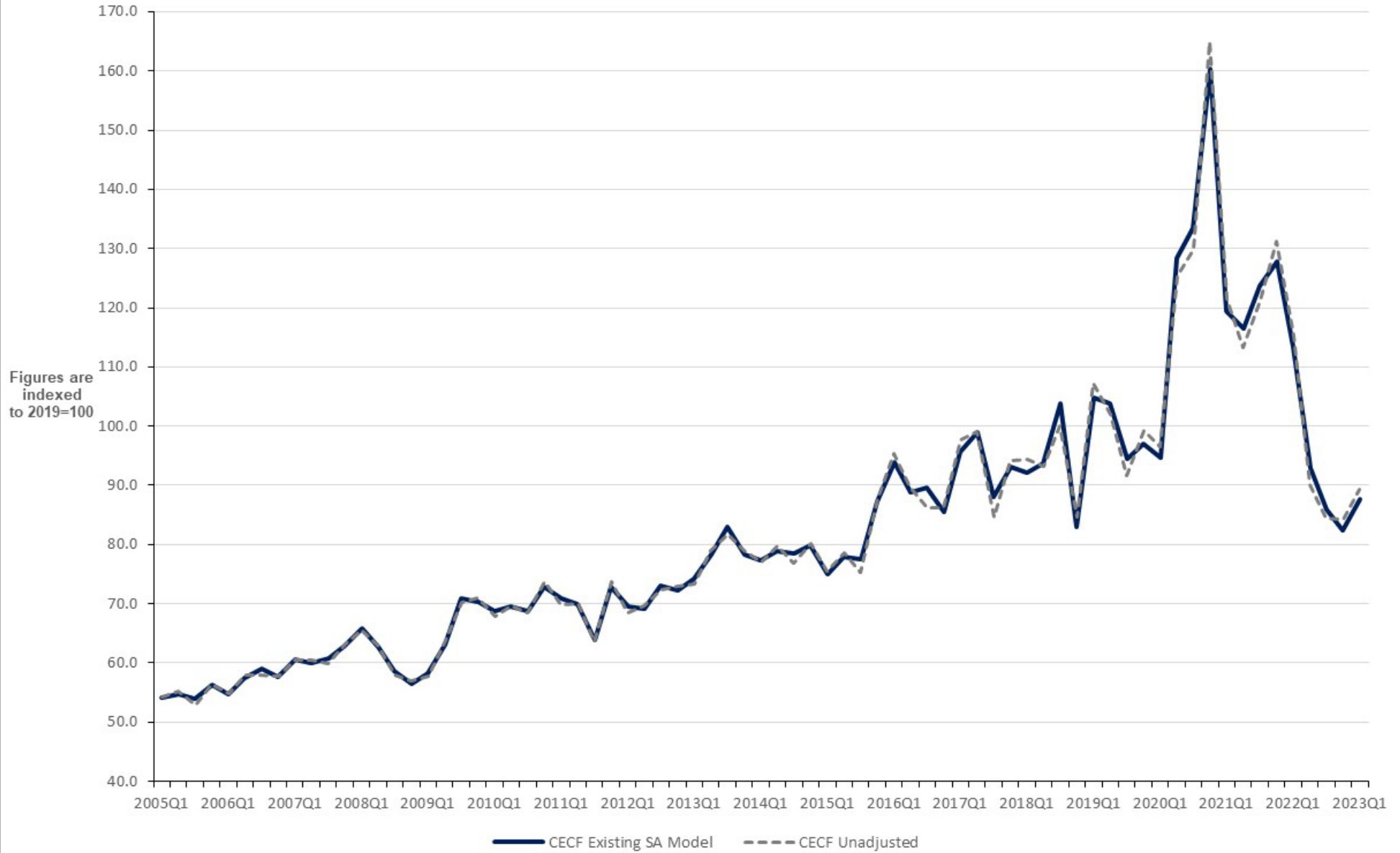
CA Time Series



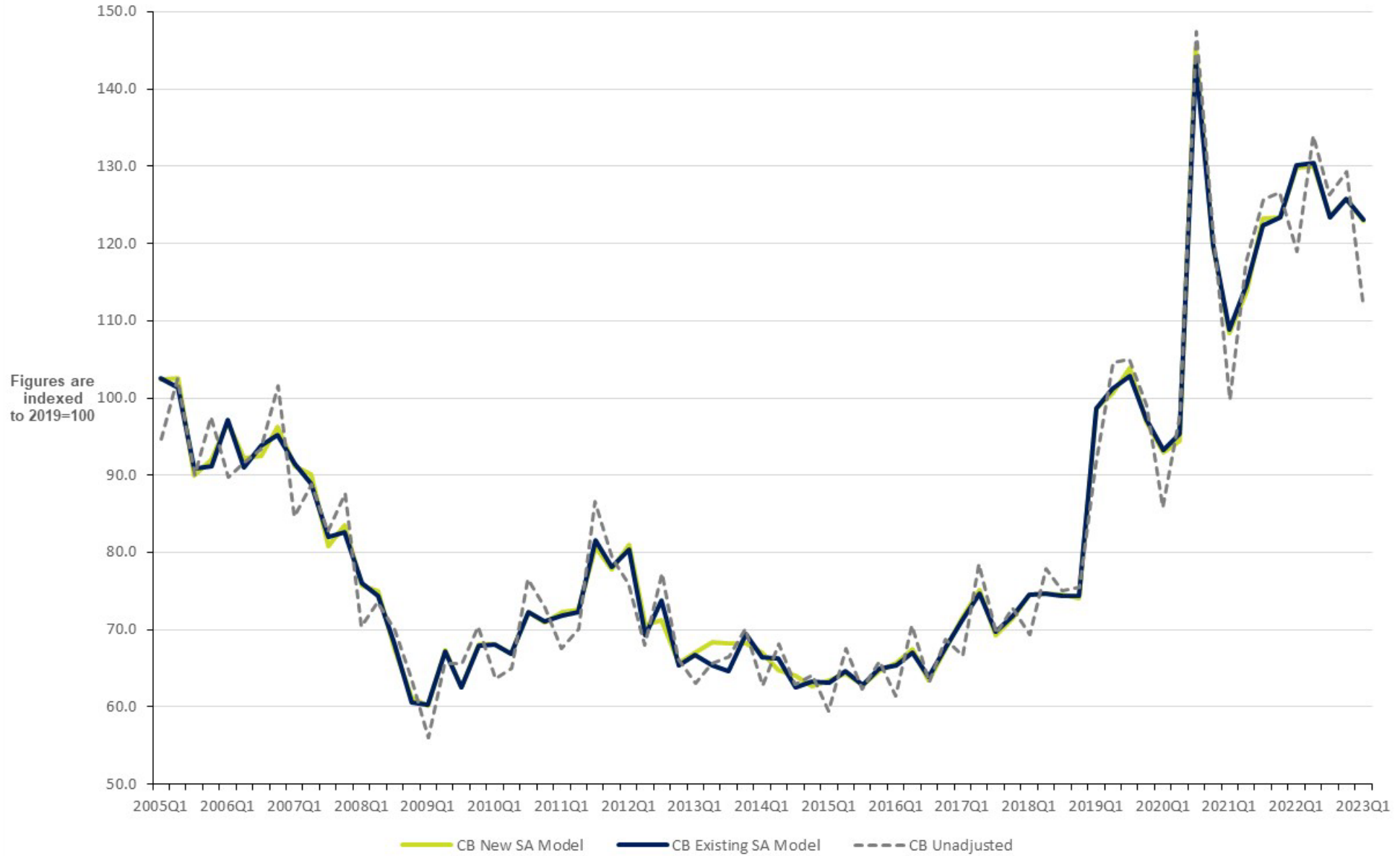
CH Time Series



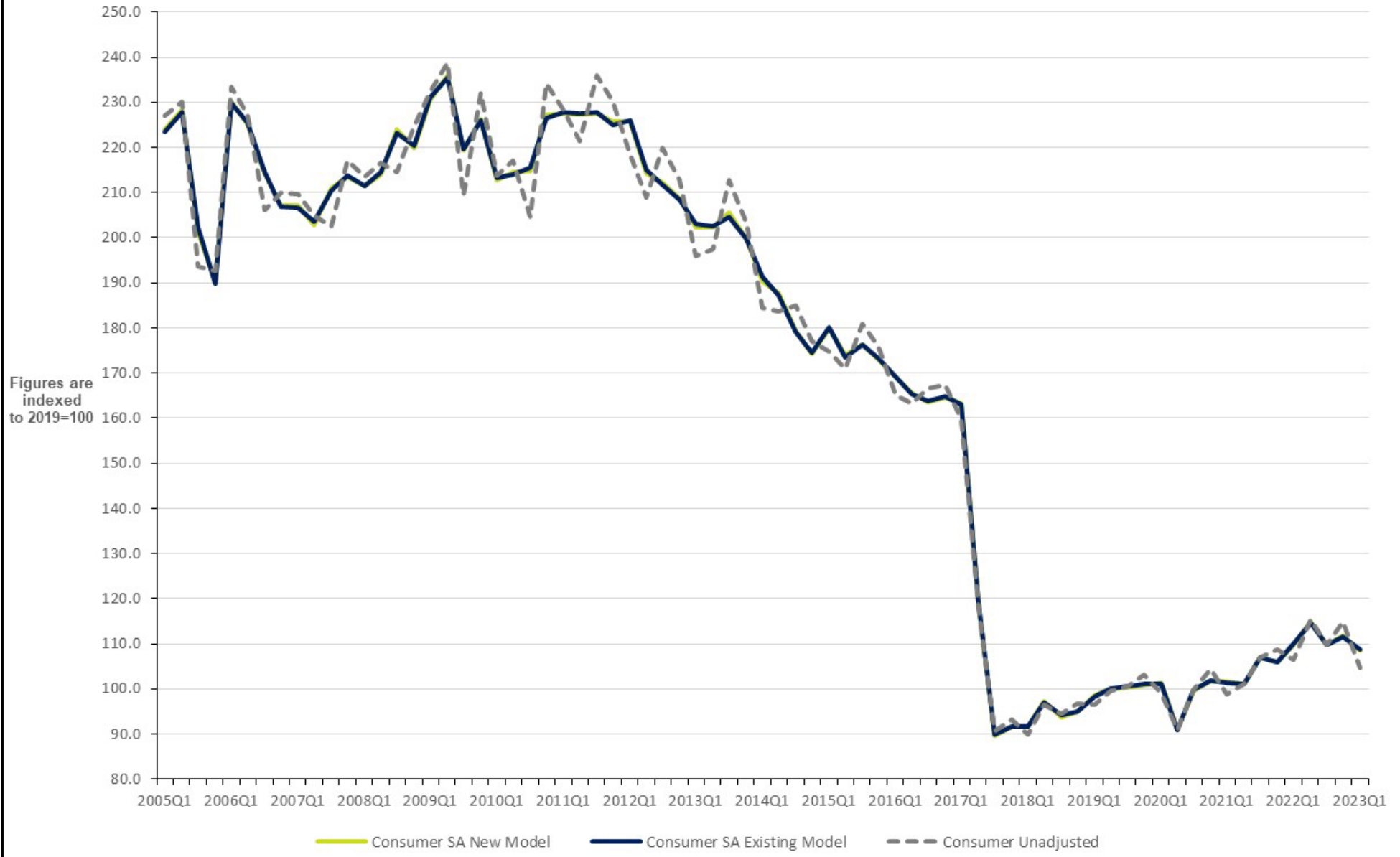
CECF Time Series



CB Time Series



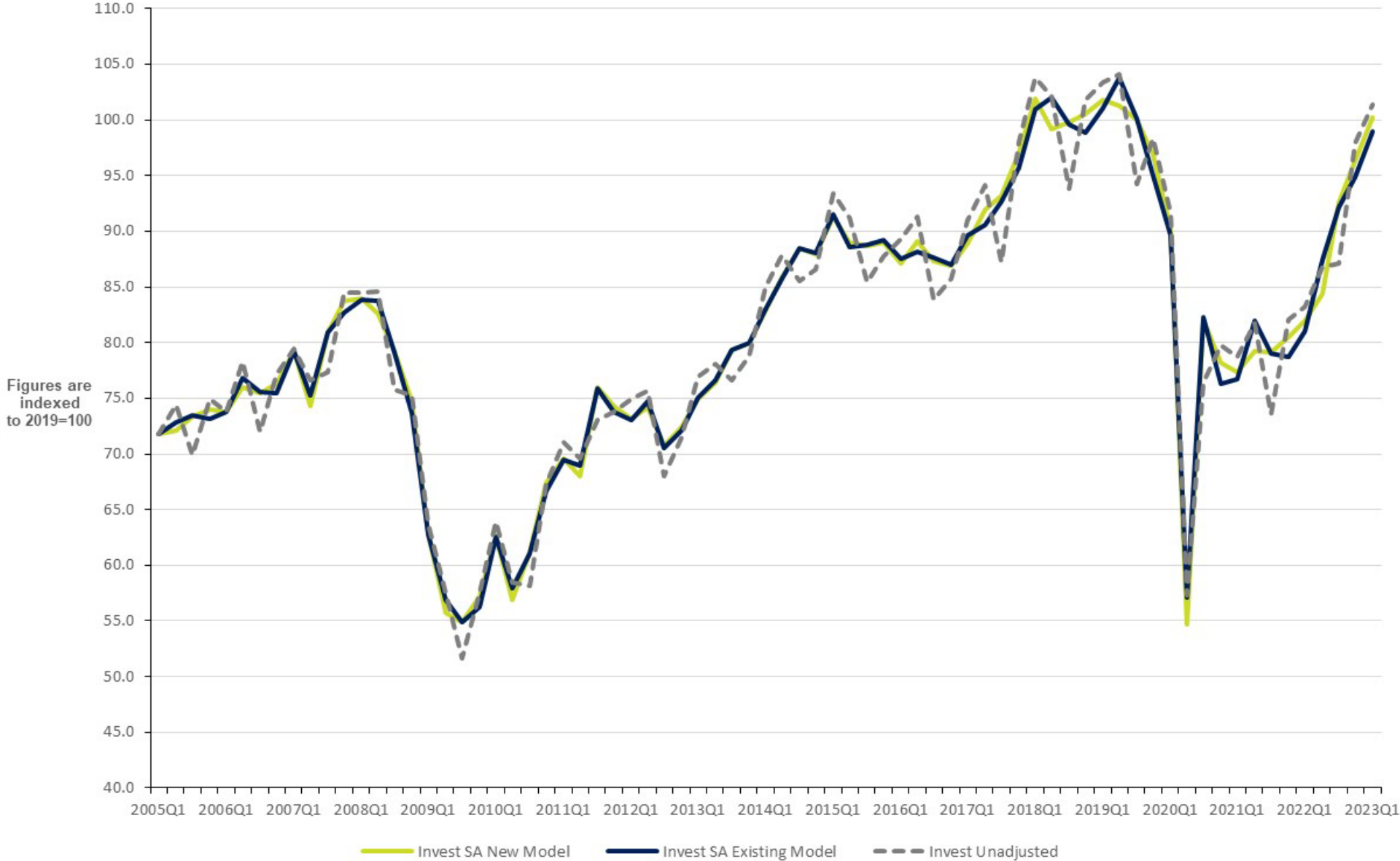
Consumer Time Series



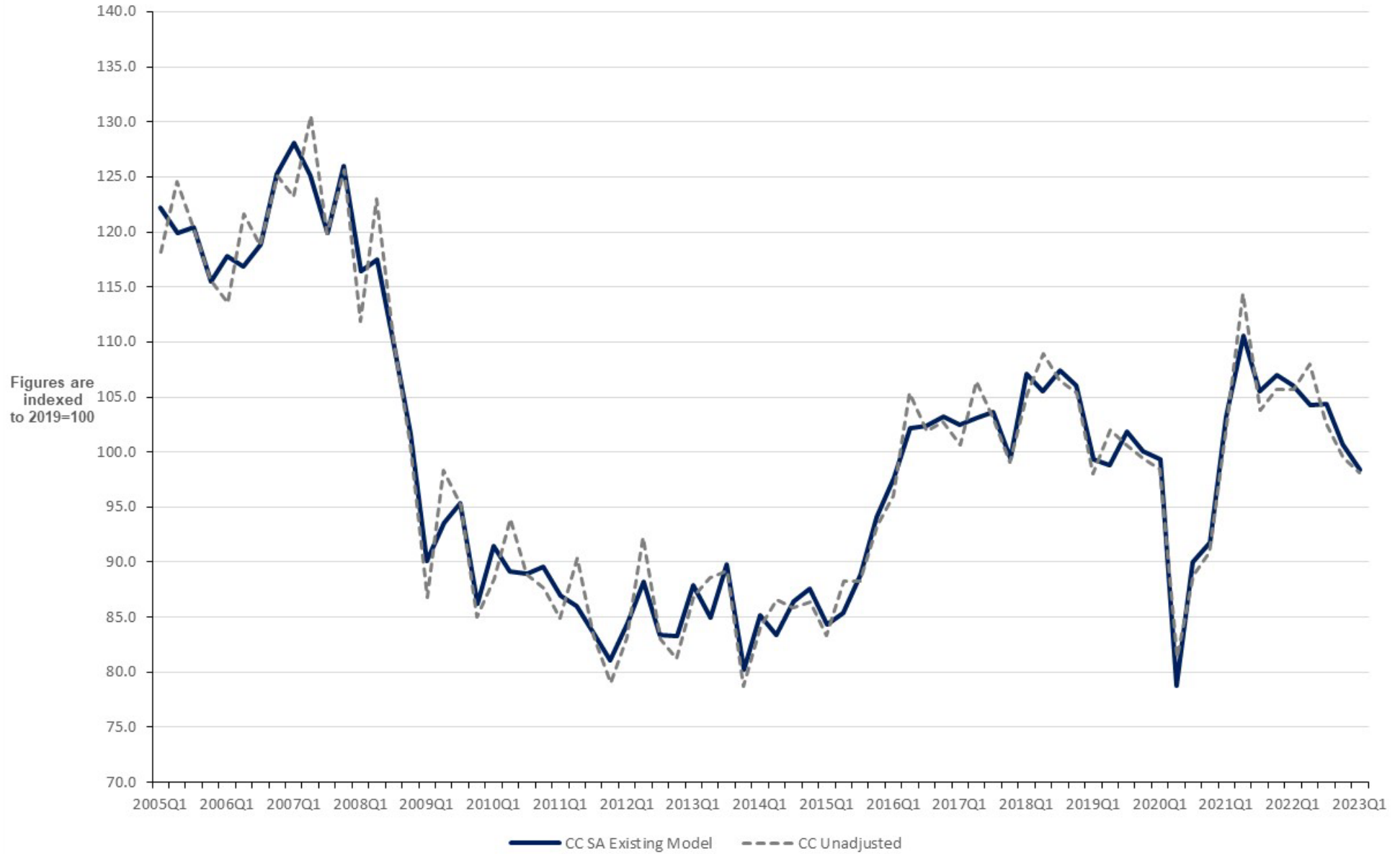
Intermediate Time Series



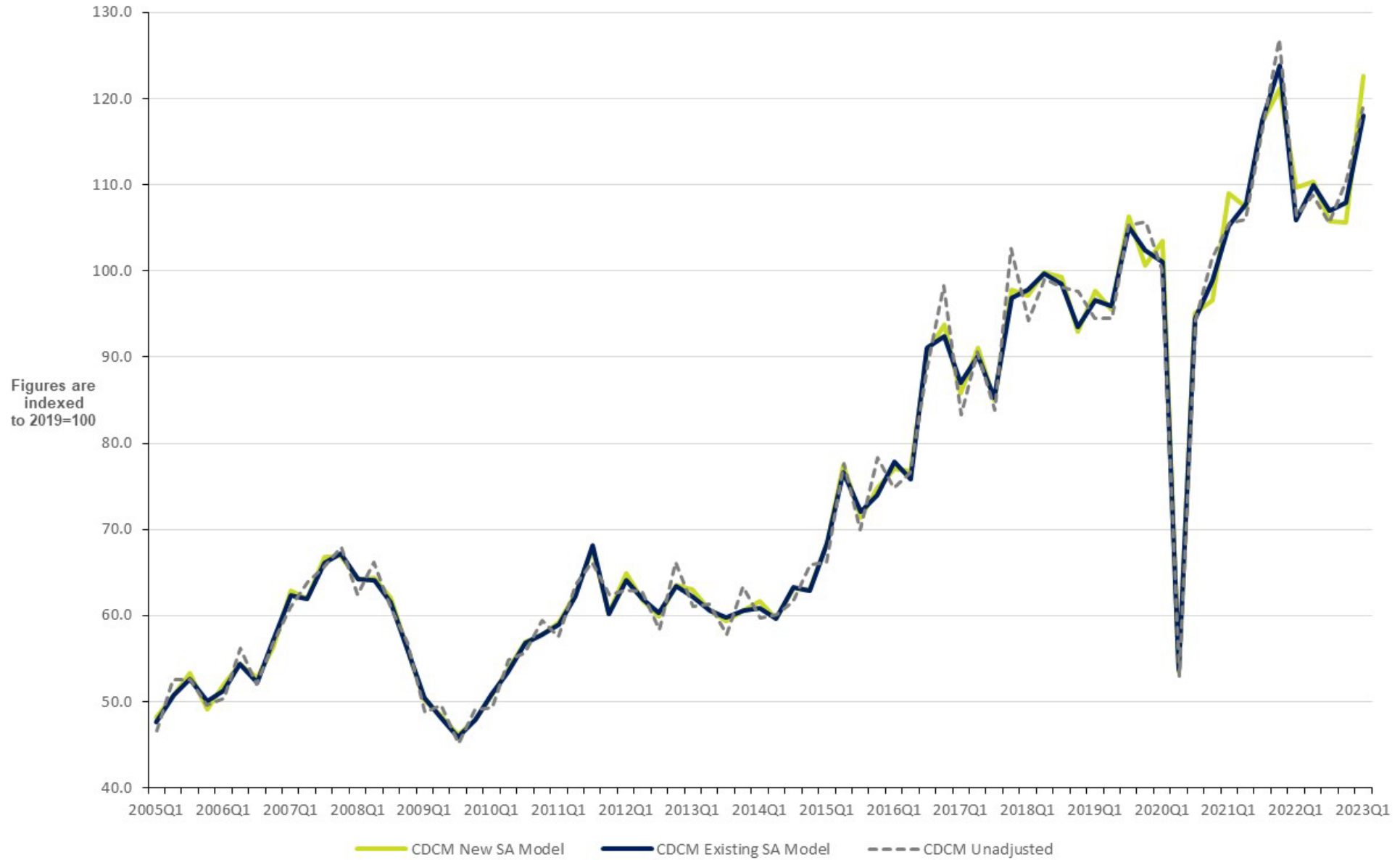
Investment Time Series



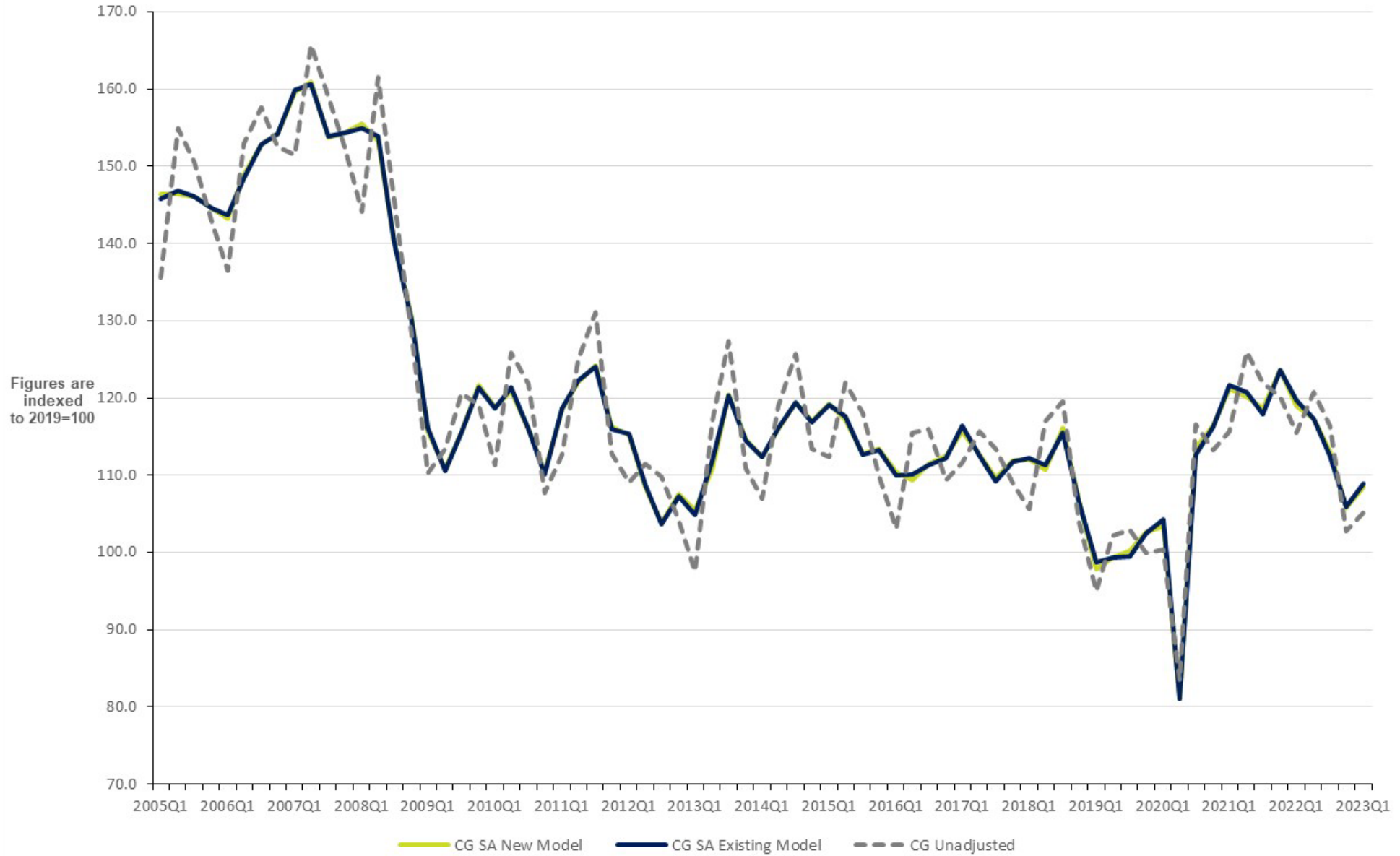
CC Time Series



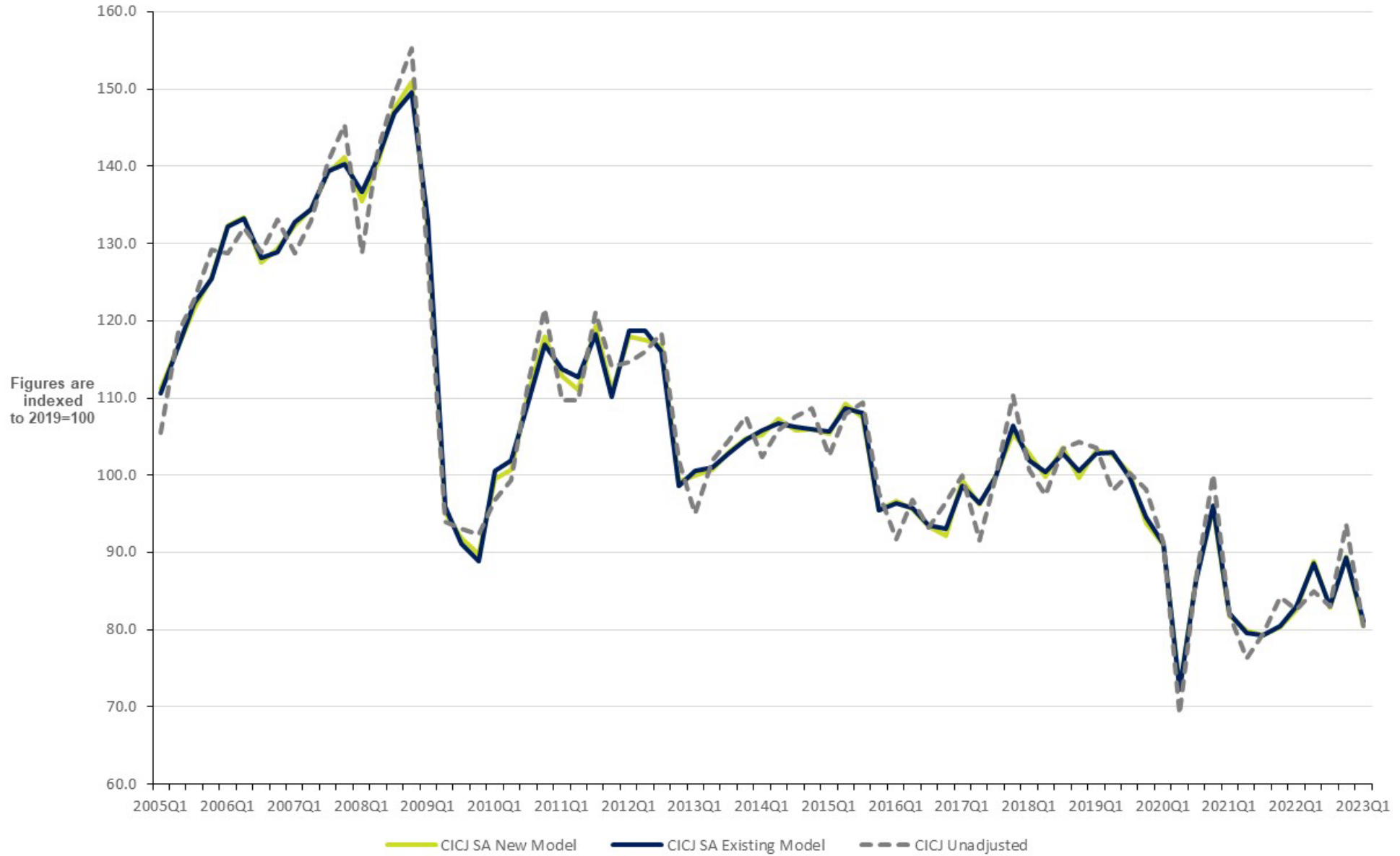
CDCM Time Series



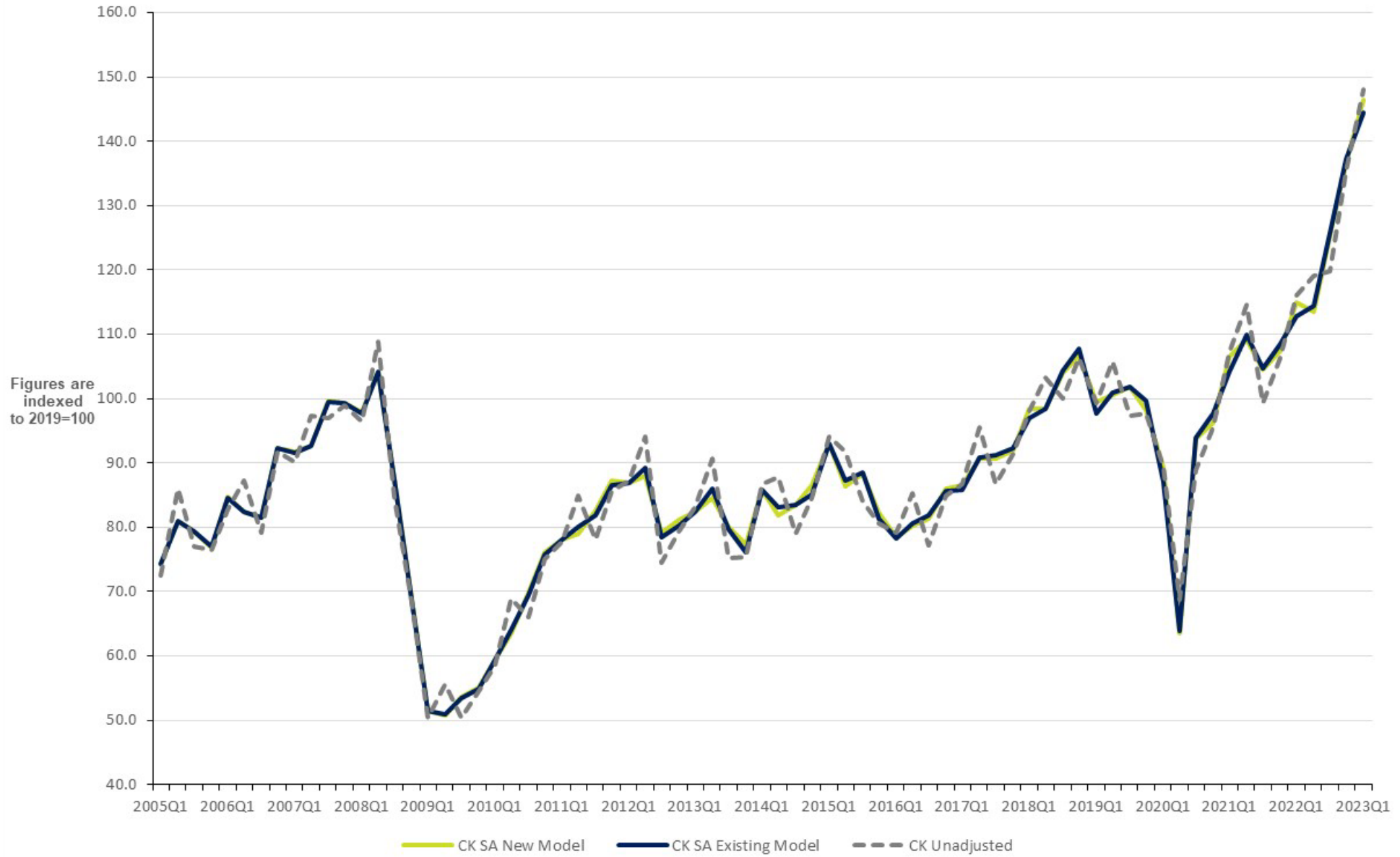
CG Time Series



CICJ Time Series



CK Time Series



CL Time Series

