To adjust or not to adjust: the Seasonal Adjustment of UK CPI and CPIH 1958-2024[1]

Huw Dixon, Cardiff University and NIESR,

Monica George Michail, NIESR

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In this presentation we seek to answer the following questions.

1. Are CPI and CPIH seasonal?

2. Can we seasonally adjust them: what is the best method?

   These issues we address primarily with 1988-2024 data.

We do not consider in detail the issue of direct vs indirect SA and the extent of revisions. These are dealt with in detail in our report *Seasonal Adjustment of CPI and CPIH*, NIESR Policy Paper 45 (May 2025).

3. Looking at the long run (1958-2024), has seasonality changed?

1: Seasonal Adjustment in UK

1. The ONS seasonally adjusts many statistics – most components of GDP, Trade data. However, currently it does not SA CPI and CPIH.

2. In the past, the view was taken that RPI should NOT be SA. Michael Baxter (1999) highlighted reasons not to SA RPI:

    a. Much of the seasonality is due to annual changes in indirect taxes, which are caused by Government action rather than climatic or socioeconomic factors.
    b. Seasonally adjusting RPI might be seen to be at odds with the policy that RPI and its components are never revised (SA is subject to revision)
    c. The Annual inflation rate of the SA series may differ from the original data, causing confusion with regard to the *statutory and contractual* uses of RPI and the use of RPIX as the inflation target.

3. Instead, the ONS did SA RPIY (RPI excluding Indirect taxes), which was called “SARPIY”. Discontinued in 2014.

4. The same arguments apply to CPI and CPIH as applied to RPI in 1999. CPIY was discontinued in December 2021.

5. Why is the ONS revisiting this issue? One big factor is that several NSIs have started to produce SA CPI equivalents: these include the US BLS, Canada, Germany, France, Japan, Australia.

6. The almost universal method is the US Census X-12/13 method with or without SEATS and TRAMO. The software for implementing this has improved. Makes it easier to do.

7. This talk is based on a report written for the ONS by myself and Monica George Michail, and I would like to thank various people form the CPI team at Newport and the august members of the APCP-T advisory panel. It should be published by NIESR in May.

8. In this paper, we will take a longer-term view, using the historic CPI and CPIH series produced by the ONS enabling us to cover the period 1958 – 2024 rather than starting at 1988. The historic series has just two-digit COICOP, whilst the data from 1988 goes to 4 digit COICOP.

The data

Three different ways of representing inflation data.

1. ***The CPI index***. This is an index, currently with 2015=100.

2. ***Annual or "year on year" inflation***. This is the headline inflation which is reported in the news and reflects the proportional change in the CPI index in the last 12 months.

3. ***Monthly or "month on month" inflation***. This is the inflation that happens in one month, the change comparing the current month and the previous month.

All three are different ways of representing the same data: from the index you can derive the annual and monthly inflation figures and vice versa (almost).

Whilst the ONS reports all three, *by far the greatest attention is given to Annual inflation*.

BUT Seasonal adjustment has little effect on Annual figure. Its main effect is to adjust the CPI index and monthly inflation.

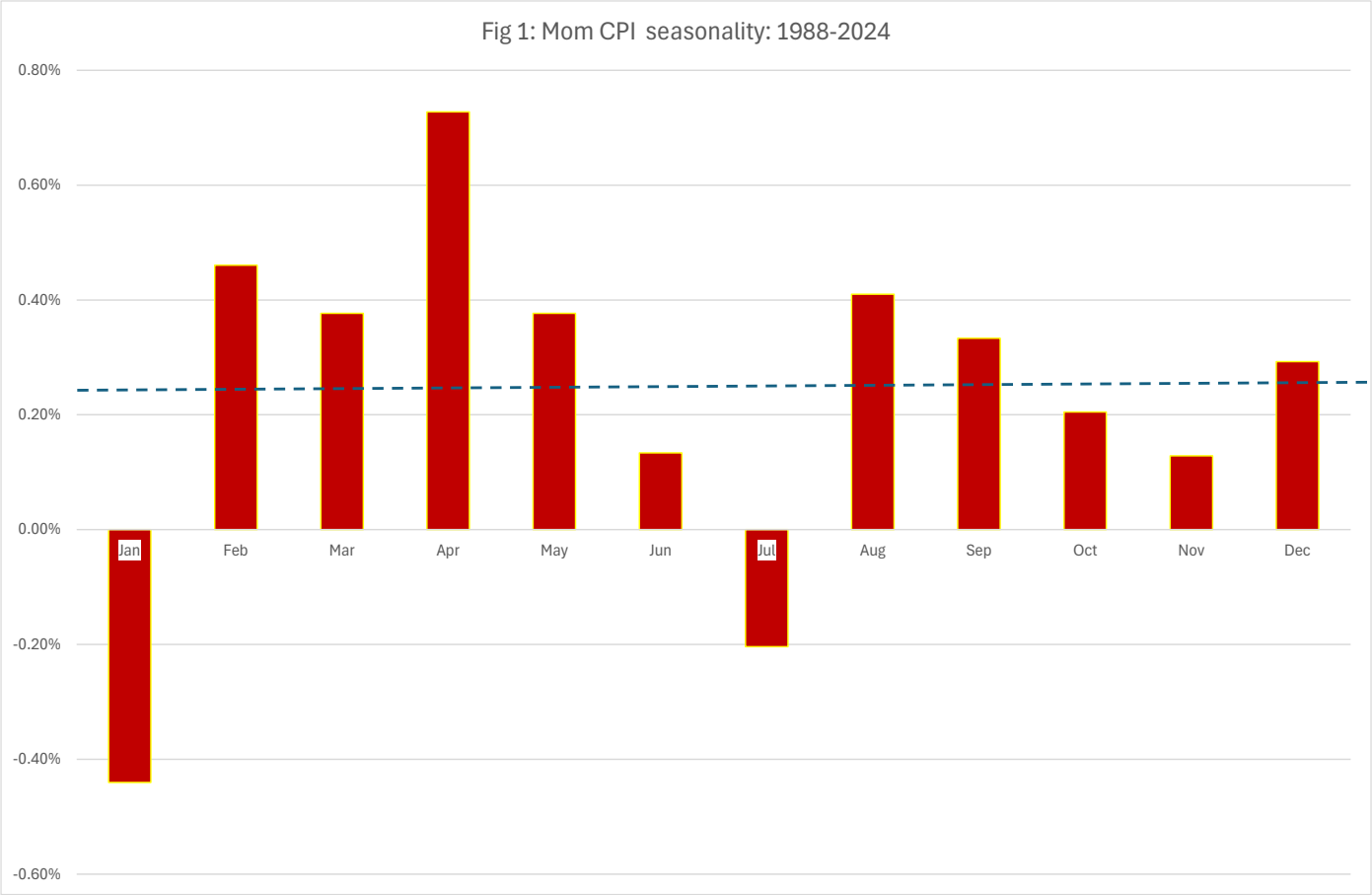
Most of the data we used came from the Consumer Price Inflation Tables, and in particular Table 56 for CPIH and Table 57 for CPI, which give the CPI index from January 1988 to present, broken down into two, three and four digit COICOP. The data prior to 1988 is from the historic series which goes back to 1949, although we decided the earliest data were less reliable and so started from 1958.

2: Is the UK CPI data seasonal (1988-2024)?

1. Two basic aspects of seasonality: (a) within year seasonality (the months are different), (b) correlations at "seasonal intervals" (e.g. 12 month). Within year seasonality sufficient for seasonal correlations, but seasonal corelations not sufficient for long-run within year seasonality.

2. Let us first concentrate on (a), within year seasonality. Do the months differ? Here we can focus on the monthly inflation rate (month on month inflation). We have data 1988 to 2024 (36 years, and 36 observations on each month). Does average monthly inflation differ across the 12 calendar months? Yes IT does!

Fig 1: Mom CPI seasonality: 1988-2024



Over the 36 years, January and July have negative monthly inflation: Feb and Aug have high “bounce back” inflation. April very high (budget effects).

3. A very simple way to capture this "within year" variation is using monthly dummies; if we regress the mom inflation for each of the 432 months on a constant with 11 monthly dummies. By construction, the fitted values for each month will be given by the monthly dummy and the residuals across the years for that month will be approximately zero. A simple measure of this aspect of seasonality is the R^2 for this simple regression.

4. We can break up the CPI all items index into its various sub-components down to the 4-digit COICOP level. We find great heterogeneity in the R^2 for the various components.

Table 2: Simple Monthly Dummy regressions				
R squared	CPI		CPIH	
	Mean	Median	Mean	Median
All items	0.521	-	0.534	-
12 2-digit	0.282	0.150	0.259	0.150
85/87 4-digit	0.244	0.147	0.220	0.108

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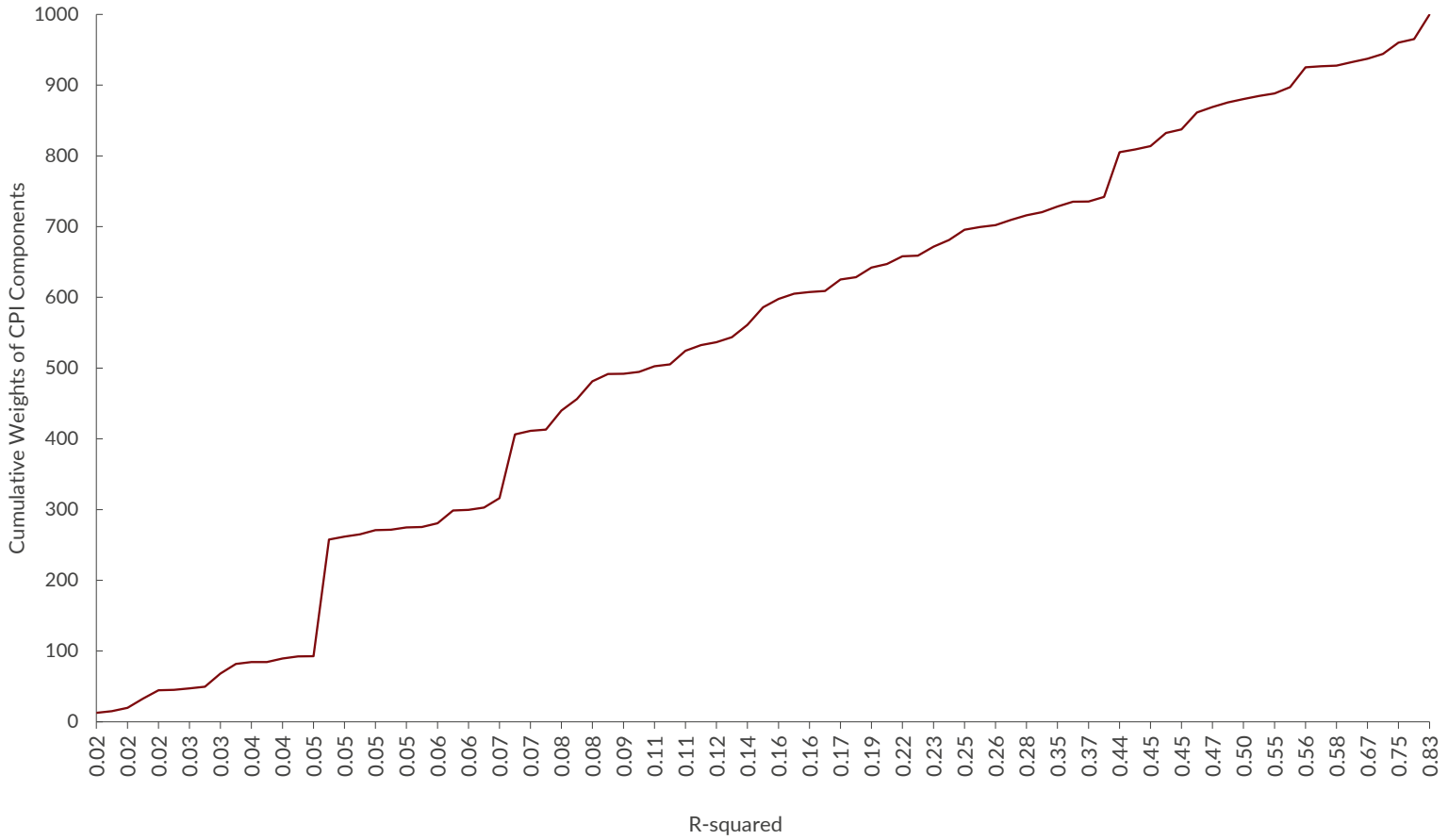

"CDF" of R^2 In terms of COICOP shares (total 1000): highest digit available. Great Heterogeneity!

5: “Seasonal” Autocorrelation.

This is the 12 month auto-correlation of inflation. Yes, this is certainly present: if you run a simple AR(12) on monthly UK inflation, you get a highly significant coefficient on the 12th lag (roughly 0.2), even if you also have monthly dummies. This is sometimes interpreted as short-run seasonality (although it could be inflation persistence of some kind).

6: Seasonality tests. Some focus on the “within year” seasonality (monthly dummies, Kruskal-Wallace tests) some more on the seasonal autocorrelation aspects (ACF/PCF, Spectral peaks). We place priority on the KW.

3: How to seasonally adjust?

1. We needed to come up with a method for SA around 140 CPI/CPIH series, from the All Items level (the official statistics) down to the 4-digit COICOP level. These are found in Tables 56 and 57 of the consumer price inflation Tables (about to change).

2. The US Census X12/13 method is the most commonly applied method. This is a framework that can be applied in different ways, but at its core it uses the moving averages and the ARIMA framework. We found that the JDemetra+ (JD) was easiest to use and had good "default" settings we were able to adjust easily for problematic time series.

3. The method breaks down the time series into trend/cycle, seasonal and irregular components. The process of SA involves identifying the seasonal element and taking it out of the time series.

4. There are big outliers in the CPI data (for example Norman Lamont's increase of VAT by 2.5% in April 1991, the OFGEM price cap increases in April and October 2022). The Seasonal adjustment procedure removes these prior to the SA process and then puts them back in after it has been completed into the "irregular" part (recall Baxter 1999).

5. This the seasonally adjusted figure for a particular month is the "representative" monthly value without the calendar month effect. For example, there is a January sales effect and prices usually fall in January: a seasonally adjusted figure would correct for this January effect and give a (probably) positive price increase.

6. Thus the fact that prices fall in January does NOT mean that we are seeing *deflation*: this would be clear with the seasonally adjusted price increase. The SA gives a better long term indicator although far from perfect as still noisy. Maybe need to take 3 -6 month average of SA figure,

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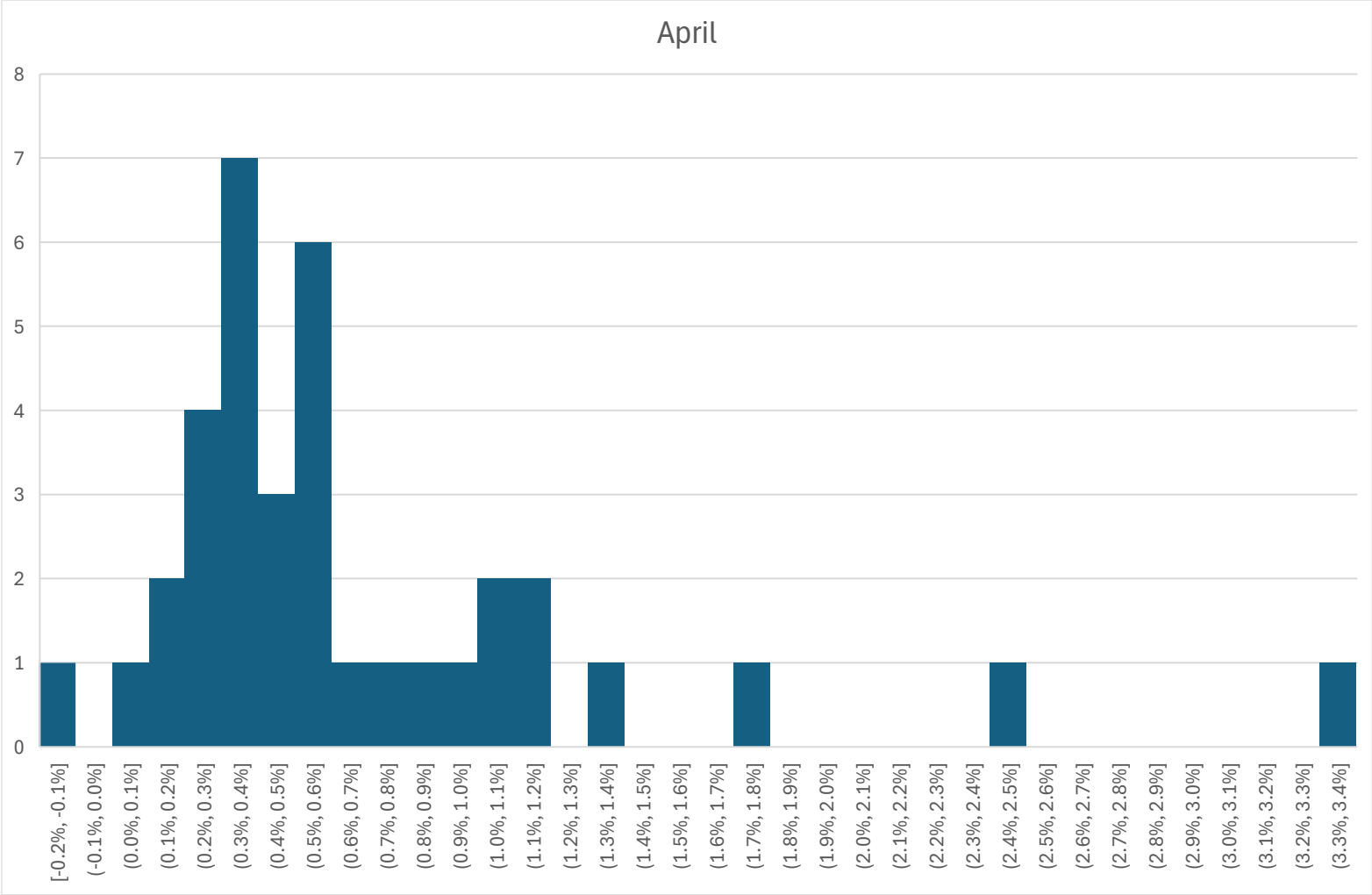

Since some of these outliers are “seasonal” (April budgets etc), will the SA series have *residual seasonality*?

The answer is “no”, or at least can be no if you make the right choices within the process.

4: The SA of UK CPI.

We made specific choices: there are many alternatives within the X13 framework and in SA generally.

1. We did not adjust series that were not seasonal (i.e. failed seasonality tests).
2. We imposed the log transformation of the CPI levels.
3. We adopted the default settings within JD except where they did not work.

With so many series to adjust not practical to have bespoke SA for each series. The most common adjustment was allowing for more outliers (the outlier sensitivity settings).

CPI and CPIH.

We broke up the series into 3 segments: 1988(1985) – 2003, 1997-2018, 2012-2024.

- The JD selects a specific ARIMA model for the whole period adjusted: breaking it up allows a different model for each sub-period.
- Overlap: there is an end point problem for SA, because it uses a centred moving average: for the last observations it needs to forecast future outcomes, for the first it needs to "start-up".
- We throw away the overlap and just keep one year in common to chain the series together. Our chaining years were 2015 (where all series are at 100) and 2000. We are thus able to partially avoid the end point problem.
- This method is in line with Eurostat recommendations.

- For the All items and twelve 2-digit COICOP we can use the historic CPI series to start from 1985, but for 3 and 4-digit COICOP we have to start from 1988. The only "end point" issue is with the last couple of years (2022-4).

Results:

- Levels: on average, SA series is close to Original Series (OS), (within 0.8% over 36 years).

- Annual (headline): always within 0.1 pp (one exception, January 1990 -0.11 pp difference). In general, SA does not influence Headline inflation.

- Monthly: much more interesting. Mean not affected, but SD almost halved. Seasonality a source of systematic variability in monthly inflation.

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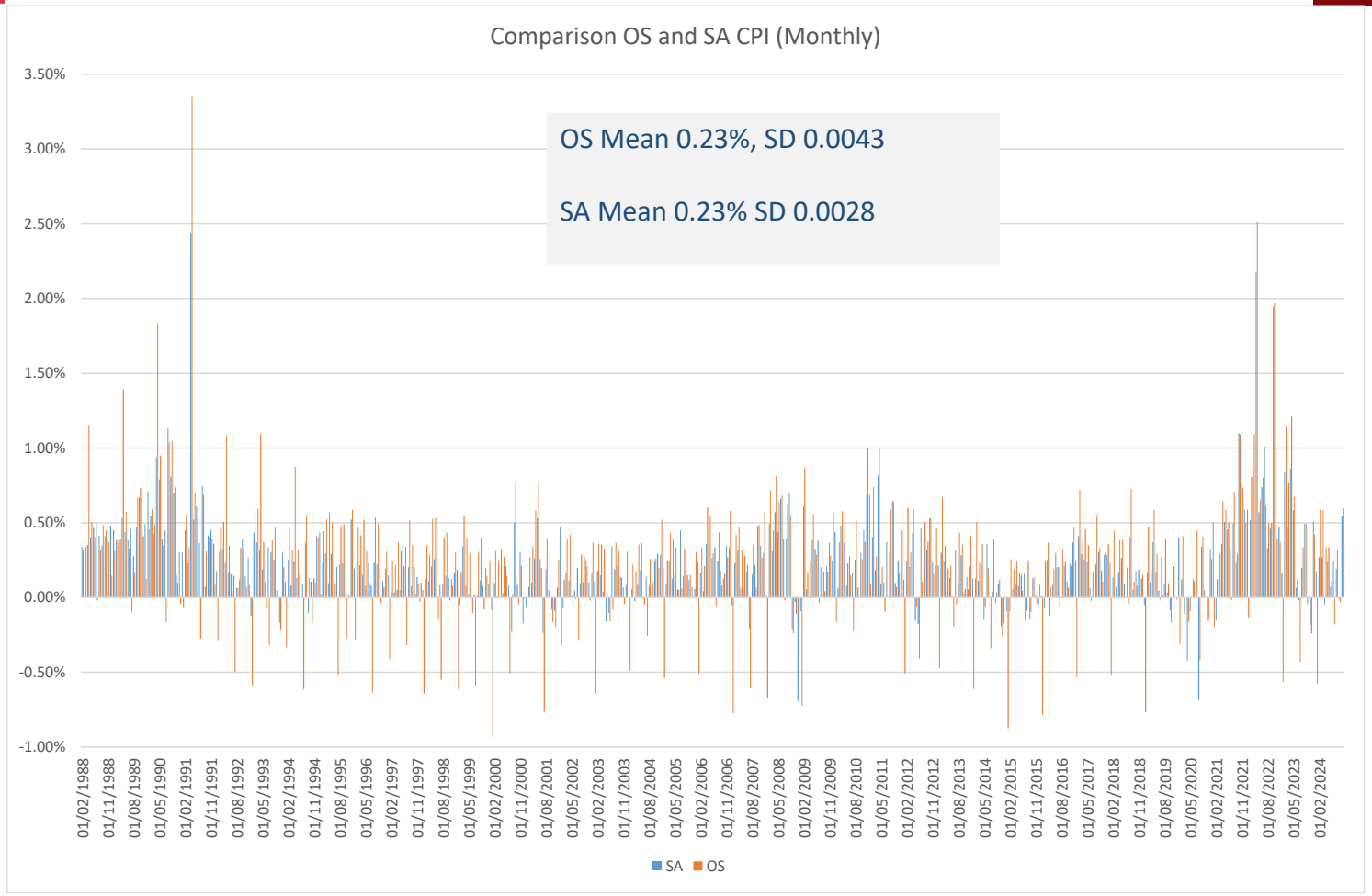
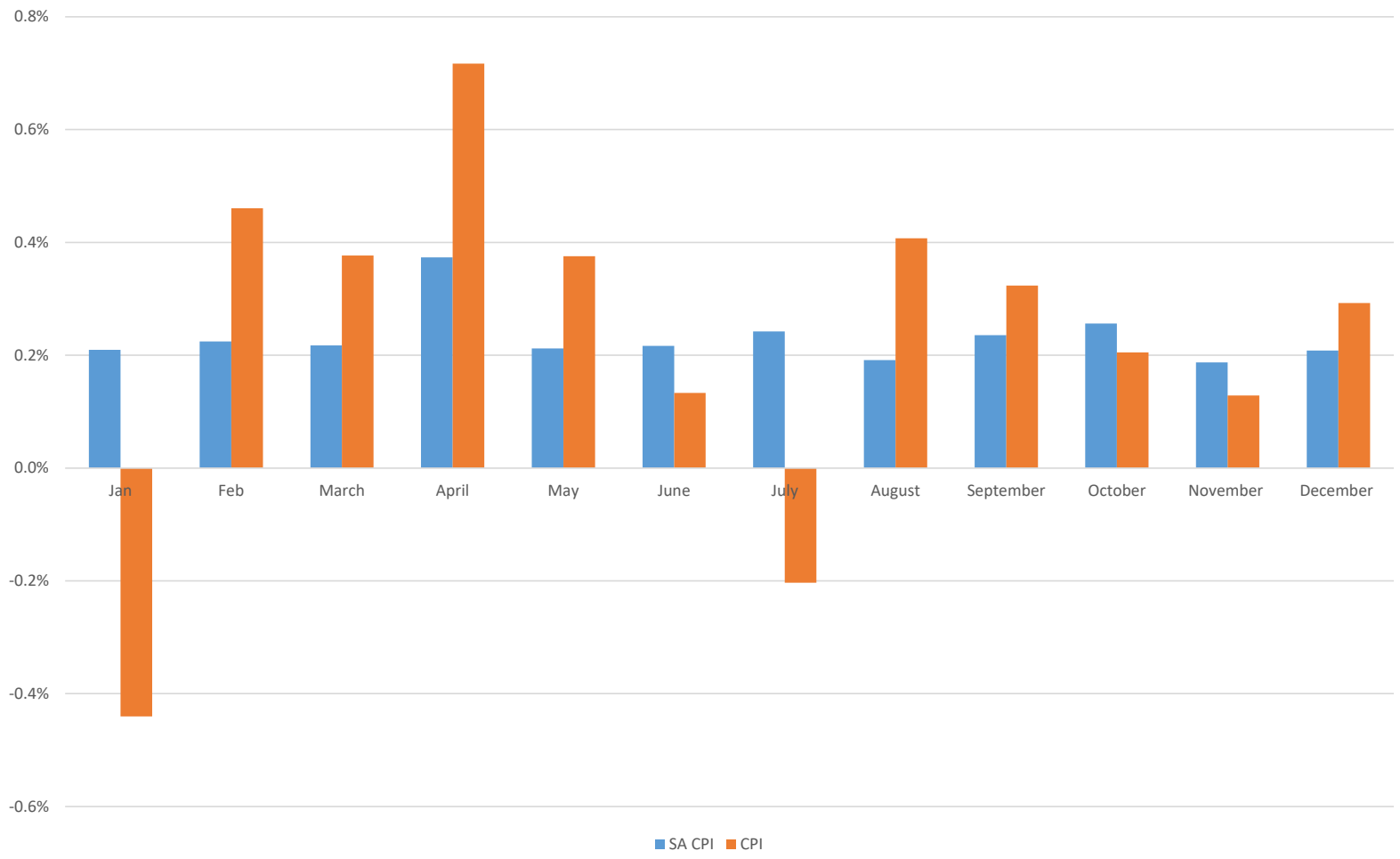


Within year variation: almost eliminated (“seasonal” outliers in the irregular)

Fig 2.1 CPI Average Monthly inflation by Month: Before and After SA



So, SA successful at All items level. What about lower down? 140 series (including aggregates), no time for detail. BUT: the vast majority are seasonal. We did not SA if clearly not seasonal (did for marginal cases), and also policy induced seasonality.

Some really “Classic Seasonality”: Clothing and Footwear (Division 04).

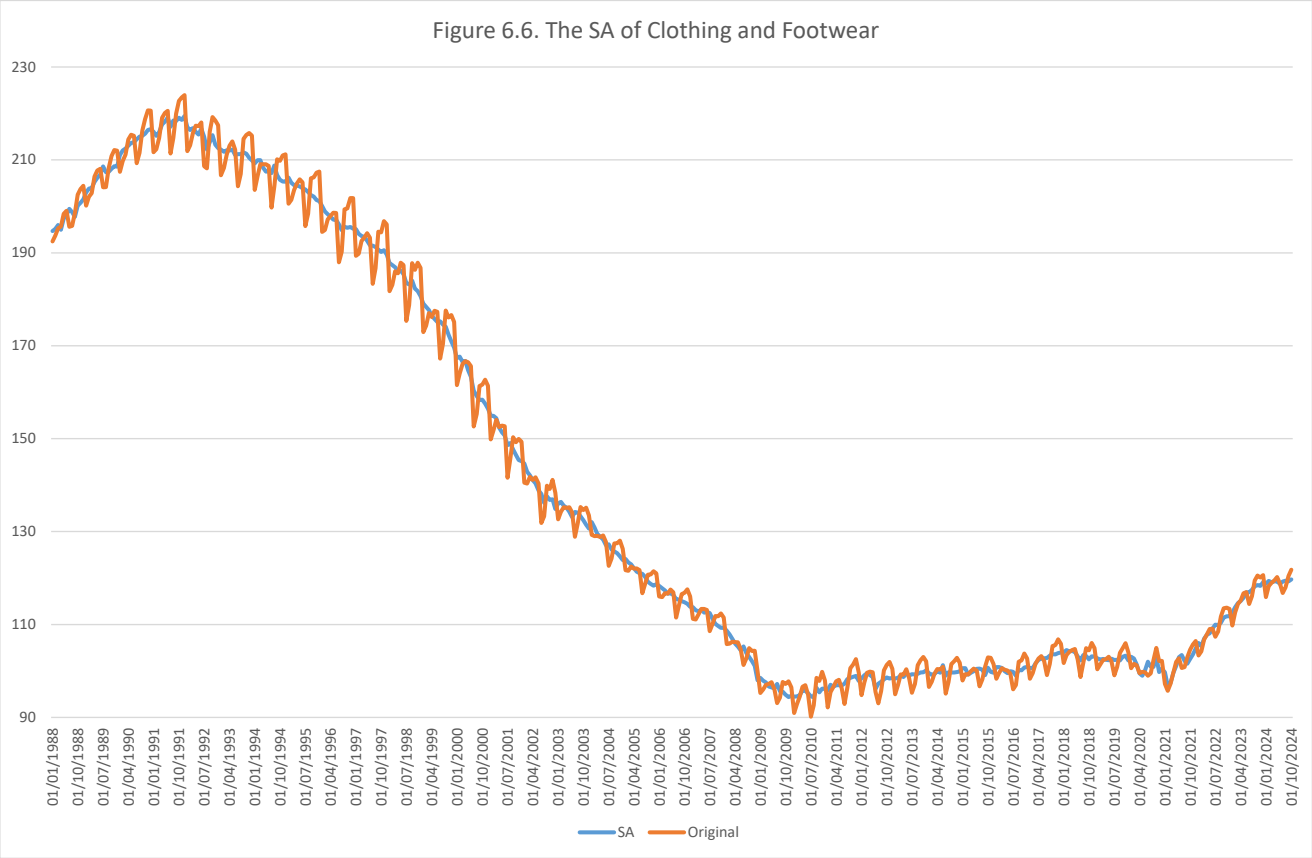
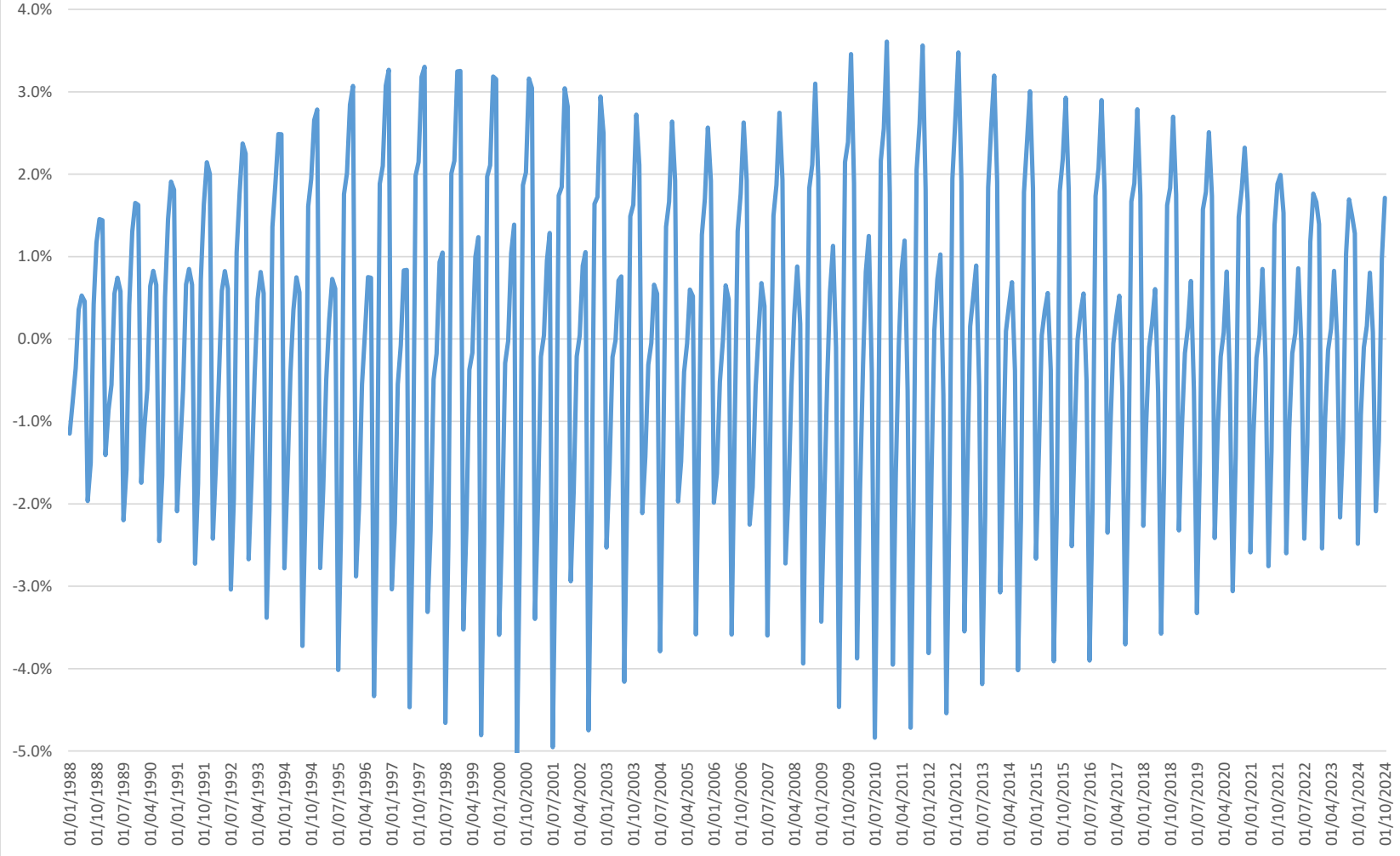


Fig 6.6 The seasonal element as a proportion of the original data



Historic series 1958-2024.

We broke up the series: 1958-1970, 1970-1979, 1979-1988 chined together at 1970, 1979 and 1988 (with added bits at beginning and end). This gives us over 60 years of data.

Has seasonality changed? Look at seasonal factors estimated by X-13. A seasonal factor of 1.2 (0.9) means that the month in question has a seasonal effect 20% higher (10% lower) than standard month.

CPI all items: the “sale month” (lowest factor) has changed:

1958-1974 it was September

1975-1982 December

1983-1988 February

1989-2024 January.

Less seasonality over all since 1994 (and most 1968 to 1979).

Seasonality small: always less than 1%, mostly less than 0.5%.

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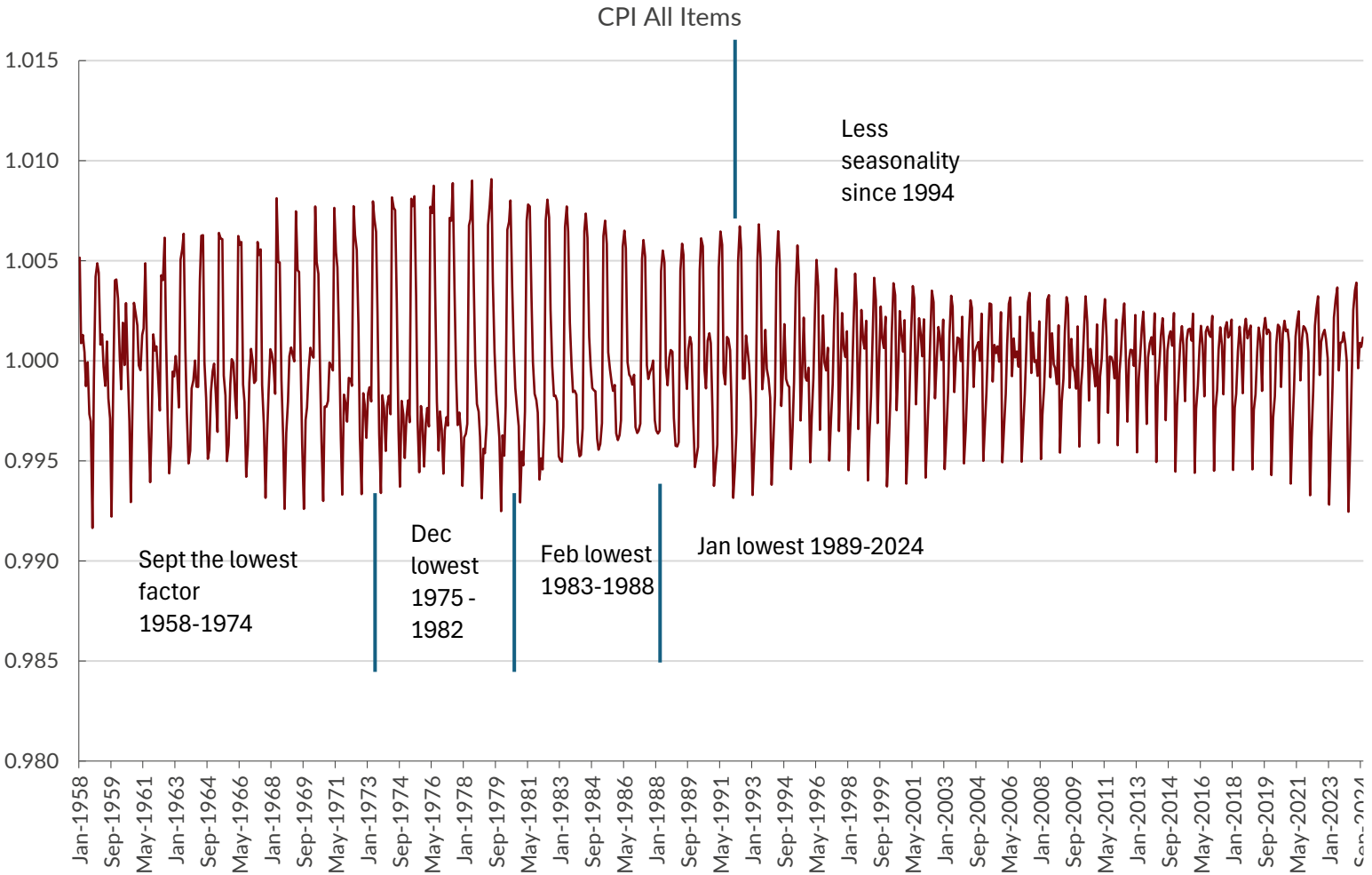

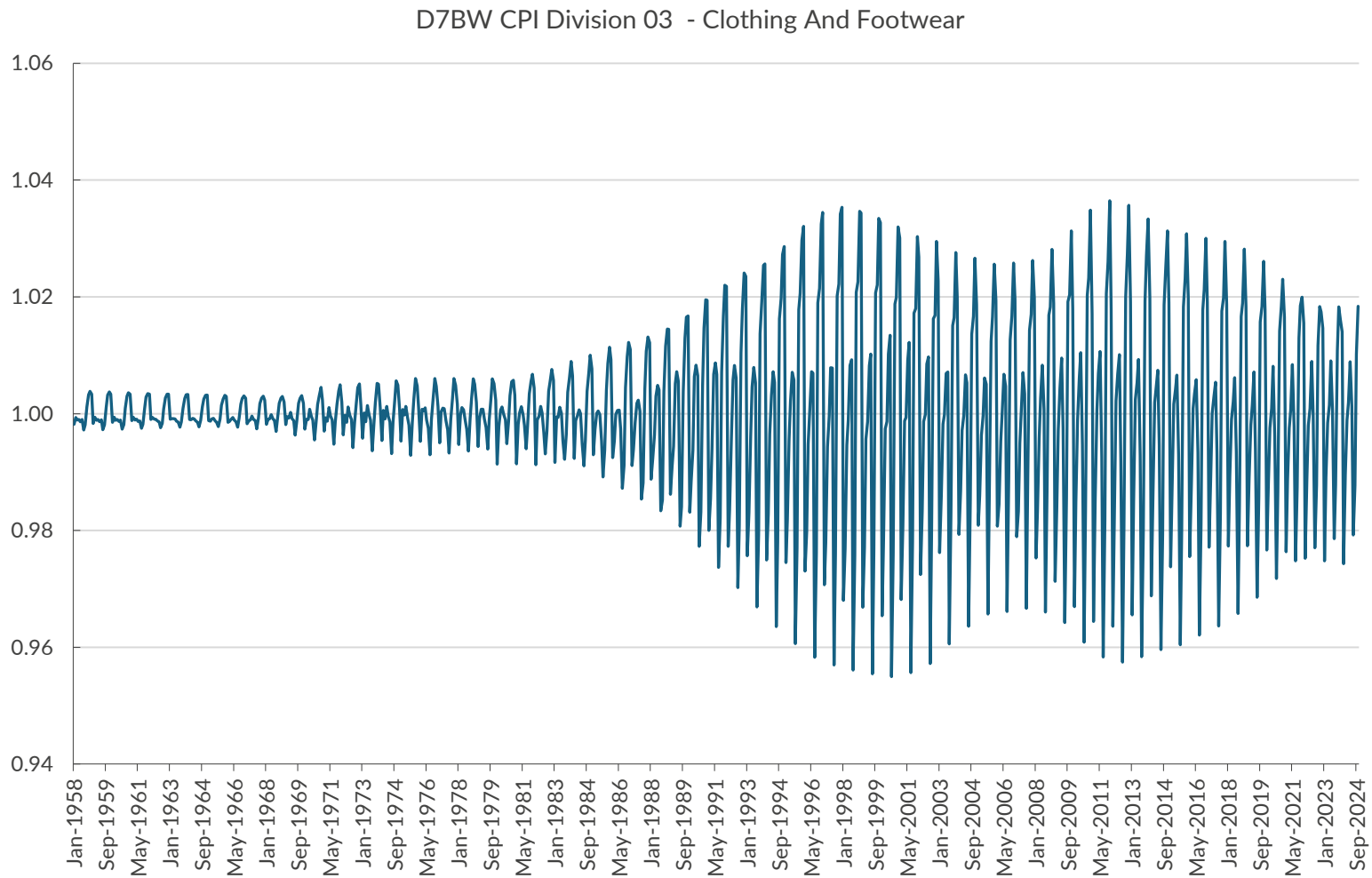

Clothing and footwear has become ***much more seasonal***. Sales mainly in July (but also January). Peak months mainly November.

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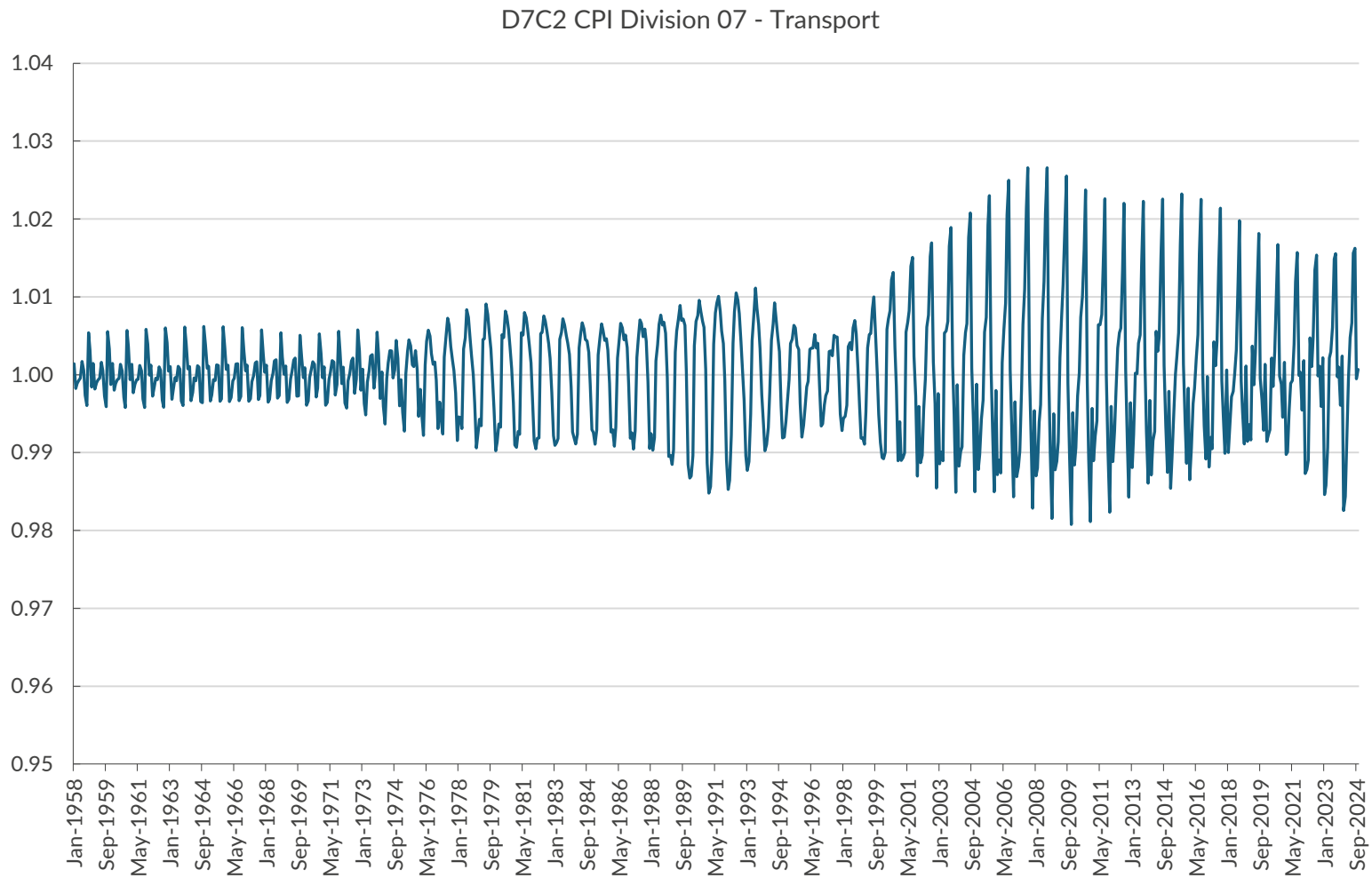

Transport very seasonal, and more so since 2000 (peaked in 2006).

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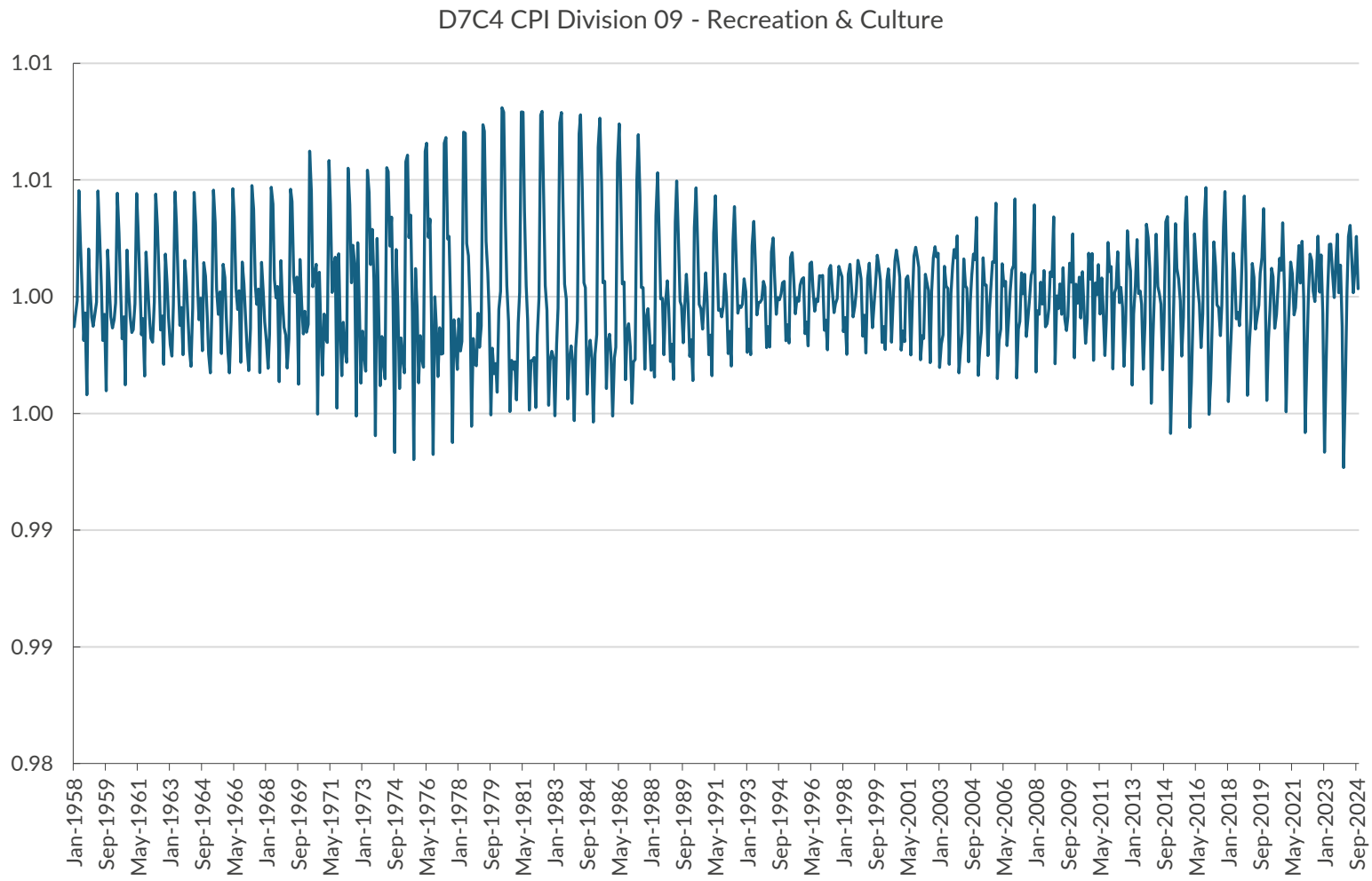
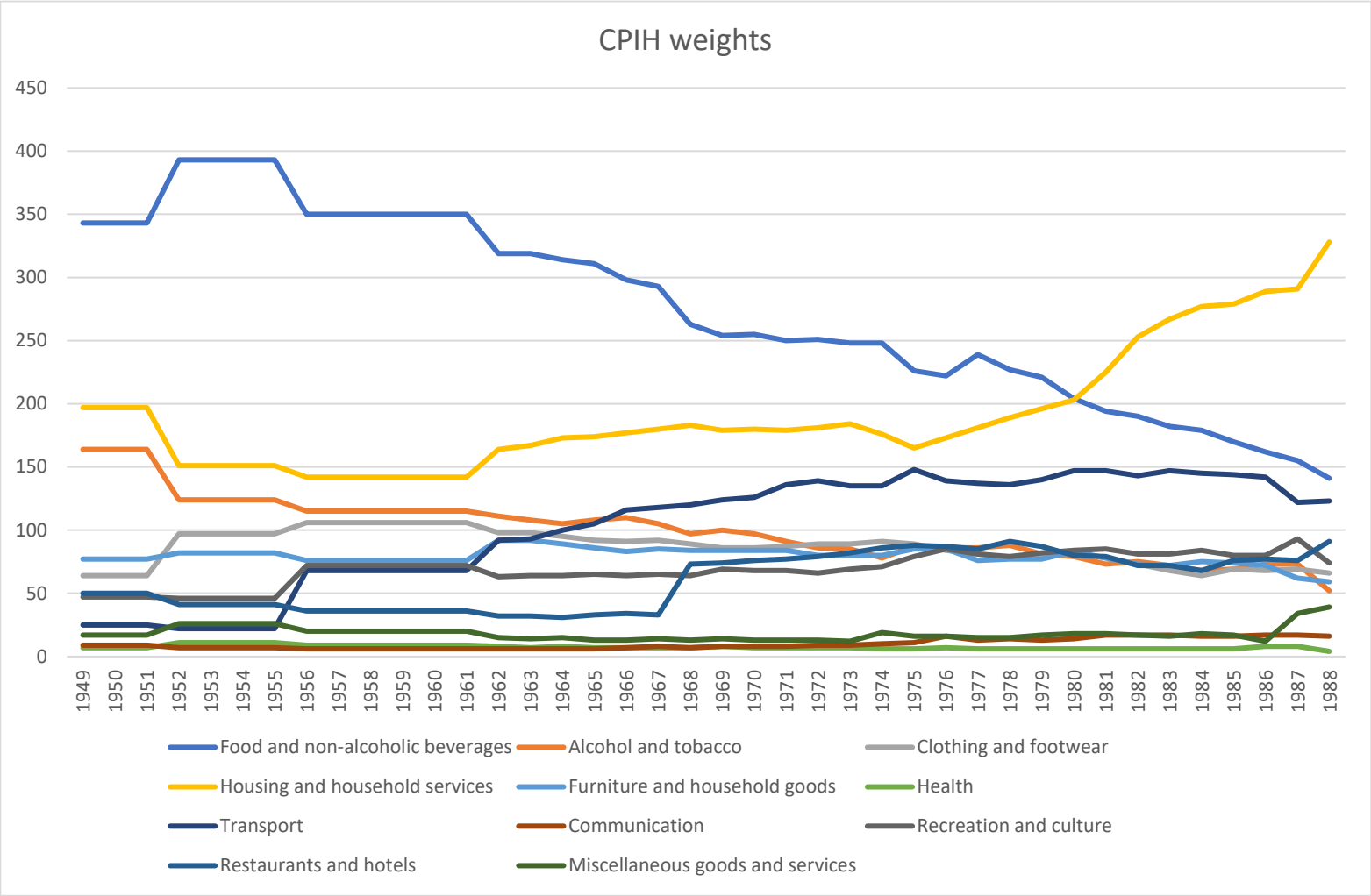


Recreation and Culture: highly seasonal up to 1987, less so 1988-2014, up-tick since 2015.

Changing CPI weights.



Part of the Reason for the secular change in seasonality of CPI is the big change in expenditure shares. Food starts off very big and declines. Food was also more seasonal in the period before refrigerators and freezing came into play.

Other elements increase (Transport, Recreation and Culture): also their seasonality shifts over time.

So it is partly a story of a change in the composition of expenditures and also changes in seasonality of the individual components.

Conclusions

Q1: Are CPI and CPIH seasonal? Answer: Yes (both within year and 12 month correlations)

Q2: Can we seasonally adjust them: what is the best method? Yes, using the method we recommend in our report.

Q3: Looking at the long run (1958-2024), has seasonality changed? Yes it has!