Calculating Exit and Entry Effects in the UK Consumer Price Series

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Executive Summary

The ONS already provides tables in its inflation bulletins with monthly inflation rates that are meant to help users decompose the changes in the 12-month inflation rates of consumer price aggregates. However, these should be supplemented by calculating and, where necessary, publishing exit and entry effects that precisely decompose those changes in annual inflation rates. The ONS should also forego in future use of the term "base effects" to refer to "exit effects".

Entry and Exit effects on measuring UK CPI Inflation

The Office for National Statistics bulletin *Consumer price inflation, UK: June 2023* notes regarding the 12-month inflation rate of the UK CPI: "The slowdown in the annual rate between May and June 2023 was a result of prices rising by 0.2% on the month compared with a rise of 0.7% a year earlier." As it happened, the monthly increase in the UK CPI went from 0.7% in May to 0.1% in June, similar to the decline in the 12-month inflation rate from 8.7% to 7.9%, so without such a remark, readers might have the erroneous impression that the decline in the monthly rate was closely connected to the decline in the annual rate, which was not the case. In the preceding month, as can be seen from Table 1 below, the coincidence between changes in monthly and 12-month inflation rates no longer holds. While there is again a big drop in the monthly inflation rate, from 1.2% in April to 0.7% in May, there is no change in the 12-month rate of change, which is 8.7% in both months. This is not surprising because the monthly rate of change in June 2022 was 0.7%, the same as the monthly rate of change in June 2023.

Table 1: Exit and Entry Effects for the UK CPI: May to July 2023

Month	CPI	1-mth %	11-mth %	12-mth %	Difference	Exit Effect	Entry Effect	DMRs
Apr-22	120.0							
May-22	120.8	0.7						
Jun-22	121.8	0.8						
Jul-22	122.5	0.6						
Aug-22	123.1	0.5						
Sep-22	123.8	0.6						
Oct-22	126.2	1.9						
Nov-22	126.7	0.4						
Dec-22	127.2	0.4						
Jan-23	126.4	-0.6						
Feb-23	127.9	1.2						
Mar-23	128.9	0.8	7.4					
Apr-23	130.4	1.2	7.9	8.7				
May-23	131.3	0.7	7.8	8.7	0.025	-0.720	0.745	0.024
Jun-23	131.5	0.2	7.3	8.0	-0.728	-0.892	0.164	-0.675
Jul-23	130.9	-0.5		6.9	-1.107	-0.617	-0.49	-1.031

The 12-month inflation rate of the UK CPI for May 2023 can be written as:

100 x [P(2023,May/2015)/ P(2022,May/2015)-1]

For June 2023 it is:

100 x [P(2023,Jun/2015)/ P(2022,Jun/2015)-1]

The difference between them can be written as:

100x P(2023,May/2015)/P(2022,Jun/2015)x[P(2023,Jun/2015/P(2023,May/2015)-P(2022,Jun/2015/P(2022,May/2015)] (1)

Here each of the 12-month inflation ratios is written as the product of the 11-month inflation ratio for May 2022 to June 2015, which they both have in common, and the monthly inflation ratio that distinguished one from the other.

This leads us to the expression for the exit effect:

100x P(2023,May/2015)/P(2022,Jun/2015)x[1- P(2022,Jun/2015/P(2022,May/2015)] (2)

It can be seen that it simplifies to the difference between the 11-month inflation rate for May 2023 and the 12-month inflation rate for May 2023, i.e.

100x [P(2023,May/2015)/P(2022,Jun/2015)-1]- 100x [P(2023,May/2015)/P(2022,May/2015-1] (2a)

The 11-month inflation rate for May 2023 is what the 12-month inflation rate for May 2023 would have been if there were no inflation in the exit month of June 2022.

The entry effect can be found residually from the difference between the results of (1) and (2) but it can also be expressed in a formula:

100x P(2023,May/2015)/P(2022,Jun/2015)x[P(2023,Jun/2015/P(2023,May/2015)-1] (3)

It can be seen that it also simplifies, in this case, to the difference between the 12-month inflation rate for June 2023 and the 11-month inflation rate for May 2023. The latter is what the 12-month inflation rate for June 2023 would have been if there were no month-to-month inflation in the entry month of June 2023.

100x [P(2023,Jun/2015/P(2022,Jun/2015)-1]- 100x [P(2023,May/2015/P(2022,Jun/2015)-1] (3a)

It can be seen from (2) that the exit effect is basically just the negative of the monthly percentage change for June 2022, which is amplified or de-amplified by the price ratio for the 11-month span from June 2022 to May 2023. Similarly, from (3) it can be seen that the entry effect is basically just the monthly percentage for June 2023, amplified or de-amplified by the same price ratio as in (2).

Now, looking at formulas (2a) and (3a), it can be seen that the same 11-month percent change for May 2023 is added in calculating the exit effect, while it is subtracted in calculating the entry effect, so it disappears when (2a) and (3a) are added together to calculate the difference between the 12-month inflation rates for June 2023 and May 2023.

The 12-month rate of change can be treated as a transformation of the geometric product of 12 monthly price ratios, for all the months of the calendar year. One can criticize the decomposition proposed for conflating the price relatives of the exiting and entering months with the product of the price relatives for the intervening months. The thing is, the intervening 11 months are common to both 12-month inflation rates. If the exiting monthly relative is replaced by a monthly relative of the same magnitude there will be no difference between the consecutive 12-month inflation rates.

An alternative linear decomposition, which is pretty much what the ONS actually does now, would be to just look at the negative of the monthly percent change for the exiting month as the exit effect, the monthly percent change for the entering month as the entry effect, and treat any residual difference between the 12-month rates of change as an interaction effect. It is hard to see why this would be any better. The monthly percent changes are always there in the publication to be examined in any case, and surely there is merit in a decomposition that highlights the amplifying or de-amplifying role of the 11-month percent change. It is fair to say that this is a linear decomposition of what is essentially a non-linear relationship, but most people think more naturally in linear terms. Given that this is the case, this linear decomposition seems to be better than any alternative one.

In Table 1 exit and entry effects are calculated for the UK CPI for the months from May to July 2023, but we will concentrate on June 2023, where the exit effect was the largest in absolute magnitude. The exit effect here rounds to -0.9%, while the monthly inflation rate for June was only 0.8%. If there had been no inflation between June 2022 and May 2023 the exit effect would have been -0.8%, however the inflation rate was very high, at 7.9%, and so amplified the absolute magnitude of the exit effect. The absolute value of the entry effect is also amplified, although this is not obvious with rounding to one decimal place. The final column of Table 1 shows the difference between the monthly inflation rate for the entry month and the exit month, which is often equal, to one decimal place of accuracy to the difference between the 12-month inflation rates. Note that in July 2023 this was not the case. The difference between the monthly rates rounds to -1.0%, while the difference between the 12-month rates rounds to -1.1%. Note that in every case, looking at the estimates rounded to three decimal places, the difference between the monthly rates underestimated the absolute magnitude of the difference between the 12-month inflation rates, and this was because there was no amplification provided by the 11-month inflation rate.

These results were generated from the CPI series provided on the ONS database, which only provides one decimal place of precision. All percent changes were calculated from it, ignoring the tables of 1-month and 12-month percent changes provided online. Ideally, these estimates would be recomputed using estimates for the CPI series in double precision. While the results they would give would be different they would lead to similar conclusions.

The All-items CPI is used as an example since it is the target inflation indicator for the Bank of England, but the same analysis applies for any other aggregate price series, whether the CPIH, the RPI or the experimental HCIs. Any of these series would not tend to show big differences between the exit effect and the negative of the monthly inflation rate for the exiting month, simply because these highly aggregated series are never as volatile as their components. Table 2 shows an example of a highly volatile component of the RPI, the series for ground rent and dwelling insurance. Although it has a small expenditure weight, it has made an oversized contribution to the inflation premium of the RPI over the CPI, since the CPI almost entirely excludes owner-occupied housing costs.

Table 2 shows the exit effect calculated for the month of December 2022.

Table 2: Exit and Entry Effects for the RPI for housing: dwelling insurance and ground rent for December 2022								
	DOBV	1-mth %	11-mth %	12-mth %	Difference	Exit Effect	Entry Effect	DMRs
Nov-21	470.8							
Dec-21	515.6	9.5						
Jan-22	561.3	8.9						
Feb-22	570.1	1.6						
Mar-22	571.7	0.3						
Apr-22	579.0	1.3						
May-22	582.0	0.5						
Jun-22	590.3	1.4						
Jul-22	598.0	1.3						
Aug-22	604.4	1.1						
Sep-22	617.7	2.2						
Oct-22	631.6	2.3	34.155					
Nov-22	636.2	0.7	23.390	35.132				
Dec-22	634.4	-0.3	13.023	23.041	-12.091	-11.741	-0.349	-9.799
DMRs: difference between monthly inflation rate for the entry month rate and the exit month.								

In December 2021 there was a huge 9.5% increase in the series. There was also a huge 23.4% 11-month inflation rate for the series for November 2022 (i.e., from December 2021 to November 2022). This very substantially amplified the exit effect, which was -11.7%, much in excess in absolute magnitude to the -9.5% one obtains by looking at the December 2022 inflation rate with a negative sign. There was only a 0.3% monthly decline in the index in December 2022, the first such decline since January 2021, so the change in the 12-month inflation rate from 35.1% in November 2022 to 23.0% in December 2022 was due almost entirely to the exit effect. While the method I have prescribed perfectly decomposes that change, the difference in monthly inflation rates, which is roughly -9.8%, is way off the -12.1% mark. While such extreme examples are rare, their existence shows that the ONS should invest in more precisely calculating and publishing exit effects and entry effects.

The aforementioned ONS bulletin *Consumer price inflation, UK* actually publishes Tables 1 to 3 for the CPIH and the CPI which show, for those aggregates and their main components, both 12-month inflation rates for consecutive months and the monthly inflation rates for the most recent month and the same month of the preceding calendar year. So a first step in this direction would be to put in brackets the exit effect for the earlier monthly inflation rates and the entry effects for the later monthly inflation rates wherever these differ in absolute magnitude from those monthly inflation rates by at least 0.1 percentage points. With time, this kind of analysis could be made available for virtually all published series.

For those who think this kind of decomposition, while correct, is unimportant, and largely irrelevant, I would hope that you are correct. It would mean a halcyon period of price stability lies ahead for the United Kingdom. However, in that case, exit and entry rates could still be calculated as a precaution, and only inserted in publications if a more inflationary environment creates a need for them.

Sadly, the UK consumer inflation measures dropped seasonal weights for fruits and vegetables with the February 2008 update, so there are no longer any items that simply drop out of the index basket in their out-of-season months in the RPI or in any UK consumer inflation measure. However, it is worth mentioning that the method described for calculating exit effects can be used for highly seasonal items that are out-of-season for some months of the year. In fact, although I am not aware of any official price series for an item that is in-season for only two consecutive months, there is no reason that one could not calculate exit effects for such a series. In some countries, an index for Christmas trees might conform to this model, with the good in-season in November and December, out-of-season in the other months of the year. In this case, one could calculate the exit effect for November in analyzing the change in the 12-month inflation rate when a December update becomes available.

For a seasonal item that is only in-season in one month of the year, exit effects cannot be calculated, because there is only one 12-month inflation rate for the item for any given year, which also defines the annual average inflation rate. This is the case, for example, with the actual Christmas tree index in the French agricultural output price index, only in-season in December, and also with the index for lilies of the valley, only in-season in April.

Although the ONS no longer has seasonal weights for fruits and vegetables, the UK package holidays CPI is a seasonally weighted series, and that one can decompose the differences between its 12-month inflation rates as described above, even if it doesn't mean very much, given that only the 12-month rate of change for January of each year has any real meaning, and that meaning is not obvious. I have described the problems with this series in an earlier paper.

DEFRA does have seasonal weights for fresh fruits and vegetables in its agricultural output price indices, but there is no detail published for the components. However, Table 3 in the appendix shows entry and exit effects calculated for a seasonally disappearing item in the French index of agricultural products for production, namely dahlias. (In the UK output agricultural price indices, flowers are not assigned seasonal weights, although they really should be.) In France, these are in-season from October through May and out-of-season from June through September. Remember that this is a producer price index and does not relate to when irises can be purchased by French consumers at retail outlets. It can be seen that here, with the very strong seasonal price movements, the exit and entry effects that decompose the differences between annual inflation rates are not at all well approximated by the difference between entering and exiting monthly percent changes almost in any case. Between January and February 2023, for example, the annual inflation rate increases by about 20.3 percentage points, but the difference between entering and exiting monthly percent changes is only 14.0 percentage points. The reason for this, of course, is the very strong 11-month percent change for the 11-month period from February 2022 to January 2023 (45.0%), which amplifies the impact of the difference in entering and exiting monthly percent changes.

This is not a problem that UK price index markers face in the present, but hopefully it will be one that they face in the future.

Terminology debates are usually the most boring of all intellectual debates, but this paper will nonetheless end with a plea to the ONS to forego the use of the term "base effect" for what I have described here as an "exit effect". The phrase "base effect" seems to have been first used by Statistics Canada in its October 2002 CPI update.

There was a big drop in energy prices in October 2001, the month following the 9/11 terrorist atrocities, enough to make the October 2011 month-to-month inflation rate show a decrease of 0.5%. When this dropped out of the annual inflation rate in October 2002, it shot up from 2.3% in September to 3.2% in October. This should have been called an exit effect, but for some reason Statistics Canada chose to call it a base effect, concentrating on the October 2002 inflation rate being calculated on a lower October 2001 base than the September 2002 base, when this was just an artifact of the exceptional October 2001 monthly inflation rate. For some reason this term has metastasized all over the world since then, as far away as India.

While economic experts understand what is going on when it is invoked, it is puzzling to the layman, the more so since all official indices do undergo base changes from time to time that do have their implications for inflation rates. The term “exit effect” or, for greater completeness “same-month-of-the-previous-calendar-year-inflation-rate exit effect” tells the user much more clearly what is going on. I had previously used the term “rotating-out effect”, which is properly descriptive, since the earliest month rotates out of the 12-month inflation rate when there is a CPI update, as the new month rotates in. However, this is also a laborious term, so it is better just to stick to “exit effect”.

In the most recent update of the Canadian CPI, one finds the following passage: “Offsetting the deceleration in the all-items CPI was a year-over-year increase in gasoline prices, which rose at a faster pace in September (+7.5%) compared with August (+0.8%) due to a base-year effect.” Here, gasoline refers to what in Britain would be called “petrol”. This is a reference to a 7.4% decline in gasoline prices from August to September 2002. This actually had an exit effect of 8.1 percentage points in determining the 6.7 percentage points increase in the 12-month inflation rate, the negative of the -7.4 percentage points decline being amplified by the 8.88% increase in gasoline prices over the 11 months between September 2022 and August 2023. There was a 1.4% decline in gasoline prices from August 2022 to September 2023, but the entry effect also had its absolute value amplified by the big increase in gasoline prices over the 11-month interval. Anyway, even if one accepts the “base effect” terminology, and one shouldn’t, we are obviously dealing with a move from a base month of August 2022 to a base month of September 2022, so the “base year effect” description is simply fallacious.

Even if the ONS should not choose to make any changes to its publications, the mechanics of calculating exit effects and entry effects is straightforward, and could easily be carried out by data analysts where it would make a difference. This paper will not discuss the extension of this method to quarterly price indices (e.g., the implicit price index for household final consumption expenditure), but the steps involved should be obvious.

<u>References:</u>

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Appendix: Table 3 - French Index for Dahlias: Exit and Entry Effects

Month		% change 1-month	% change 11-month	% change 12-month	Difference	Exit Effect	Entry Effect	DMRs
Oct-21	114.6							
Nov-21	132.3	15.4						
Dec-21	171.4	29.6						
Jan-21	183.7	7.2						
Feb-22	181.0	-1.5						
Mar-22	139.6	-22.9						
Apr-22	144.9	3.8						
May-22	173.5	19.7						
Jun-22								
Jul-22								
Aug-22								
Sep-22								
Oct-22	153.1		15.7	33.6				
Nov-22	226.5	47.9	32.1	71.2	37.6	-17.9	55.5	32.5
Dec-22	244.9	8.1	33.3	42.9	-28.3	-39.1	10.7	-21.4
Jan-24	262.4	7.1	45.0	42.8	0.0	-9.6	9.5	0.0
Feb-23	295.2	12.5	111.5	63.1	20.3	2.1	18.1	14.0
Mar-23	193.1	-34.6	33.3	38.3	-24.8	48.4	-73.1	-11.7
Apr-23	196.8	1.9	13.4	35.8	-2.5	-5.1	2.6	-1.9
May-23	183.7	-6.7		5.9	-29.9	-22.4	-7.6	-26.4