Europe Economics

Addendum to Europe Economics Review of Approach to Inflation and Input Prices taken by National Highways

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Contents

1 Introduction

This document is an addendum to a previous report by Europe Economics which reviewed National Highways' input price inflation methodology (hereafter referred to as our "2023 report").[1] In this addendum, we review updated inflation proposals included in National Highways' interim version of the draft Strategic Business Plan (hereafter referred to as its "dSBP"), update our own previous analysis to take account of the latest data, and set out an alternative approach to take account of inflation risk.

The structure of this addendum is as follows:

- Section 2 reviews the inflation proposals in National Highways' dSBP;
- Section 3 updates Europe Economics' analysis of real price effects (RPEs);
- Section 4 presents our alternative approach to taking account of inflation risk; and
- Section 6 is an appendix which contains further discussion of the current outlook for inflation in the UK.

[1] Europe Economics, "Review of Approach to Inflation and Input Prices taken by National Highways", March 2023

2 Review of National Highways' dSBP Inflation Proposals

2.1 Summary of National Highways' proposals

For the third road period (RIS3), National Highways is proposing to shift from using bespoke BCIS indices to adopting Consumer Price Index (CPI) forecasts with Real Price Effect (RPE) adjustments for three "swimlanes": Enhancements, Capital Renewals, and Maintenance.

National Highways is using OBR's November 2023 CPI forecasts, along with an assumption that CPI inflation in 2029/30 (which is beyond the OBR's forecasting horizon) will be 2 per cent in line with the Bank of England's target.

National Highways is using a seven-step procedure to calculate the RPE adjustment that it proposes to apply for each swimlane:

- Step 1: Trend Analysis: This initial step involves analysing historical data to identify the relationship between CPI and specific cost proxies for each swimlane. The cost proxies for each swimlane are based on the input price indices and associated weights shown in the table below. National Highways has derived the weights based on a review of the proportion of costs subject to indexation using each of the indices under its existing contracts. For each swimlane, National Highways then identifies what wedge relative to CPI (working in 0.25 per cent increments) most closely matches historical data for the period January 2011 to July 2021. The analysis yielded preliminary adjustments of +0.75 per cent for Enhancements, +1.25 per cent for Capital Renewals and +0.25 per cent for Maintenance.

Table 2.1: Input price indices used by National Highways for each "swimlane"

Swimlane	Input price index	Weight (%)
Enhancement	Implied Output Price Indicator for new work: infrastructure (IOPI)	75
	BCIS Road Cost Index	25
	Total for enhancement	100
Capital Renewals (see note)	Renewals and Construction Works Index	60
	Bitumen Index	29
	Machine Surfacing Index	7
	Professional, Scientific and Technical Activities Index	4
	Total for capital renewals	100
Maintenance	Average Weekly Earnings (AWE): Construction	58
	ONS: Rental and Leasing Services of Construction and Civil Engineering Machinery and Equipment	28
	Bitumen Index	14
	Total for maintenance	100

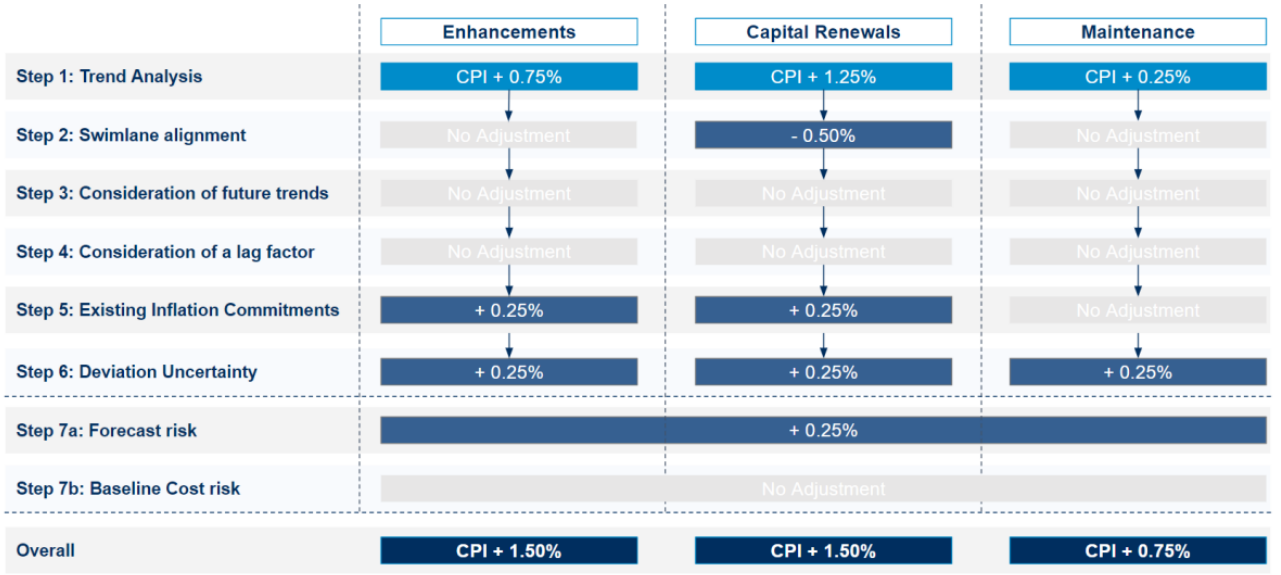
Note: Section B to National Highways' dSBP states that 5 per cent of capital renewals expenditure in RP2 was indexed to RPIx (RPI All Items Excluding Mortgage Interest), but that RPIx is unlikely to be used for indexation in future contracts as RPIx is no longer classified as a national statistic. Hence, National Highways has incorporated this 5 per cent weight on RPIx into the weightings on the Machine Surfacing Index and the Bitumen Index. The weights for capital renewals shown in the table are those that apply after this reallocation, and have been taken from National Highways' trend analysis spreadsheet.
Source: National Highways

- Step 2: Swimlane Alignment: National Highways considers that Enhancements and Capital Renewals experience similar rates of inflation. It states that the uplift it has calculated for Capital Renewals in Step 1 is higher than that for Enhancements due to the inclusion of bitumen in the weighted cost proxy for Capital Renewals, as there was a large increase in the price of bitumen during the historical period that

was analysed. National Highways recognises that similar price increases for bitumen are not expected to continue into RP3. Hence, in Step 2 the RPE for Capital Renewals was adjusted downwards by 50 basis points, aligning both swimlanes to CPI +0.75%.

- Step 3: Future Trends: National Highways analysed OBR forecasts, which suggest that real wages will increase during RP3, as well as forecasts of crude oil prices, which suggest that bitumen prices may be flat or declining over the next few years. It stated that the effect of bitumen prices on the Capital Renewals swimlane had already been address in Step 2. For Maintenance, it concluded that an additional +25 basis points to account for expected wage inflation was offset by a -25 basis points adjustment due to anticipated moderation in bitumen price inflation, resulting in no net change from the initial trend analysis.
- Step 4: Lag Factor: An evaluation of contract terms revealed an average lag of 3-6 months between inflation index movements and cost impacts on National Highways, which National Highways deemed not to be material enough to warrant further adjustments to estimated RPEs.
- Step 5: Existing Inflation Commitments: National Highways argues that an adjustment +0.25 per cent is required for the Enhancement and Capital Renewals swimlanes. The reason given by National Highways is that its existing contracts are indexed to inflation measures like IOPI, and IOPI exceeded CPI +200 basis points (which it uses internally for commercial forecasting) during the recent spike in inflation.
- Step 6: Deviation Uncertainty: National Highways argues that a further +0.25 adjustment should be applied to all swimlanes because the gap between CPI and actual construction inflation widened during the recent period of high inflation.
- Step 7: Risk Provision: National Highways incorporates a further +25 basis points adjustment for all swimlanes, to address the risk that outturn CPI may be higher than forecast CPI. It also considers the risk of unexpected inflationary pressures materialising through the end of RIS2, but it does not make any adjustment to RPEs for this risk.

The chart below is taken from National Highways' dSBP and summarises the results of the seven-step process.



Source: National Highways

Additionally, the report outlines specialised inflation profiles for exceptions not directly tied to the main swimlanes. National Highways adopts the following approach to these exceptions:

- For DBFO (PFI) contracts, inflation profiles are constructed based on Retail Price Index (RPI) forecasts, incorporating the same risk adjustment of +0.25 per cent as applied above in Step 7.
- Energy costs are addressed through specific unit rate forecasts. A Crown Commercial Service (CCS) forecast is used for 2025/26, with forecasts for subsequent years built up by using Department for Energy Security and Net Zero forecasts for energy costs (with adjustments for VAT and the Climate Change Levy), and assuming CCS non-energy costs increase in line with the CPI. No further risk adjustment is applied as the price that National Highways pays for electricity includes a hedge premium.
- Staff costs are projected to increase at a fixed annual rate of 3 per cent, broadly based on the comparison of independent forecasts published by HM Treasury.[2] No further risk adjustment is applied to these costs.
- For the Lower Thames Crossing project, National Highways uses tailored inflation forecasts provided by BCIS, with no further risk adjustment.
- Lastly, "other" costs are handled through a mix of inflation profiles. National Highways applies a risk adjustment of +0.25 per cent to these inflation profiles.

2.2 Comparison with National Highways' previous proposals

The inflation proposals in National Highways' dSBP are similar to its previous RIS3 inflation proposals that we reviewed in our previous report,[3] except that National Highways is now proposing a higher RPE for maintenance.

The table below is taken from our previous report and summarises National Highways' previous proposals. We then explain how this previous analysis can be mapped onto National Highways' new seven-step methodology.

Table 2.2: Summary of National Highways previous RIS3 inflation proposals (presented as percentage wedge above CPI)

	Wedge relative to CPI based on data from Jan 2011 to Jul 2021 (interpreted as "lower bound")	Additional wedge added to obtain "higher bound"	"Higher bound"	Preliminary recommendation "excluding risk"	"Risk provision"	Recommended figure for RIS3
Enhancement	0.75	0.5	1.25	1.25	0.25	1.5
Capital Renewals	1	0.5	1.5	1.25	0.25	1.5
Maintenance	-0.5	1	0.5	0	0.25	0.25

Source: National Highways

The wedge relative to CPI in the first column of the table is based on the same kind of trend analysis that National Highways now labels "Step 1". As discussed later, the figure that National Highways now obtains for Capital Renewals has increased (to +1.25 per cent) due to the correction of an error in National Highway's previous analysis, while its figure for Maintenace has also increased (to +0.75 per cent) because it is now using different input price indices for this swimlane.

In its previous analysis, National Highways treated the results of its trend analysis as a "lower bound", and then added an additional wedge to obtain a "higher bound". It justified this on the basis that its trend analysis excluded the high inflation period from July 2021 to October 2022. This is equivalent to the adjustments in Steps 5 and 6 of National Highway's new methodology, as these adjustments are also justified on the basis of data from the recent period of high inflation. In the case of Enhancements and Maintenance, the quantitative

[2] Forecasts for the UK economy: November 2023 - GOV.UK (www.gov.uk)

[3] Europe Economics, "Review of Approach to Inflation and Input Prices taken by National Highways", March 2023

size of this adjustment (+0.5 per cent) is identical to the adjustment that National Highways is now making in Steps 5 and 6 combined.

In picking a preliminary recommendation "excluding risk" from its range, National Highways previously chose to align its recommendation for Enhancements and Capital Renewals on the basis that these swimlanes faced similar cost pressures. This is equivalent to the swimlane alignment in Step 2 of its new methodology. (In the case of Capital Renewals, the higher figure that National Highways now obtains in its trend analysis is offset by a higher deduction in its Step 2 swimlane alignment.)

The "risk provision" applied in National Highways' previous analysis is identical to the Step 7a forecast risk adjustment that it applies in its new methodology.

Using its new seven-step approach to presenting its analysis, National Highways arrives at an identical RPE recommendation of +1.5 per cent for Enhancements and Capital Renewals, but a substantially large RPE recommendation (of +0.75 rather than +0.25 for Maintenance.

2.3 Review of steps in National Highways' methodology

Below, we review in turn each of the seven steps in National Highway's methodology.

Step 1: Trend analysis

The spreadsheet that National Highways uses for its Step 1 trend analysis is structured in the same way as the spreadsheet that it used to produce the "lower bound" estimates in its previous inflation proposals (see our 2023 report). It also uses the same data period of January 2011 to July 2021.

In the case of the Enhancements swimlane, National Highways uses the same input price indices and the same weights as previously to construct its blended index. As would be expected, it therefore obtains the same result: an RPE uplift above CPI of +0.75 per cent.

For Capital Renewals, National Highways uses the same input price indices and weights as previously, but the result it obtains has changed because it has corrected an error in the bitumen data that it was using previously. This means that its trend analysis now identifies a wedge above CPI of +1.25 per cent for this swimlane, in place of its previous figure of +1 per cent.

Crucially, however, the entire wedge for Capital Renewals is driven by the inclusion of the bitumen index. Without the inclusion of bitumen,[4] the wedge would be zero, as recommended in our previous study.

In the case of the Maintenance swimlane, National Highways is now using completely different indices from before, increasing the number it gets to CPI +0.25 per cent (instead of CPI -0.25 per cent). This positive wedge is entirely driven by the bitumen price index, which is now included for maintenance with a 14 per cent weighting. Without the bitumen price index, the wedge would still be CPI -0.25 per cent, as in National Highways' previous analysis.

Step 2: Swimlane alignment

In Step 2, National Highways reduces the RPE wedge for Capital Renewals from 1.25 per cent to 0.75 per cent to align it with the wedge for Enhancements. In explaining this adjustment, National Highways states (added emphasis):

[4] We have analysed the effect of removing the bitumen index by replacing the data for the bitumen price index with CPI in National Highways' spreadsheet.

> … the uplift for Capital Renewals is notably higher than the uplift for Enhancements **due to the inclusion of bitumen** within the weighted cost proxy. … **there was a large increase in the price of bitumen during the time period considered** for the trend analysis. … As **this high rate of inflation is not anticipated to continue into RP3**, the uplift for Capital Renewals can be considered as overinflated.

However, the adjustment that National Highways makes in this step is insufficient to remove the effect of bitumen prices. As mentioned earlier, fully removing the bitumen effect would reduce Capital Renewals wedge to zero.

In addition to the fact that historical movements in bitumen prices are not representative of what is likely to happen in RP3, we also note that BCIS has in the past caveated its bitumen index (which is based on the ONS PPI for Heavy Fuel Oil).

Step 3: Future trends

In contrast to National Highways' analysis, we do not consider that the two opposite effects that National Highways analyses in Step 3 exactly offset for the Maintenance swimlane.

In Step 3, National Highways makes the following arguments:

- Wages – National Highways points out that OBR forecasts suggest that wages will rise in real terms. It argues that this effect will be especially pronounced in the construction sector. It argues that this will affect the Maintenance swimlane, where it is placing a 58 per cent weight on construction wages.
- Bitumen – National Highways accepts that historical bitumen price inflation captured in its Step 1 trend analysis is not likely to continue into RP3, with forecasts suggesting flat or declining crude oil prices. This will mean that the wedge over CPI for both Capital Renewals and Maintenance is overestimated.

National Highways argues that Step 2 has already addressed the issue of bitumen prices for the Capital Renewals swimlane. However, as discussed above, we consider that the Step 2 adjustment is insufficient to fully remove the effect of historical increases in bitumen prices.

In discussing OBR forecasts, National Highways uses an out-of-date OBR forecast from March 2023 which has a higher figure for wage inflation than more recent forecasts. In particular, it uses the March 2023 OBR forecast to argue that wage inflation in the UK was expected to exceed CPI by 170 basis points over the first two years of RP3. However, the OBR's November 2023 forecasts (which National Highways uses elsewhere in its document when forecasting CPI) imply significantly lower wage inflation, with an average annual wedge of 0.7 per cent for the period 2025/26 to 2028/29. The wedge is smaller still in the more recently published March 2024 OBR economic outlook, which forecasts real wage growth of 0.4 per cent for the same period.

For the Maintenance swimlane, National Highways argues that a 0.25 per cent increment for higher wages is offset by a 0.25 per cent decrement to remove bitumen effect. It does not present any calculations to justify its claim that these effects have a magnitude of 0.25 per cent.

We calculate that for the Maintenance swimlane:

- Removing the effect of historical increases in bitumen prices would imply a decrement of 0.5 per cent if using the National Highways spreadsheet which works in 0.25 increments, or a decrement of 0.58 if a precise figure is used.
- OBR wage forecasts would imply an increment of 0.23 per cent (calculated as average wage growth of 0.4 per cent per annum from OBR's March 2024 forecasts multiplied by the 58 per cent share that National Highways says that wages account for in the Maintenance swimlane).

These figures suggest that the downwards adjustment required to remove the bitumen effect is more than double the upwards adjustment required to take account of real wage growth.

Step 4: Lag factor

We agree with National Highways that no adjustment should be made to estimated RPEs for lags in its contracts.

Steps 5 and 6: Existing inflation commitments and deviation uncertainty

As explained below, Steps 5 and 6 of National Highways' approach are double-counting the same risk and the evidence presented for these adjustments is also selective and weak.

First, Steps 5 and 6 are double-counting the risk that the RPE wedge may be insufficient if experience during recent inflation spike is repeated during RP3. Step 5 applies a 0.25 uplift to Enhancements and Capital Renewals due to a wedge between IOPI and CPI+200 (used internally within National Highways for commercial forecasting) between April 2022 and March 2023. Step 6 applies a 0.25 uplift to all three swimlanes due to a widened wedge between CPI and three construction price indices (IOPI, BCIS Renewals & Works and BCIS ROCOS) between August 2021 and October 2022. The overlap between the justification for these two steps can be seen by:

- The overlap in indices: One of three indices that National Highways uses in justifying Step 6 is IOPI, which is also used to justify Step 5.
- The overlap in time periods: The time period that National Highways analyses for Step 6 overlaps with time period used to justify Step 5.

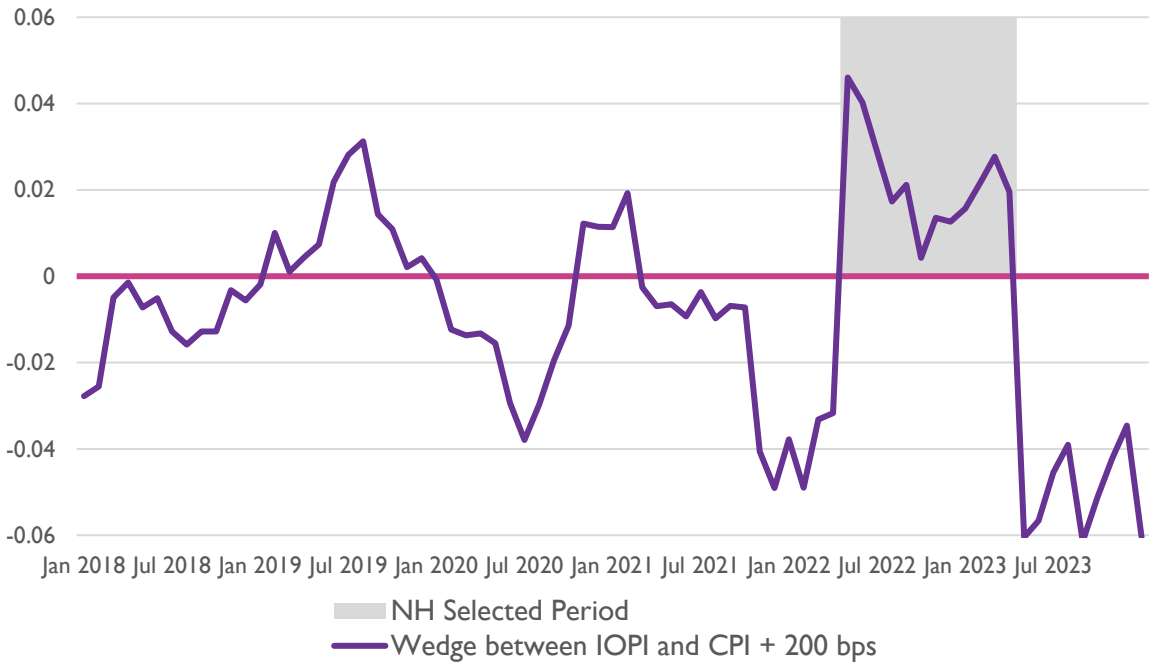
In its response to a Request for Information, National Highways claims that the distinction is that Step 5 is based on actual indexation in its contracts. However, that should already be captured in its choice of input price indices in its Step 1 trend analysis, since this was justified based on the proportion of its contracts that were indexed to different indices.

In our view, the rationale for the adjustment that National Highways makes in Steps 5 and 6 is also weak. National Highways acknowledges that similar conditions to the recent inflation spike are not expected in RP3.[5] Given this, it is unclear why a substantial increment (equating to 0.5 for Steps 5 and 6 combined, in the case of Enhancements and Capital Renewals) should be added to the inflation profiles on the basis of what happened during the recent inflation spike.

For both steps, we consider that National Highways is selective in the time periods that it considers. Given that funding is provided for a five-year period, it would be most relevant to look at what happened over the past five years as a whole when investigating the effect of recent inflationary conditions. In relation to step 5, the average wedge between IOPI and CPI+200bps (see figure below) is -0.9 over the last five years, and is negative either side of inflation spike period selected by National Highways.

[5] In particular, on page 40 of Section B of its dSBP, it acknowledges: "this period of high inflation is not anticipated to continue into RP3".

Figure 2.1: The period selected by National Highways to justify Step 5



In relation to Step 6, over the last five years, the average Compound Average Growth Rate (CAGR) of the three construction price indices that National Highways analyses is only 1.1 higher than the CAGR of CPI. This is much lower than the high wedges that National Highways obtains in its Step 6 analysis by focusing on a much narrower window of time.

There is a further problem with the way in which National Highways has applied its Step 5 adjustment. National Highways argues that this adjustment is justified based on movements in IOPI during the recent inflation spike, and it applies the adjustment to both Enhancements and Capital Renewals. However, the information that National Highways provides in Appendix 2 suggests IOPI is only used for indexation in contracts that are relevant to Enhancements. Hence, there does not appear to be any rationale for also applying the adjustment to Capital Renewals.

National Highways offers no quantitative analysis to support a magnitude of 0.25 per cent for the size of the increments that it adds in Steps 5 and 6. In a response to a Request for Information, National Highways pointed to its trend analysis spreadsheet as providing supporting information for the size of these adjustments, but it does not contain any analysis relevant to these steps.

It is worth noting that the size of the adjustment for the recent inflation spike would probably be significantly less if National Highways had simply included the most recent years of data in its Step 1 trend analysis. Including the recent inflation spike in the historical trend analysis would imply that the probability of similar events occurring during RP3 is equivalent to the frequency with which such events have occurred historically since January 2011 (the starting year used in National Highway's trend analysis). By adding wedges for this risk which are probably much higher than the adjustment which would be obtained from including recent years within the trend analysis, National Highways is implicitly assuming a much higher probability of such events occurring during RP3. This contradicts is own acknowledgement that similar conditions to the recent inflation spike are not expected in RP3.

Nonetheless, we accept that there is a risk that outturn RPEs may differ from ex ante allowances. For reasons discussed in Section 2.5, we do not agree with the inclusion of a risk allowance within inflation forecasts, and consider that this RPE risk should be covered in other risk allowances. Our advice for taking account of input inflation risk is set out in Section 0.

Step 7: Risk provision

Conceptually, the risk that outturn CPI inflation may differ from CPI inflation forecasts is distinct from the RPE risk addressed in Steps 5 and 6, so this step does not double-count the previous two.

However, there is no quantitative analysis at all provided by National Highways to justify the size of the adjustment that it proposes. In a response to a Request for Information, National Highways stated that its trend analysis spreadsheet provided supporting information for the size of this adjustment. However, our review of the spreadsheet suggests that it does not contain any analysis relevant to this step.

For reasons discussed in Section 2.5, we do not agree with the inclusion of a risk allowance within inflation forecasts, and consider that inflation risk should be covered in other risk allowances. Our advice for taking account of inflation risk is set out in Section 0.

2.4 Review of National Highways' approach to exceptions

This section sets out our review of National Highways' approach to inflation for the various cost categories that lie outside of the three main swimlanes (referred to as "Exceptions" in the dSBP). The "Exceptions" categories are:

- DBFO (PFI)
- Energy
- Staff costs
- Lower Thames Crossing (LTC)
- Other

2.4.1 DBFO (PFI)

The inflation profile applied to DBFO costs by National Highways is based on OBR RPI forecasts from November 2023, with a 0.25 percentage point uplift applied to account for forecast risk in the same way as done in Step 7a for the swimlane analysis.

Given National Highways' PFI contracts are indexed to RPI, we agree with using OBR RPI forecasts as the basis for the DBFO inflation profile. Our view on the use of a 0.25 percentage point uplift for forecast risk is the same as set out in Section 2.3.

2.4.2 Energy

National Highways has calculated bespoke electricity price forecasts (p/kWh) for RP3, as shown in Table 2.3 below. National Highways' figure for 2025/26 is based on a forecast for this year from Crown Commercial Service (CCS) (the organisation through which National Highways purchases its electricity). CCS forecasts are not available for later years, and so National Highways has constructed its own forecasts using data from the Department for Energy Security and Net Zero (DESNZ).

Table 2.3: Breakdown of National Highway's bespoke electricity price forecasts (p/kWh)

	25/26	26/27	27/28	28/29	29/30	Notes
CCS: Non-energy	12.78					CCS rate includes VAT
Forecast non-energy costs		12.96	13.19	13.45	13.72	Based on inflated CCS non-energy rates
Climate Change Levy (inflated)	0.79	0.8	0.81	0.83	0.85	Based on uplifted 2024 rate of 7.75p
Total non-energy costs	**13.57**	**13.77**	**14**	**14.28**	**14.56**	
CCS: Energy costs	13.28					CCS rate includes VAT
DESNZ: Energy cost forecasts		8.7	8.47	7.83	7.57	DESNZ inflated and VAT applied
Hedge premium		2.81	2.81	2.81	2.81	Flat rate applied across all years
Total energy costs	**13.28**	**11.52**	**11.28**	**10.64**	**10.38**	
Total costs	**26.85**	**25.28**	**25.28**	**24.92**	**24.94**	

Source: Information provided by National Highways upon request.

National Highways' forecasts for energy costs from 2026/27 onwards are based on the wholesale electricity price forecasts published by DESNZ, inflated based on OBR's CPI forecasts and with VAT applied, with a flat hedge premium included. The DESNZ forecasts exclude all non-wholesale electricity costs, which include transmission costs, distribution costs, metering costs, supplier costs, supplier margins, taxes and levies. These non-wholesale costs are captured in National Highways' non-energy costs. National Highways produces its forecasts of these non-energy costs by taking the expected non-energy CCS cost for 2025/26 and inflating it using OBR's CPI forecasts for the remaining years of RP3. The climate change levy is also included, inflated from its 2024 rate using the OBR CPI forecasts.

While the CCS forecast for 2025/26 represents a credible, independent estimate, we do not agree with National Highways' approach to electricity costs for later years, which involves an unsupported assumption that non-wholesale electricity costs will move in line with CPI. The "non-energy" component of National Highways' forecasts is assumed to follow OBR's CPI forecasts, but with no evidence or analysis provided by National Highways for this assumption. The "energy" component of the forecast is supported by the independent DESNZ forecasts, but this component accounts for less than half of total electricity cost. Therefore, more than half of the inflation assumption built into National Highways' forecasts are not supported by evidence. A more robust approach would be to use the energy price forecasts published by BEIS in the Green Book supplementary guidance,[6] which are forecasts of retail prices, rather than wholesale prices, and therefore include the energy network and energy supply costs that the DESNZ forecasts exclude. The BEIS dataset includes retail price forecasts for industrial customers such as National Highways.

2.4.3 Staff costs

National Highways' inflation profile for staff costs is 3 per cent annual growth in each year of RP3. This growth rate assumption is broadly based on the average earnings consensus forecasts published by HM Treasury in November 2023, which forecast average annual earnings growth of 3.3 per cent for the years 2025 – 2027.[7]

[6] BEIS (2023) Green Book supplementary guidance: valuation of energy use and greenhouse gas emissions for appraisal – Table 4, industrial customers. [online]

[7] The latest publication of HM Treasury's consensus forecasts (February 2024, at the time of writing) forecast average annual earnings growth for the years 2025 – 2028 of 3.2 per cent. See Table M6 in HM Treasury (2024) "Forecasts for the UK economy: February 2024" [online]

As shown in the table below, National Highways' staff cost inflation assumption for RP3 is higher than the OBR's November 2023 forecast for average earnings growth (over the period of RP3 where forecasts are available), and the subsequent OBR March 2024 forecasts.

Table 2.4: Forecasted annual earnings growth from 2025/26 to 2028/29, OBR and National Highways (%)

	OBR November 2023 outlook	OBR March 2024 outlook	National Highways' RP3 profile
2025/26	1.9	1.9	3.0
2026/27	2.2	2.1	3.0
2027/28	2.6	2.3	3.0
2028/29	2.8	2.6	3.0
Average	**2.6**	**2.4**	**3.0**

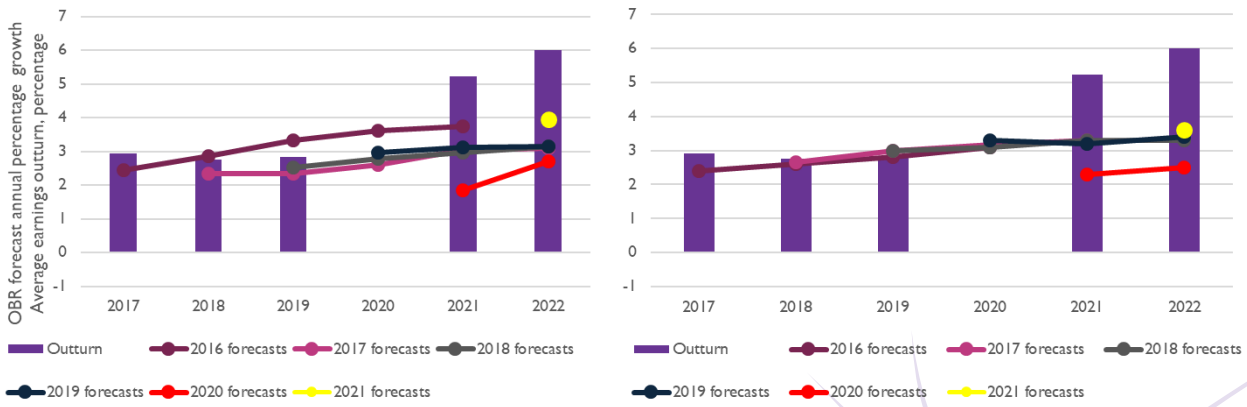
Sources: OBR November 2023 Outlook, Table A.3; OBR March 2024 Outlook, Table A.3; National Highways Inflation annex.

National Highways seeks to justify using the HM Treasury consensus forecasts by arguing that independent forecasters have previously produced more accurate forecasts than the OBR during times of macroeconomic volatility.

We do not agree with the approach National Highways has taken to forecast staff cost inflation. It is inconsistent for National Highways to use OBR's forecasts for CPI throughout its inflation analysis (and OBR's RPI forecasts), but not to use OBR's forecasts for earnings growth. Hence, we consider that National Highways should use OBR's forecasts for earnings growth as the basis for its staff cost inflation, not the HM Treasury consensus forecasts.

Our analysis indicates that there is very little difference in the historical accuracy of OBR and HM Treasury consensus forecasts of earnings growth. The graphs below compare the forecasts published by both organisations in the last 5 years with outturn earnings growth over the same period. As can be seen from the graph, any difference in the forecasting accuracy of the OBR and the consensus forecasts is marginal.

Figure 2.2: Comparison of OBR (left) and HM Treasury consensus (right) forecasts of earnings growth with outturn earnings growth



Source: Europe Economics analysis of OBR forecasts and HM Treasury consensus forecasts since 2016.

In its comments on a draft version of this addendum, National Highways stated that its pay settlements need to be consistent with the Civil Service Pay Remit Guidance. So far as we are aware, Civil Service Pay Remit Guidance is currently only available up to 2023/24, and hence cannot be used to forecast wage growth for RP3.

2.4.4 Lower Thames Crossing (LTC)

National Highways have used bespoke tender price inflation (TPI) forecasts produced by BCIS for profiling LTC costs, though these forecasts are not reflective of the reprofiled delivery programme.

We do not have information on how the BCIS TPI forecasts have been constructed, and therefore it is difficult to evaluate the appropriateness of these forecasts for LTC costs. Our 2023 report set out our general concerns with the use of TPI forecasts for regulatory purposes. That said, the inflation profiles that National Highways proposes for this cost category imply low RPEs, and hence further analysis in this area is unlikely to be a regulatory priority for ORR.

2.4.5 Other

Inflation profiles for other costs (costs that do not fall into any of the swimlanes or exception areas) vary for each cost line. Where possible, National Highways have applied the inflation profile for the most relevant swimlane.

We agree with the categorising of the most common "other" costs into different inflation profiles set out in Table 16.5 of National Highways" inflation annex. Regarding the inflation profiles themselves, the same comments that we have made in Section 2.3 on the swimlane inflation assumptions and the approach to inflation risk also apply here.

2.5 Review of National Highways' approach to inflation risk

We do not agree with the inclusion of an inflation risk allowance within the inflation forecasts (i.e. Steps 5, 6 and 7a). In our view, it lacks transparency to embed a risk allowance within inflation profiles. It means that when National Highways uplifts its costs for inflation the resulting figures are partly an allowance for the expected future level of costs and partly a risk allowance, without the breakdown between the two being made clear to stakeholders in the way that inflated costs are presented. It would be much more transparent to use inflation profiles which represent a central expectation of future inflation, and take account of inflation risk elsewhere in the funding settlement.

National Highways approach has a number of consequences which we view as undesirable, including the following.

- There will be compounding effects when an inflation figure with a risk uplift is applied each year of RP3. The result will be that National Highways will benefit from a risk allowance which increases in each year of RP3, and which is also higher in total across RP3 than might appear at first sight, without this being transparent to stakeholders. This is illustrated by the table below, which shows the effect of applying National Highways' RPE for Capital Renewals, with and without the risk uplifts implied by Steps 5, 6 and 7a, to hypothetical ongoing expenditure with a starting index value of 100. The final column shows how the implicit risk allowance increases each year. The implicit risk allowance in the final year represents 3.8 per cent of the expected value of the cost — much more than stakeholders might assume given that the uplift to the inflation figure itself is only 0.75 per cent.[8]

[8] The figure of 3.8 per cent is calculated as the implicit risk allowance in Year 5 of 3.9 divided by the inflated cost allowance in Year 5 (without the risk uplift) of 103.8.

Table 2.5: Effect of compounding when including a risk uplift within inflation assumptions

Year	Inflated cost allowance using		Implicit risk allowance
	Inflation figure of 0.75% (i.e. without risk allowance)	Inflation figure of 1.5% (i.e. with risk allowance)	
0	100.0	100.0	
1	100.8	101.5	0.7
2	101.5	103.0	1.5
3	102.3	104.6	2.3
4	103.0	106.1	3.1
5	103.8	107.7	3.9

Source: Europe Economics calculations

- National Highways does not appear to take account of the risk allowance included within inflation assumptions in when calculating overall P-values, meaning that the P-values are spuriously low. The OBR itself identifies its CPI forecasts as P50, and in our view the RPE assumptions that we recommend using later in this report (see Section 3.6) also represent P50 values for RPE wedges. This means that — in terms of input price inflation risk — National Highways would already be funded to a P50 level if it used these inflation figures. By adding a substantial risk uplift within Steps 5, 6 and 7a of its methodology, National Highways is suggesting that it should be funded to a P-value substantially above P50 in terms of inflation risk. Given that input price inflation risk is likely to be a significant element in National Highways' overall risk exposure, this would be expected to have a significant effect on the overall P-value covered by National Highways' funding settlement when all sources of risk are taken into account. (In other words, even if some other risks are only funded to a level below P50, the overall funding position may be P50 or above once we take into account the fact that inflation risk is funded to a level that is substantially above P50.) However, the substantial benefit of the risk allowance embedded within inflation profiles does not appear to be taken into account by National Highways when it calculates the P-value covered by the funding settlement. This means that – subject to the findings of the wider review of risk allowances – the overall P-values quoted by National Highways will be spuriously low.
- National Highways' approach means that the risk uplift embedded in its inflation figures is applied to risk allowances. National Highways applies its inflation assumptions (including its risk allowances) to its allowances for project and portfolio risks. While it is appropriate to uplift project and portfolio risk allowances for the true expected level of inflation, in our view it does not make sense to apply a risk uplift to a risk allowance.

Hence, we recommend that no risk allowances should be embedded within National Highway's inflation assumptions. In Section 4, we set out our proposed alternative approach to taking account of inflation risk as part of National Highways' risk modelling.

3 Updated Europe Economics Assessment of Real Price Effects

This section sets out our updated RPE analysis, in which we investigate whether there is evidence of a material wedge between National Highways' input prices and CPI. In our 2023 report, we used data up to 2020 for our main wedge analysis, excluding data from 2021 and 2022 due to the atypical inflation spike that happened in these years. However, we also carried out sensitivity analysis in which we investigated the effect of including data for 2021 and 2022, where available. For National Highways' three swimlanes, we have updated the sensitivity analysis from our 2023 report by using the latest data for the input price indices we analysed for each swimlane. In most cases, the historical data for input price indices now covers 2023. In the case of the Maintenance swimlane, we have also analysed two new input price indices included in National Highways' blended index for Maintenance.

For electricity costs and staff costs, we have updated our sensitivity analysis in the same way as for the three swimlanes. In addition, we have updated our analysis of relevant forecasts for each of these cost categories, making use of the latest available forecasts in each case.

3.1 Enhancements

For the Enhancements swimlane, our 2023 report analysed historical data on the wedge between CPI and the following five indices:

- ONS IOPI - Infrastructure: new work
- ONS COPI - Infrastructure: new work
- BCIS - ROCOS: combined
- BCIS - FOCOS: combined
- BCIS - ROADCON TPI

The updated data has had no material impact on our previous findings for any of these five indices. For the ONS IOPI "Infrastructure: new work" index, our 2023 report found a statistically significant average annual wedge of 0.9 per cent for the period 2011-2020, and a statistically significant wedge of 1.1 per cent for 2011-2022. For the period 2011-2023, there is a statistically significant wedge of 0.9 per cent per annum. For the other ONS index, COPI "Infrastructure: new work", our 2023 report found no evidence of a statistically significant wedge, and this remains the case when using the updated data. Similarly, there was no evidence of a wedge for the BCIS ROADCON TPI in our 2023 report, and the updated analysis also finds no evidence of a wedge. For the BCIS ROCOS combined index, our updated analysis finds a statistically significant wedge of 2.3 per cent per annum for the period 2000-2023 (up to August 2023). This is in line with the wedges estimated for 2000-2020 (2.2 per cent) and 2000 – August 2022 (2.6 per cent) in our 2023 report. For the BCIS FOCOS combined index, our updated analysis finds a statistically significant wedge of 1.9 per cent per annum for the period 2000-2023 (up to August 2023). Again, this is in line with the wedges estimated for 2000-2020 (1.6 per cent) and 2000 – August 2022 (2.2 per cent) in our 2023 report.

The table below summarises our updated findings.

Table 3.1: Comparison of findings from 2023 report and updated analysis for Enhancements indices

Index	Findings from our 2023 report	Updated sensitivity analysis
ONS IOPI - Infrastructure: new work	0.9% wedge for 2011-2020 1.1% wedge for 2011-2022	0.9% wedge for 2011-2023
ONS COPI - Infrastructure: new work	No wedge	No wedge
BCIS - ROCOS: combined	2.2% wedge for 2000-2020 2.6% wedge for 2000-2022 (Aug)	2.3% wedge for 2000-2023 (Aug)
BCIS - FOCOS: combined	1.6% wedge for 2000-2020 2.2% wedge for 2000-2022 (Aug)	1.9% wedge for 2000-2023 (Aug)
BCIS - ROADCON TPI	No wedge	No wedge

Source: Europe Economics analysis

Given that none of our findings have materially changed in the updated sensitivity analysis, our conclusion for Enhancements remains the same as in our 2023 report. Hence, we remain of the view that the balance of evidence suggests that there is an RPE for the Enhancements swimlane.

3.2 Capital Renewals

For the Capital Renewals swimlane, our 2023 report analysed historical data on the wedge between CPI and the following five indices:

- ONS COPI - Non-housing repair and maintenance
- ONS AWE - Professional, Scientific and Technical Activities
- BCIS PAFI - Renewals and construction works
- BCIS PAFI - Bitumen
- BCIS PAFI - Machine surfacing

The updated data has no material impact on our previous findings for any of these five indices. For all five indices, our 2023 report found no evidence of a statistically significant wedge. The updated sensitivity analysis again finds no statistically significant wedges, with the one exception of the ONS AWE for Professional, Scientific and Technical Activities. For this index, there is a statistically significant wedge of 1.4 per cent for the sensitivity period 2001-2023. However, our 2023 report excluded data from 2020 and 2021 in our analysis of this index due the impacts of Covid-19 on the index. We continue to consider that it is appropriate to exclude this data. The wedge for the period 2001-2023, excluding Covid-19 impacted years, is not statistically significant.

The table below summarises our updated findings for Capital Renewals.

Table 3.2: Comparison of findings from 2023 report and updated analysis for Capital Renewals indices

Index	Findings from our 2023 report	Updated sensitivity analysis
ONS COPI - Non-housing repair and maintenance	No wedge	No wedge
ONS AWE - Professional, Scientific and Technical Activities	No wedge when excluding 2020-2022	No wedge when excluding 2020-2022
BCIS PAFI - Renewals and construction works	No wedge	No wedge
BCIS PAFI - Bitumen	No wedge	No wedge
BCIS PAFI - Machine surfacing	No wedge	No wedge

Source: Europe Economics analysis

In our 2023 report we also analysed forecasts of oil prices published by BEIS as a proxy for bitumen forecasts. This was because historical increases in bitumen prices were the main driver of the positive wedge that

National Highways had estimated for Maintenance, but we considered that the future path of real bitumen prices was more likely to be downwards as the "Ukraine effect" unwinds.

We have updated this analysis with BEIS' November 2023 publication.[9] For the years 2025-2030, the average annual wedge between CPI and oil price inflation implied by BEIS' forecasts is -3.0 per cent in the "low" scenario, -1.9 per cent in the "central" scenario, and 1.9 per cent in the "high" scenario. The range implied by these forecasts is similar to that implied by the earlier January 2023 BEIS forecasts that we analysed in our 2023 report.[10] However, the central scenario of -1.9 per cent implies a significant negative RPE for bitumen going forward, whereas previously the central scenario implied a small positive wedge for bitumen of 0.4 per cent. This strongly reinforces the argument that we made in our 2023 report that ORR should not recognise a positive RPE for Capital Renewals that is based on historical increases in bitumen prices, given that such increases in bitumen prices are unlikely to be repeated in RP3. The latest forecasts could even be used to argue for a negative RPE wedge for Capital Renewals on the basis that bitumen prices are likely to decline. However, given that the high and low scenarios suggest a wide range of -3.0 to +1.9 per cent for the future path of bitumen prices, we think there is insufficient certainty that bitumen prices will fall to draw this conclusion.

Given that none of our findings from historical analysis of the five indices have materially changed in the updated sensitivity analysis, and given the updated BEIS oil price forecasts reinforce the argument in our 2023 report, our conclusion on Capital Renewals remains the same as in our 2023 report. Hence, we remain of the view that the balance of evidence suggests that there is not an RPE for the Capital Renewals swimlane.

3.3 Maintenance

For the Maintenance swimlane, our 2023 report analysed historical data on the wedge between CPI and the following four indices:

- BCIS - Routine, Cyclic and Time Charge Works
- ONS PPI - Repair and Maintenance Services
- ONS PPI - Repair and Installation Services
- ONS COPI - Non-housing repair and maintenance

There is no new data available for the ONS PPI "Repair and Maintenance Services". The updated data has had no material impact on our previous findings for any of the remaining three indices. For all three indices, our 2023 report found no evidence of a statistically significant wedge. The updated sensitivity analysis again finds no statistically significant wedges.

National Highways included two additional series in its blended index for Maintenance, namely:

- ONS AWE – Construction
- ONS SPPI – Rental and leasing services of construction and civil engineering machinery and equipment

We have analysed the historical data for each, and find no evidence of a positive wedge from either. There is no statistically significant wedge between the ONS AWE construction index and CPI, over our main period of analysis of 2001-2020, over the sensitivity period 2001-2023, or over alternative shorter periods (such as a period constructed by excluding Covid-19 years, or by using only the years after the global financial crisis).

[9] BEIS (2023) Green Book supplementary guidance: valuation of energy use and greenhouse gas emissions for appraisal – Table 7, industrial customers [online]

[10] The January 2023 BEIS forecasts implied average wedges for 2025-2030 of 1.8 per cent in the low scenario and -2.8 per cent in the high scenario. Note that the labels "high" and "low" for these scenarios are based on the forecast level of prices, rather than the percentage changes through time. The more recent BEIS forecasts from November 2023 have negative price changes in the low scenario and positive price changes in the high scenario (i.e. the opposite way round to the January 2023 forecast). However, the overall range of -3.0 to +1.9 per cent in the November 2023 forecasts is similar to range of -2.8 to +1.8 in the previous January 2023 forecasts.

For the ONS SPPI, there is no significant wedge over our main period of analysis of 2000-2020, nor over the sensitivity period of 2000-2023. However, there is a statistically significant negative wedge of -2.1 per cent for the period 2010-2023 (i.e. the post-crisis period).

The table below summarises our updated findings for Maintenance.

Table 3.3: Comparison of findings from 2023 report and updated analysis for Maintenance indices

Index	Findings from our 2023 report	Updated analysis
BCIS - Routine, Cyclic and Time Charge Works	No wedge	No wedge
ONS PPI - Repair and Maintenance Services	2.4% wedge for 2000-2020 No wedge if excluding 2009/10	No new data, series ends 2020
ONS PPI - Repair and Installation Services	No wedge	No wedge
ONS COPI - Non-housing repair and maintenance	No wedge	No wedge
ONS AWE - Construction (NEW)	N/A	No wedge
ONS SPPI - Rental and leasing services of construction and civil engineering machinery and equipment (NEW)	N/A	No wedge for 2000-2020 No wedge for 2000-2023 -2.1% wedge for 2010-2023

Source: Europe Economics analysis

We note that National Highways has indicated that 58 per cent of its Maintenance costs are labour costs. If this is accepted by ORR, then the RPE that is applied to Staff costs should also be applied to 58 per cent of the maintenance swimlane. We set out our updated analysis of the RPE for Staff costs in Section 3.5.

Given that none of the findings have changed for the four indices previously analysed, and the two new indices provide no evidence of a positive RPE (there is minor evidence for a negative RPE), we continue to conclude that there is no evidence of an RPE for the remainder of the Maintenance swimlane.

3.4 Electricity

For electricity, the updated sensitivity analysis of historical outturn electricity prices (for very large customers) finds a statistically significant average annual wedge of 7.4 per cent for 2007 – 2023. However, as set out in our 2023 report, we do not consider historical electricity price changes to be reflective of the expected RPE for electricity in RP3, due to the likely unwinding of the inflationary spike caused by the Russia-Ukraine conflict.

Therefore, we have also updated our analysis of electricity price forecasts, using the most recent publication of BEIS' forecasts.[11] For the years 2025-2030, the average annual wedge between CPI and electricity price inflation implied by BEIS' forecasts is -0.5 per cent in the "low" scenario, -6.3 per cent in the "central" scenario, and -12.5 per cent in the "high" scenario.[12] The evidence from the BEIS forecasts indicates a negative RPE is expected for electricity over the next five years, in line with the findings from our 2023 report, though the negative wedges from our updated analysis are smaller than those in our 2023 report (-2.3 per cent (low scenario), -8.4 per cent (central scenario) and -14.2 per cent (high scenario)). For reference, the DESNZ forecasts for wholesale electricity prices used by National Highways in its electricity price forecasts indicate

[11] BEIS (2023) Green Book supplementary guidance: valuation of energy use and greenhouse gas emissions for appraisal – Table 4, industrial customers. [online]

[12] The BEIS forecasts are for calendar years, not financial years. Approximating the wedge implied for the financial years 2025/26 to 2029/30 based on a pro-rata conversion of the calendar year forecasts yields implied RPEs of -0.2 per cent (low scenario), -7.0 per cent (central scenario) and -16.1 per cent (high scenario).

a negative annual average wedge of 7.7 per cent for the years 2025-2030. In fact, by combining the two sets of forecasts (BEIS' retail price forecasts and DESNZ's wholesale price forecasts, both of which are published in real 2022 prices), the implied wedge for non-wholesale electricity prices (the difference between retail prices and wholesale prices) can also be calculated. Based on the central BEIS forecasts, the average annual wedge for non-wholesale electricity costs is -5.2 per cent for the years 2025 – 2030. This is substantially lower than the assumed wedge of zero in National Highways' forecasts.

3.5 Staff

For staff, our 2023 report analysed historical data on the wedge between CPI and the following four indices:

- ONS ASHE - Professional Occupations
- ONS ASHE - Skilled Trades
- ONS ASHE - Process, plant and machine operatives
- ONS AWE - Whole economy

The updated data has no material impact on our previous findings for any of these four indices. For all four indices, our 2023 report found no evidence of a statistically significant wedge. The updated analysis again finds no statistically significant wedges.

Our 2023 report also analysed forecasts of wage inflation published by the OBR and the Bank of England, and we have updated that analysis with more recent forecasts. The November 2023 OBR economic outlook, the publication used by National Highways for CPI forecasts, forecasts an average annual wedge of 0.7 per cent for the period 2025/26 to 2028/29. The recently published March 2024 OBR economic outlook forecasts a smaller wedge of 0.4 per cent for the same period. The Bank of England's February 2024 Monetary Policy Report forecasts an average wedge of 0.8 per cent for 2025 – 2026.[13]

Our conclusions for staff costs remain the same as in our 2023 report – if weight is placed on OBR forecasts, then the evidence indicates that there is an RPE for staff costs (though a smaller RPE than found in our 2023 report). If no weight is placed on OBR forecasts, then the historical data indicates that there is no RPE for staff costs. We note that an assumption of zero wage growth would not be consistent with assuming economy-wide productivity growth when setting National Highways' efficiency targets.

3.6 Updated recommendations

The above analysis leads to the following changes to our RPE recommendations in the 2023 report.

[13] For comparison, the most recent OBR forecasts at the time that we wrote our 2023 report indicated an average annual wedge of 1.4 per cent for the years 2025 – 2027.

Cost category	Change from previous recommendation
Enhancements	No change (RPE of 0.75)
Capital Renewals	No change (RPE of zero*)
Maintenance	Same RPE as for "Staff" for labour element of costs No change for rest of swimlane (RPE of zero)
PFI	No change (use OBR RPI forecast)
Electricity	Use CCS forecast for 2025/26 Use percentage changes in BEIS central forecast from 2025/26 onwards
Staff	No change (if weight placed on OBR estimates, use OBR estimates for real growth in average earnings; if instead rely on historical data, assume zero**).

*As previously, our recommendation for Renewals is for an RPE of zero; but ORR has the option of using the same RPE as for Enhancements on the basis of its understanding of the swimlane.
**A zero assumption for wage growth would be inconsistent with any assumption of positive economy-wide productivity growth.

4 Alternative Approach to Taking Account of Inflation Risk

Inflation risk is the risk that outturn input price inflation is different to forecast input price inflation. It is an important risk for National Highways because it receives a fixed cash funding settlement for each Road Period, set at the start of the Road Period. The cash amount National Highways receives is based on expected inflation for the Road Period. If inflation outturns are higher, then, all else being equal, the funding will be lower than National Highways requires for to deliver its outputs. Since there is inherent uncertainty in forecasting inflation, the question arises as to how inflation risk should be treated in National Highways' funding settlement.

As discussed in Section 2, National Highways is currently taking account of inflation risk through steps 5, 6 and 7a of its methodology, which embed risk allowances into its inflation profiles. We have set out our concerns with this approach, and the lack of quantitative evidence underlying the magnitude of the risk allowances that National Highways embeds in its inflation figures. In this section we present an alternative approach to the treatment of inflation risk, based on quantitative analysis.

4.1 How inflation risk should be taken into account

In our view, inflation risk should be treated as one of the risks covered by National Highways' Central Risk Reserve (CRR), not embedded within inflation profiles for the three swimlanes. The risk of outturn inflation being different to forecast inflation is a risk which is largely outside National Highways' control, and therefore it is a portfolio risk. As a portfolio risk, it should be included in the Monte Carlo modelling of portfolio risks used to determine the allocation of CRR funding. An additional benefit of including inflation risk in the CRR is that the CRR has more stringent governance processes than project risk allowances. The inflation risk adjustments made in Steps 5, 6 and 7a of National Highways' proposals should not be included in input price inflation assumptions, so that inflation risk is solely covered by the CRR.

4.2 Empirical evidence on input price inflation risks

The size of the provision for inflation risk should be based on quantitative evidence, as far as possible. National Highways' current proposals for inflation risk (Steps 5, 6 and 7a) are not based on quantitative evidence. To include inflation risk in the CRR as we recommend, inflation risk will need to be added to the set of portfolio risks that are fed into the Monte Carlo simulations that model allocation of the CRR. To do this, National Highways would need to determine an uncertainty range for the input price inflation. The distribution of historical movements of relevant input price indices can help to determine a variance for the input price inflation that National Highways can expect to face in RP3. Another source of evidence is the confidence intervals published by OBR around its CPI forecasts.

We review these sources of empirical evidence below.

4.2.1 Confidence intervals around official CPI forecasts

The OBR's CPI forecasts include fancharts based on 10 per cent probability bands, ranging from P10 to P90. Its central CPI forecast is the P50 value. From the OBR data, we have calculated the implied 80 per cent confidence interval around its CPI forecast (the difference between its P90 forecast and its P10 forecast).

We have analysed the confidence intervals around OBR's most recent inflation forecasts, from its March 2024 Economic Outlook. These forecasts extend out to 2028. The average width of the confidence interval around OBR's forecasts for 2025-2028 is 5.6 per cent. OBR's confidence intervals are not symmetric around its central forecast – the average size of the downside (P50 – P10) is 2.5 per cent, while the upside average (P90 – P50) is 3.1 per cent. However, for reasons set out in Appendix 1, we do not consider that looking ahead there is greater upside than downside around OBR's central forecast. That implies an 80 per cent confidence interval of +/- 2.8 per cent around the CPI forecast for the years of RP3.

We note that the recent Bernanke review[14] found that the Bank of England's fancharts "have weak conceptual foundations", "convey little useful information over and above what could be communicated in other, more direct ways" and "should be eliminated". While these comments related to the Bank of England's fancharts, they suggest that caution should also be applied in drawing conclusions from OBR fancharts.

4.2.2 Evidence from historical input price inflation data

In analysing the distribution of historical changes in relevant input price indices, we focus on the blended indices constructed by National Highways rather than on individual input price series (such as those we analyse in Section 3). This is because the distribution of historical changes in an individual input price series will overstate National Highways' exposure to inflation risk, as it will not take account of the potential for outturns for different input prices to offset each other. By contrast, analysing blended indices will take this factor into account, since the blended index will capture the overall effect of changes in all of the component input price series, including in cases where outturns for different input prices had offsetting effects.

Confidence intervals can be constructed for the growth rate of National Highways' blended index for each swimlane. The confidence intervals provide an uncertainty range for the rate of growth of the input prices most relevant to National Highways' costs. This approach incorporates both CPI risk (the risk that outturn CPI inflation is different to expectations) and RPE risk (the risk that the outturn wedge between CPI and input prices is different to expectations) because movements in outturn input prices are comprised of movements in outturn CPI and movements in the outturn wedge between CPI and the input price.

We have calculated confidence intervals on the basis of the standard deviation in the annual growth rate of the indices. When calculating the standard deviation for each index, we exclude the years of the recent inflation spike (calendar years 2021 and 2022). We exclude these years because they are not representative of the inflationary environment expected in RP3 and hence the volatility in input prices and CPI in those years is not expected to be repeated in RIS3. Including those years would overstate the uncertainty around input price inflation for RIS3. (Put another way, we do not think that National Highways should be funded on the basis of an "abnormal" period of high inflation which is unlikely to be repeated during RP3.)

For the Capital Renewals and Maintenance swimlanes, we have carried out the analysis both with and without the BCIS Bitumen index that National Highways includes in the blended indices for these swimlanes. Our analysis of Step 1 of National Highways' methodology (see Section 2.3) set out how influential the inclusion of the bitumen index is on the historical trend analysis for the blended indices. National Highways have acknowledged that historical movements in bitumen prices are unlikely to be representative of movements in bitumen prices in RP3, and BCIS have held the index under review for several months due to concerns about the relevance of the underlying index (ONS PPI for Heavy Fuel Oils) to bitumen price movements. It is important to understand the impact that the bitumen index has upon the confidence intervals for inflation for these swimlanes.

[14] https://www.bankofengland.co.uk/independent-evaluation-office/forecasting-for-monetary-policy-making-and-communication-at-the-bank-of-england-a-review/forecasting-for-monetary-policy-making-and-communication-at-the-bank-of-england-a-review

We have calculated 95 per cent confidence intervals. Assuming a normal distribution of input price movements,[15] a 95 per cent confidence interval is 1.96 standard deviations either side of the central (mean) estimate of input price inflation. The results of our analysis for the three swimlanes are reported in the table below.

Table 4.1: 95 per cent confidence intervals (CI) for the annual movements of the blended indices for each swimlane (%)

	Enhancements blended index	Renewals blended index	Maintenance blended index
95% C.I. including Bitumen	n/a	+/- 10.1	+/- 5.7
95% C.I. excluding Bitumen	+/- 3.5	+/- 2.5	+/- 2.5

Europe Economics analysis. "+/- 3.5" indicates a confidence interval of 3.5 per cent either side of the mean (i.e. a total width of 7.0 per cent)

The results for Renewals and Maintenance demonstrate the influence of the bitumen index on the distribution of annual changes for both blended indices. For both swimlanes, the confidence intervals are substantially wider when bitumen is included.

In addition to the above analysis, we have calculated a confidence interval for an overall combined index across all three swimlanes. This overall index combines the three blended swimlane indices into a single index, weighted according to the total costs of each swimlane. Combining the three swimlane indices into a single index captures the effect of input price movements for one swimlane being offset or exacerbated by input price movements in another swimlane. The standard deviation for this overall index is calculated in the same way as for the three swimlane indices (i.e. excluding 2021 and 2022) and is calculated both with and without the bitumen index. The resulting 95 per cent confidence intervals are reported below.

Table 4.2: 95 per cent confidence intervals (CI) for the annual movements of the overall index (%)

	Overall blended index
95% C.I. including Bitumen	+/- 5.9
95% C.I. excluding Bitumen	+/- 2.5

Source: Europe Economics analysis

4.3 Recommendation

We recommend that National Highways uses a confidence interval of **+/- 3 per cent** as an inflation risk assumption in its CRR Monte Carlo modelling.[16]

Our recommendation is focused on the results from our analysis of the distribution of movements in the blended input price indices for the three swimlanes, excluding bitumen. We focus on the results excluding bitumen so that the results are not driven by historical movements in just one input price index that National Highways has itself accepted do not represent what is likely to happen to this input price in the future.

[15] We have used the Shapiro-Wilks test to test the normality of the distribution of annual percentage changes for each swimlane's blended index and also for the overall blended index discussed later (excluding bitumen from renewals, maintenance and the overall index). While the test has a low power due to the small number of datapoints, the test found that the null hypothesis of a normal distribution cannot be rejected.

[16] It could be argued that the confidence interval might be narrower in the earlier years of RP3 and wider in the later years of RP3, due to greater uncertainty about inflation further into the future. Due to the fact that our recommended range is derived from the historical distribution of outturn inflation figures (rather than analysis of uncertainty around a specific forecast), we are not able to provide a confidence interval that widens through time in this way. Hence, our recommendation employs the simplifying assumption that the same confidence interval applies to inflation in each year of RP3.

The results from our analysis of the blended input price indices (excluding bitumen) and the evidence from OBR justify a range for the confidence interval of +/- 2.5 per cent to +/- 3.5 per cent. The justification is as follows:

- The results of our analysis of the blended indices for Capital Renewals and Maintenance swimlanes, and the analysis of the overall index we constructed, supports a confidence interval of +/- 2.5%
- The results of our analysis of the blended index for Enhancements supports a confidence interval of +/- 3.5%
- The evidence from the OBR, which implies that a 95 per cent confidence interval must be wider than +/- 2.8 per cent, is taken into account by the upper end of the range.

Taking the mid-point of the range suggested by the empirical evidence, we recommend that a confidence interval of +/- 3.0 per cent is used by National Highways to include inflation risk in its Monte Carlo modelling of how the CRR is allocated.

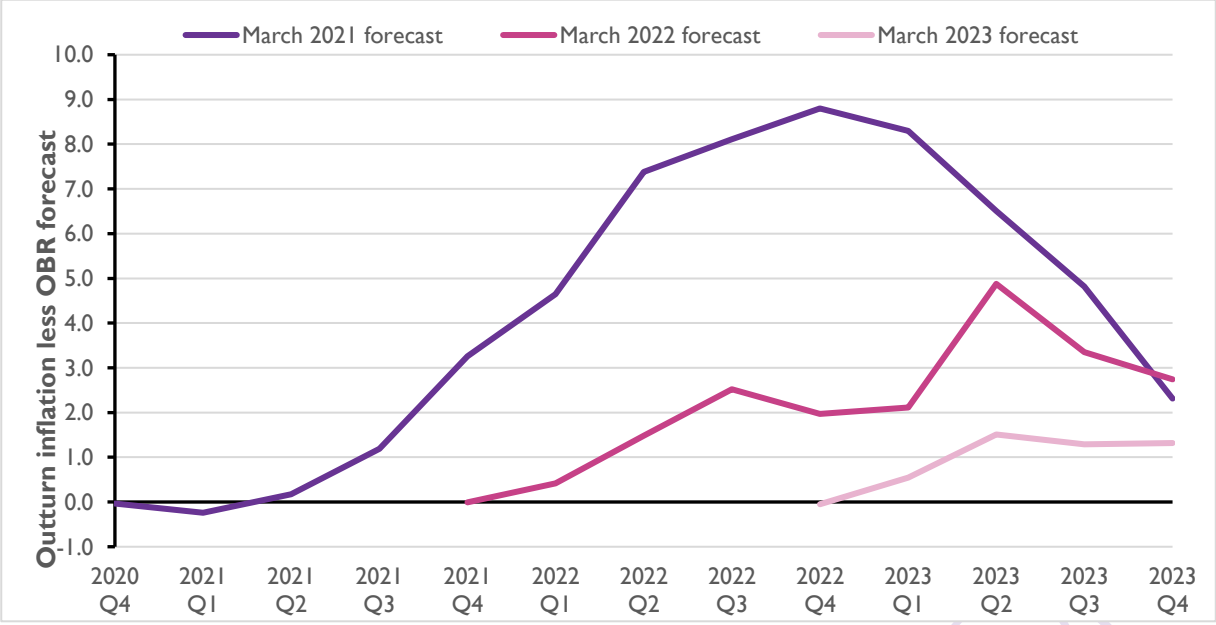
5 Appendix: the Current Outlook for Inflation in the UK

This appendix explains that, by contrast with National Highways' position that inflation risks, relative to the OBR's November 2023 forecast, lie mainly to the upside, there are reasons to believe that outturn CPI inflation in the next few years is at least as likely to undershoot the OBR's forecasts as to overshoot them. This raises further questions about the appropriateness of the adjustments that National Highways makes in Steps 5 and 6 of its methodology, since these adjustments are based on analysis of data from the recent period of high inflation, and such high inflation is unlikely to reoccur in the next few years. It also raises questions about the appropriateness of the adjustment that National Highways makes in Step 7 of its methodology, since this adjustment is explicitly aimed at addressing the risk that outturn CPI may be higher than forecast CPI.

5.1 National Highways' position

In its dSBP, National Highways stated that the CPI inflation risk that it faces is asymmetric. In a response to a Request for Information, National Highways provided further explanation of why it considers this risk to be asymmetric. It contends that the OBR's "Forecast Evaluation Report" from October 2023[17] shows that the OBR's forecasts exhibit significant downwards bias compared to outturn inflation. Over the three years from March 2021 onwards, of 24 quarters of forecasts issued by the OBR, only one was higher than outturn CPI, with the average deviation being that forecasts were 3.3 per cent lower than outturn CPI inflation. It illustrates this point using the following diagram.

Figure 5.1: Difference between quarterly OBR forecasts and actual CPI inflation



Source: National Highways analysis

[17] https://obr.uk/forecast-evaluation-reports/

5.2 Economic drivers of inflation

Mainstream economics recognises a number of drivers of inflation. These include:

1. A rise in the money supply;
2. A rise in real costs (e.g. from a rise in energy prices associated with energy becoming scarcer as a result of a war; or a rise in equilibrium real wages if, for example, the bargaining power of labour increased because union power became greater);
3. A rise in the velocity of circulation of money (e.g. if financial conditions or the financial architecture of the economy changed such that any given volume of money circulated more rapidly).

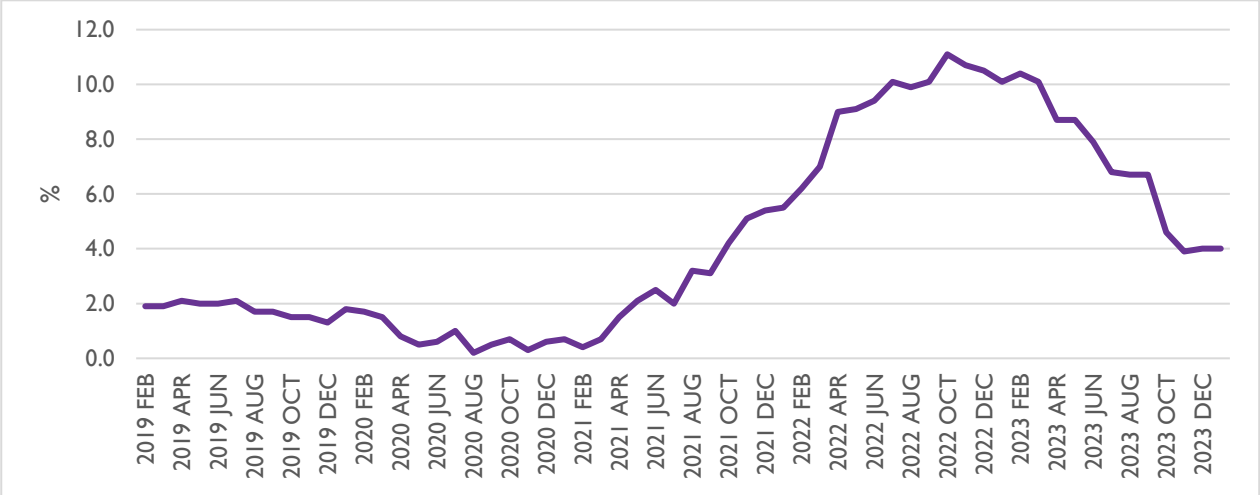
It is well-known that the relationship between any given metric for the money supply and inflation is complex, subject to long and variable lags,[18] and has a tendency towards endogenous change (in other words, any attempt to control any given measure of the money supply tends to lead to economic agents changing their behaviour in response, such that the relationship between that measure and inflation changes[19]). Indeed, when inflation changes and money supply changes are relatively small (e.g. of the order of tenths of a per cent per year deviation from target) there is no clear statistical relationship between deviations in money supply from trend and inflation at all.

However, when money supply changes are large, there is an inevitable inflationary consequence. And when inflation is high (e.g. 10 per cent) there is almost universally a monetary cause. Barring extreme events such as a domestic earthquake or a civil war, only changes in the money supply occur at a scale large enough, in a short enough timeframe, to induce inflation of that magnitude.

5.3 The inflation of 2022-2023

In 2022 there was an episode of high inflation in the UK. On the ONS' preferred metric, CPIH, annual inflation reached 9.6 per cent in October 2022. The Bank of England's policy target, CPI, reached an annual rate of 11.1 per cent than same month.

Figure 5.2: CPI inflation, past five years (%)



Inflation reached that level as a result of two of our key drivers: there was a large rise in the money supply; and there was a large rise in real costs as a result of an energy price shock. Each factor on its own would

[18] Milton Friedman famously told the US Congress that monetary policies "operate with a long lag and with a lag that varies widely from time to time."

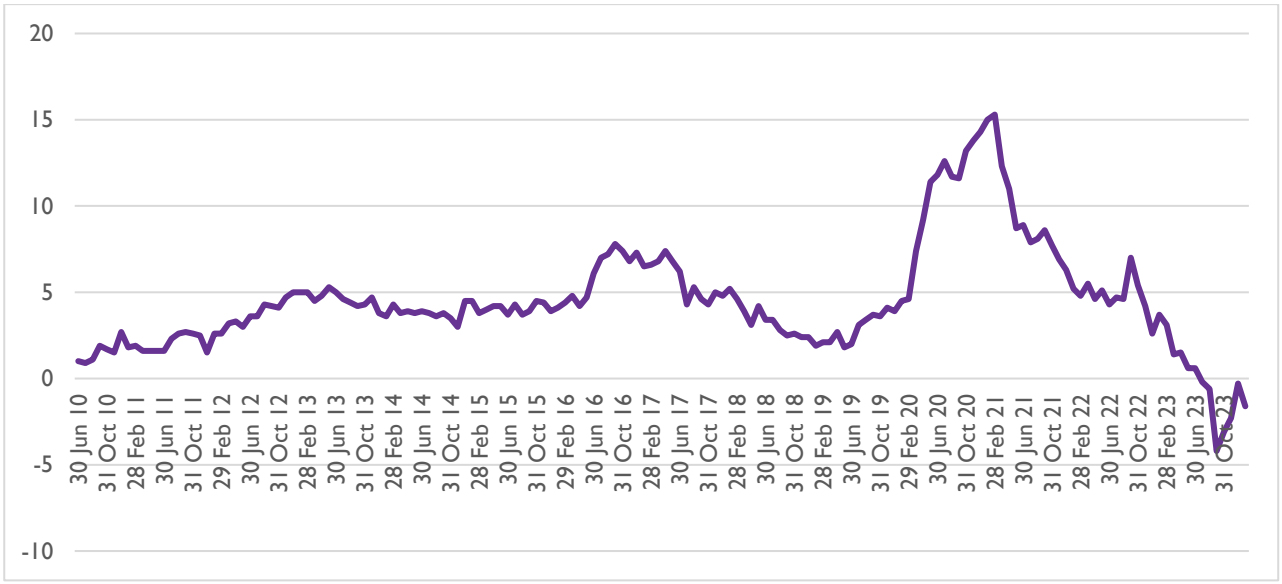
[19] This is known as "Goodhart's Law".

have been likely to take inflation well above the Bank of England's 2 per cent target. In combination they took CPI inflation into double figures for seven consecutive months.

Specifically, there were very rapid rises in energy prices and in particular of gas prices, triggered by the Russian invasion of Ukraine and the events that followed. UK natural gas futures rose from £41.25/thm on 1 March 2021 to a peak of £640.36/thm on 22 August 2022.[20] This fed through not only to household energy bills (directly raising inflation) but also to costs for firms (indirectly raising prices, especially of food, for which inflation peaked at over 19 per cent in March 2023). There were also a number of other supply chain disruptions at the end of the Covid pandemic period, as the process of aggregate supply and trade returning to closer to their pre-pandemic peak was not entirely smooth.

The other major factor in the inflation of 2022 and 2023 was the very rapid money supply growth that occurred during the Covid pandemic. We can see that illustrated in the following chart, which shows the rapid money supply growth that occurred in the period eighteen months or so before the period of inflation (around 18 months is a fairly typical lag).

Figure 5.3: Broad money (M4ex) annual rate of growth (%), 2010 to 2024



Source: Bank of England

Whereas for most of the period from 2012 onwards, annual broad money growth was maintained at or around a long-term trend of about 5 per cent, during the Covid pandemic broad money growth reached a peak of above 15 per cent in February 2021.

It is arguable that, even if it was not necessarily a mistake to have raised broad money growth so rapidly during the pandemic, the Bank of England should have anticipated, earlier in the post-pandemic period, that the result would be inflation and should have raised rates earlier in response (as happened, for example, in the United States). Former Bank of England Governor Mervyn King has articulated this position repeatedly in challenges to the current Governor Andrew Bailey during hearings of the House of Lords Economic Affairs Committee.

Be that as it may, the reality is that the Bank did not anticipate that inflation would rise as rapidly as it did. But it should be clear from our discussion above that that is not because of any intrinsic tendency in the UK forecasting community to under-estimate inflation from which a lesson might be drawn that inflation is likely to exceed current official forecasts in the future. Indeed, if anything the lesson is the opposite.

[20] Source: https://tradingeconomics.com/commodity/uk-natural-gas

The Bank and other agencies such as the OBR failed to anticipate how rapidly inflation would rise initially because they failed to anticipate that aggregate demand would recover more rapidly than aggregate supply at the end of the Covid pandemic, because they failed to anticipate the Russian invasion of Ukraine and, even after it had occurred, failed to anticipate quite how rapidly energy prices would rise, and, most importantly, because they failed to anticipate the implications of the very rapid monetary growth that occurred during the Covid period.

There is no good basis, at present, to anticipate that supply cost risks lie to the upside relative to official forecasts. It is not inconceivable that events in the Middle East could escalate into a wider conflict, but the risks of that happening and the implications for energy prices are already embodied in official inflation forecasts. More significantly, there is no currently-ongoing episode of rapid monetary growth that will only issue in inflation with a lag that policymakers might currently be failing to appreciate the significance of as they did in late 2021 and through 2022. Indeed, as we can see from Figure 5.3 the situation is currently precisely the opposite. We have recently been in a period of rapid (indeed, on some measures unprecedented since at least the 1940s) monetary contraction. Insofar as the lesson of 2021-2023 was that the Bank and OBR fail to anticipate properly the lagged implications of contemporary monetary growth, the conclusion from current events would be that inflation risks are more likely to lie to the downside than the up.

There is by no means a consensus, amongst those critical of current policy stances and current official inflation forecasts, that they are too low. For example, on 19 March 2024 Citi economists were quoted saying that interest rates are currently at least two percentage points too high and that the Bank of England will make a "screeching reversal" when it becomes clear rates have been kept too high for too long.[21] At the most recent Monetary Policy Committee meeting one MPC member, Swati Dhingra, voted for a cut. The Bank's inflation forecasts when it last raised rates (August 2023) were for inflation to be around 5 per cent during 2023 as a whole. The actual figure was 4 per cent. As recently as November 2023 the Bank forecast inflation would reach 2 per cent by the end of 2025. It is now widely expected to drop below 2 per cent in April 2024.

Thus, although it is true that official inflation forecasts tended to under-estimate future inflation during the period 2021 to 2023, that was not because of any systematic tendency for inflation to be under-forecast. If there is a lesson to be drawn it is that official forecasts tend to under-state the implications of ongoing large deviations of money supply growth from trend (though small deviations may well be irrelevant, at least if temporary). The correct application of that lesson to the current context would be that one should be concerned that inflation risks might lie to the downside, relative to official forecasts — and indeed under-shooting of such forecasts done in 2023 has been the recent experience and is expected to be the experience through much of 2024 and 2025.

We do not draw the conclusion that one should assume that inflation will systematically undershoot official forecasts and introduce some mechanism in anticipation of such undershooting. But we do draw the conclusion that there is no robust basis for assuming outturn inflation will systematically tend to overshoot official forecasts.

[21] https://www.telegraph.co.uk/business/2024/03/19/andrew-bailey-already-too-late-on-rate-cuts-citi-bank/