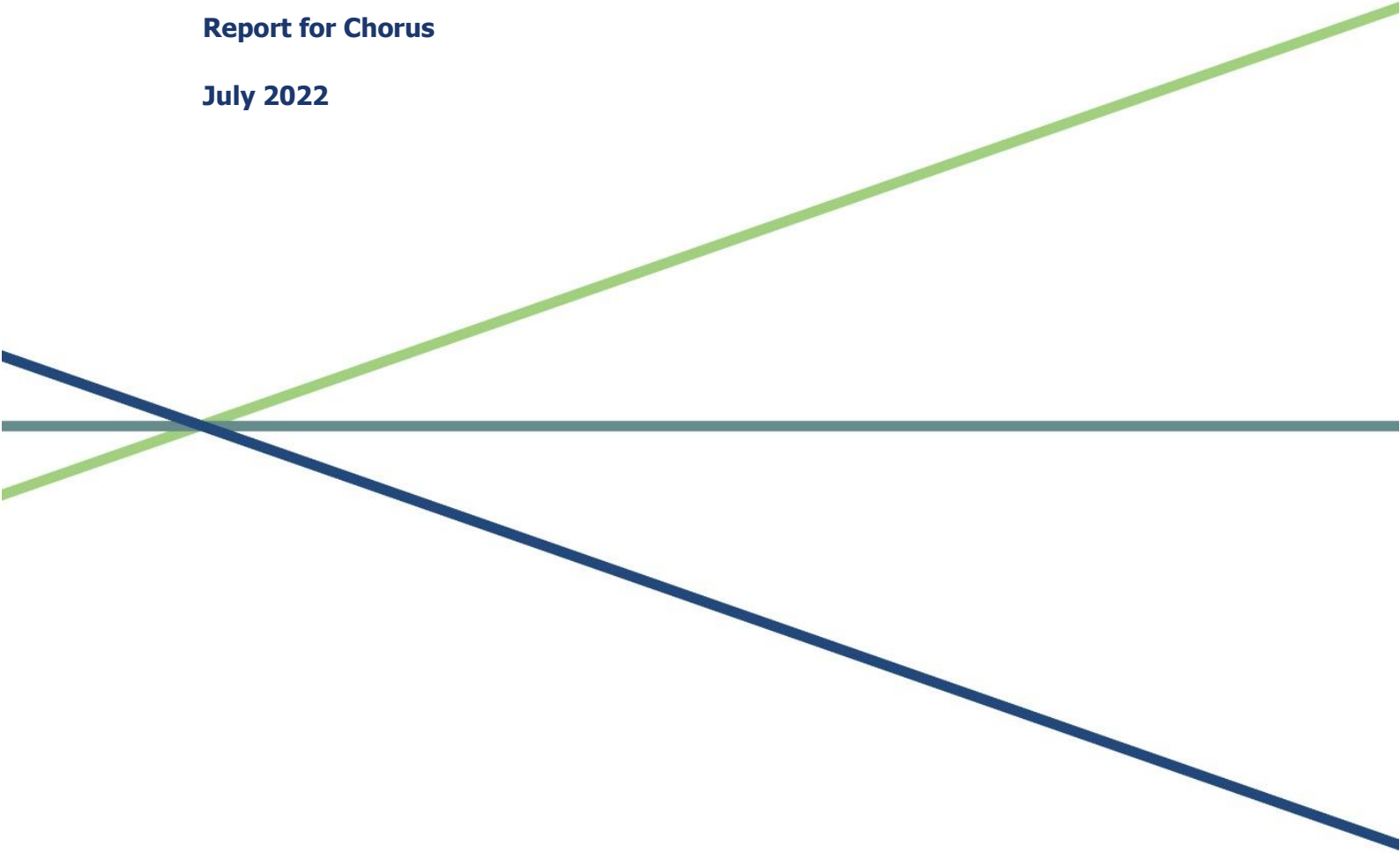


Options to address the gap in CPI inflation correction

Report for Chorus

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1. Introduction and summary

1.1 Purpose of this report

1. Under the Commerce Commission’s standard approach to setting and reviewing regulatory price controls, a correction is made for the difference between the forecasts of inflation that are applied when setting a control, and the subsequent actual outcome for inflation. Incenta Economic Consulting (“Incenta”, “us” or “we”) has been asked by Chorus to assess whether, under the correction that is to be applied in relation to Chorus:
 - a. there is a gap (in the sense of a missing time period) in the quarters of inflation that were forecast and for which a correction for the difference between forecast and actual inflation is to be made, and
 - b. if so, which options may be applied to correct this gap.
2. As this issue is of wider relevance, we have been asked to prepare this report for the Commission’s review of the Input Methodologies (IMs) for the firms that are regulated under Part 4 of the Commerce Act.¹

1.2 Summary of our findings

1.2.1 Is there an issue?

3. The regulatory price control² the Commission determined for Chorus can be considered a form of CPI-X regulation, which has an objective of (substantially) shielding regulated businesses from the effects of unanticipated inflation.³ The Commission has referred to this objective as “real” financial capital maintenance.
 - a. An objective of CPI-X regulation is to deliver a target real return on investment, irrespective of the actual level of inflation. As part of this, the exposure of asset owners to the risk of changes in the prices paid for inputs is also reduced, although the risk of real changes in input prices typically remains with regulated businesses.
 - b. Such an allocation of inflation risk is also typically seen as advancing customers’ interests, given that incomes tend to rise and fall with inflation, and with it, consumers’ capacities to pay.

¹ Whilst the regulatory regime applicable to Chorus is very similar to Part 4 of the Commerce Act (aside from in relation to certain, specific issues, such as the method for setting the initial regulatory asset base), the regime is given effect via a separate instrument (Part 6 of the Telecommunications Act) and Chorus’ current Input Methodologies – which were finalised in October and November 2020 – are not part of the current review.

² We use the term “regulatory price control” as a generic reference to any form of price control, including a price cap and revenue cap (Chorus currently is subject to a revenue cap).

³ The reference to “inflation” in this report is intended to mean increases in general output prices (as measured by the Consumer Price Index), except where other concepts of inflation are referenced expressly.

4. The revenue requirement the Commission calculated for Chorus – which followed the Commission’s standard practice – built in forecasts of inflation, and specifically:
 - a. an estimate of the nominal (inflation-inclusive) cost of capital was applied to calculate the (nominal) return on assets, which is assumed to embed the market’s forecast of inflation
 - b. the regulatory asset base was projected over the regulatory period, which included forecast revaluation gains, based on explicit forecasts of inflation
 - c. operating and capital expenditure were also forecast, building in a forecast of inflation as well as changes in these input prices relative to general inflation (i.e., real input price changes), and
 - d. a forecast of inflation was also applied when the setting the formal regulatory price control (which involved a smoothing of the revenue requirement over the period).
5. Under Chorus’s IMs and Price Quality Determination (PQD) for the first regulatory period, a correction will be made for the difference between these forecasts of inflation, and actual inflation, through two complementary steps.
 - a. *Period to period* – the regulatory asset base will be rolled-forward to the start of the next regulatory period (i.e., when prices are next reviewed) using actual inflation over the first regulatory period, rather than the forecasts that were used to determine regulatory price controls.
 - b. *Within-period* – a further adjustment will be made for the difference between forecast and actual inflation via a “wash-up” at the end of the regulatory period, to correct for the effect on the revenue cap during the regulatory period of the difference between inflation forecasts and actual inflation.⁴
6. We understand that the model for dealing with inflation – and the method of correction – that is applied to Chorus as described above is materially the same as for the (non-exempt) electricity distribution businesses and the gas transmission business.⁵

⁴ There is a further step for Chorus, namely that the revenue cap for the second and third years of the regulatory period will be adjusted to include an updated forecast of inflation for the year ahead. The “wash-up” then corrects for the difference between the updated forecast of inflation and actual inflation. However, this intermediate step only changes the mechanism through which an adjustment for inflation is made and the timing of that adjustment, rather than the extent of the adjustment in total that is made.

⁵ The intermediate step explained in footnote 4 does not appear to apply to the other sectors, although for the reasons noted in footnote 5 this is not material to the matters addressed in this report. This issue is also not relevant to sectors or firms regulated only under Information Disclosure as the IMs in those cases leave flexibility about how matters like inflation corrections are addressed.

7. Importantly, however, the Commission’s “within-period” correction for inflation is incomplete.⁶
 - a. The first year for which a correction for inflation is applied is for the difference between forecast and actual inflation between the first and second year of the new regulatory period. Given the measure of inflation that is applied when making this correction:⁷
 - i. The first quarter for which a full correction is made for the difference between forecast and actual inflation is the first quarter of the second year (Q1 year 2).
 - ii. Only a partial correction is made for the difference between forecast and actual inflation in Q2 year 1 to Q4 year 1, and there is no correction made for Q1 year 1 or for any quarter prior to this.
 - b. However, capital cost allowances will typically build in forecasts of inflation spanning 9 months prior to the start of the regulatory period, as well as forecasts during the first year.⁸ Similarly, expenditure allowances will typically build in forecasts of inflation spanning 6 to 9 months prior to the start of the regulatory period, as well as forecasts during the first year.⁹
 - c. Thus, there are between 15 and 18 months for which only a partial, or no, correction is made for the difference between forecast and actual inflation.
8. Whilst it may seem that the consequence of not adjusting for inflation during such a short period should be modest, the recent behaviour of inflation demonstrates that material shocks to inflation are possible, which can generate a very material effect on real FCM.
 - a. We calculate for a simple example that the shortfall generated by this gap in inflation correction if the recent behaviour in inflation was experienced again could amount to

⁶ The Commission also uses two different measures of inflation in its calculations: capital cost allowances are calculated based on the change in CPI over a year, and expenditure and revenue are forecast (and the wash-up is applied) based on the change in the average of the four CPI values from one year to the next. Whilst it may seem incorrect to use different measures of inflation – and, in particular, to forecast capital cost allowances on one basis and then to apply a wash-up in respect of all cost components including capital costs on a different basis – there is a close correspondence between the different measures of inflation and any error generated is very small. The relationship between the two measures is demonstrated via a simulation in Appendix B, section B.2.

⁷ The fact that Q2 year 2 is the first quarter for which a full correction is made is shown via a simulation, which is referenced in section 3.2 and set out in detail in Appendix B (section B.1).

⁸ The first year of Chorus’s regulatory period is (calendar year) 2022, and the inflation forecasts applied in relation to capital cost allowances were based on the RBNZ May 2021 forecasts, implying that the forecasts commenced with the June 2021 quarter.

⁹ Again, taking the example of Chorus, the inflation forecasts applied to calculate the expenditure allowances were based on the RBNZ August 2021 forecasts, implying that the forecasts commenced with the September 2021 quarter.

approximately 7 per cent of the aggregate revenue requirement over the regulatory period.¹⁰

- b. The existing wash up would amount to approximately 1 per cent of the aggregate revenue requirement, leaving a shortfall of approximately 6 per cent of the aggregate revenue requirement.
9. In our view, it would be inappropriate to assume that such an “error” in relation to one regulatory period will be cancelled out by the potential for future “errors” in the reverse direction, for two reasons.
- a. First, equal sized errors across regulatory periods would only cancel out if the size of the relevant business (and its RAB in particular) remains constant in real terms. For Chorus, this will not be the case given that part of its RAB (the financial loss asset) is being depreciated at a reasonably fast rate. We suspect that similar issues may exist in the gas sector.
 - b. Secondly, as shown in this simple simulation (but using the actual recent experience of inflation) the error in relation to any regulatory period could be sufficiently large that there is no reasonable prospect of this being offset by future errors in the reverse direction.
10. Moreover, making a full correction for inflation forecasts is not especially difficult, as we discuss next.

1.2.2 Potential solutions

11. It would be reasonably straightforward, in respect of regulatory periods that are yet to commence, to modify the current within-period correction so that a correction is made for the difference between forecast and actual inflation for all of the quarters for which inflation is required to be forecast. Two principal options exist.
- a. *Extend the wash-up for inflation* – the current inflation wash-up can be extended to correct for the effect on the first-year revenue requirement of the difference between forecast and actual inflation prior to, and during, the first year of the regulatory period.
 - i. As a practical matter, this would mean adjusting for the accumulated difference between forecast and actual inflation for the two years prior to the commencement of the regulatory period (i.e., between the “gap year” (year -1) and the first year of the regulatory period).¹¹

¹⁰ This example assumes that the first year of the firm’s regulatory period is 2022, that the RBNZ May 2021 forecasts were applied for all purposes, and that the RBNZ May 2022 forecasts turn out to be correct.

¹¹ It is noted that inflation would not have been forecast for all of the quarters in question (as some actual inflation values would have been applied); however, where actual inflation values were used originally, no adjustment would be generated.

- ii. The Commission would also need to apply the same source of underlying inflation forecasts when deriving capital cost allowances and forecasting expenditure (that is, for example, using the RBNZ May 2021 forecasts for all purposes). This is to ensure that there is a common “forecast” against which “actuals” can be compared and the correction made.
- b. *Create a new, comprehensive wash-up for inflation* – which would involve dispensing with the existing inflation wash-up with an alternative under which the revenue requirement model is re-run at the end of the regulatory period that applies (i) the same real return on assets as applied in the original determination, but (i) using actual inflation in place of the forecasts for both the forecasts of expenditure and the calculation of capital cost allowances.¹² The difference between the original and updated revenue requirement calculations would then be washed-up. Whilst such an adjustment may seem complex, where the Commission is already required to re-run the building block model to conduct other wash-up calculations (as is the case for Chorus), the incremental effort required would be small.

1.3 Structure of this report

12. The remainder of this report is structured as follows.
 - a. Chapter 2 sets out further background to the inflation linking of revenues / prices.
 - b. Chapter 3 then discusses the Commission’s standard approach for creating inflation protection, and makes the case that a material residual exposure to inflation-risk remains (the inflation correction gap).
 - c. Chapter 4 then discusses two options to address this gap in inflation correction.
 - d. Finally, the appendices expand on some of the more technical issues covered.

¹² The effect of this is that the annual nominal WACC would vary depending on the annual actual inflation.

2. Objectives of CPI-X revenue / price paths

2.1 Intent of CPI-X regulation

13. A key objective of CPI-X regulation is to ensure that a regulated business makes a target real return on capital (and receives a real return of capital), irrespective of how inflation evolves and, more importantly, how actual inflation differs to the forecasts. The Commission's term for this outcome is the preservation of real financial capital maintenance.
14. A secondary objective of CPI-X regulation is to reduce the extent to which a regulated business is subject to inflation risk over the prices it pays for inputs, and principally the inputs to operating expenses. In this case, however, the extent of this inflation protection will depend on the precise form of the CPI-X control, as well as other settings in the regime.
 - a. Under a simple CPI-X regime, a regulated business is protected from the CPI component of input price inflation, but is left exposed to changes in real input prices (or, alternatively, assumes for simplicity that input prices tend to move in line with CPI, for example, $CPI+Y\%$, where Y is reasonably stable).
 - b. For a number of inputs (such as wages), the assumption that input prices move approximately in line with CPI is most likely a reasonable one, although the assumption will not be true for all inputs, at least in the short term (that is, the real prices of inputs are likely to change). For this reason, the inflation protection in relation to new expenditures will be imperfect.
15. Moreover, there are well known imperfections in the measures of inflation, which also means that inflation protection will be imperfect. Thus, the objective of inflation protection should be seen as one of providing substantial protection from inflation, rather than perfect protection.
16. Importantly, however, whilst the discussion above is framed in terms of protecting *asset owners* from inflation risk, the transfer of risk is symmetrical, and this is a circumstance where implicitly allocating this risk to customers typically is also seen as beneficial to consumers. This is because incomes tend to be related to inflation, and so the capacity of customers to pay for utility services should be higher when inflation is higher, and lower when inflation is lower.

2.2 Mechanisms to provide inflation protection

17. Where the “building block” approach¹³ to determining regulatory price controls is applied, an important element of inflation protection is normally achieved by indexing

¹³ The “building block” approach refers to the approach of determining the total cost of providing a regulated activity principally with reference to the actual cost incurred (or forecast to be incurred) by a regulated business. Thus, a central element of the approach is the regulatory asset base, which reflects the aggregate value of past investments in the eyes of the regulator that remain unrecovered at any

(revaluing) the regulatory asset base (RAB) by actual inflation when the RAB is being updated (or rolled-forward) from one regulatory period to the next. Applying actual inflation in this process has the effect of correcting for any errors in the forecasts of inflation that were made for one regulatory period, when setting prices for the next regulatory period. As this aspect of inflation protection works from regulatory period to regulatory period it can be interpreted as providing protection from long-term inflation risk.

18. There are then two broad methods by which inflation protection is typically provided under CPI-X regimes during a regulatory period.
 - a. First, cost items – including the RAB and the capital cost allowances that flow from this – and so prices / revenues can be established in constant price (real) terms, and then converted to nominal terms (i.e., as required for pricing) on an ongoing basis depending on actual inflation.¹⁴
 - i. As a practical matter, applying actual inflation on a dynamic basis requires a lagged measure of inflation to be applied (for example, inflation for a calendar year may be proxied by the inflation measured over the year to the previous September quarter).
 - ii. Applying the lagged proxy for inflation will be unbiased over time, provided there are no “gaps” in the correction.¹⁵
 - b. Secondly, cost items and hence prices / revenues can be established in nominal terms for a regulatory period, building in explicit forecasts of inflation. A correction can then be made for the difference between forecast and actual inflation. This correction could be done during a regulatory period once the actual inflation measure is available, or at the end of the regulatory period, or via a mixture of both.
19. The first of these two approaches (i.e., applying a lagged proxy for actual inflation on an ongoing basis) was dominant in the early days of CPI-X regulation, including in the UK, and remains the basic approach in Australia. The second approach is now applied in the UK, and is the approach implemented in the IMs. The reason for the second approach now being preferred in the UK (and, in most cases, by the Commission) is because, whilst the “lagged inflation” convention is unbiased over time, it may create perverse incentives if there is a sufficiently large shock to inflation.¹⁶ We accept that the move

point in time. The Commission applies the building block approach for determining regulatory price controls, and for framing its activities under Information Disclosure, for all industries regulated under Part 4 of the Commerce Act and in relation to Chorus’s regulated fibre services.

¹⁴ An equivalent method is to establish prices or revenues in nominal terms using forecasts of inflation, and then to correct for the difference between actual and forecast inflation when setting prices for the year in advance, including the first year of the regulatory period, on an ongoing basis, applying a lagged measure of inflation (as discussed in paragraph 18.a.i).

¹⁵ I.e., a one-off shock to inflation in a particular quarter will flow through to prices / revenues, just with a lag.

¹⁶ We understand the Commission applies a lagged measure of inflation for the gas distributors; however, the specific challenges in that sector would reduce concerns about creating possible incentives for over-investment.

away from the use of a lagged index by the Commission, and preference instead to rely on an inflation “wash up”, is well-founded.

2.3 Correcting revenue for inflation is equivalent to correcting every cost item for inflation

20. In the discussion above, the “within period” correction for inflation was described as something that could be given effect through an adjustment to revenues or prices, and indeed this is the effect of the current correction for inflation applied by the Commission. Thus, implicit in this discussion is that, when an inflation correction is made to prices or revenue, this is equivalent to applying an inflation correction to all of the underlying cost items, including the capital cost allowances.¹⁷
21. In relation to operating expenses, it is self-evident that that applying the correct inflation correction to revenue will have the effect of adjusting the expenditure allowance. This is because there is a one-for-one relationship between the revenue allowance and the allowance for operating expenditure.
22. The implication that a correction to capital cost allowances may be made via an adjustment to revenue is also correct. The relationship between the revenue requirement, and capital cost items, is more complex, and so this equivalence is best established via a simple example. We set out this example in Appendix A.
23. An important part of the analysis presented in this appendix relates to how errors in inflation forecasts effect capital cost allowances. The components of the capital cost calculation that depend on a forecast of inflation – and so are incorrect if there is a difference between forecast and actual inflation – are as follows.¹⁸
 - a. First, the opening RAB for a regulatory period will build in forecasts of inflation from the year before the start of the regulatory period (the “gap year”).
 - b. Secondly, the return on assets and depreciation in each year of the regulatory period (including the first) are set in “revenue date” terms, which includes a forecast of inflation.
 - c. Thirdly, the revaluation gains over the regulatory period are based on a forecast of inflation, which in turn will flow into the “return on assets” and “depreciation” components from the second year of the regulatory period.

¹⁷ I.e., the return on assets and depreciation, net of the revaluation gain.

¹⁸ It is also noted that the nominal WACC that is required to deliver the target real WACC in a determination will also change with the level of actual inflation. However, this effect alone does not change the annual revenue requirement amounts because the higher nominal return on assets in the building block calculation is offset with a higher forecast revaluation gain (with this gain being an offset to the revenue requirement).

3. The standard treatment of inflation and “gap” in inflation correction

3.1 Commission’s method

24. Under the Commission’s standard calculations, the revenue requirement that is calculated for the regulatory period ahead is based upon forecasts of inflation, and specifically:
 - a. an estimate of the nominal (inflation-inclusive) cost of capital was applied to calculate the (nominal) return on assets, which is assumed to embed the market’s forecast of inflation
 - b. the regulatory asset base was projected over the regulatory period, which included forecast revaluation gains, based on explicit forecasts of inflation
 - c. operating and capital expenditure were also forecast, building in a forecast of inflation as well as changes in these input prices relative to general inflation (i.e., real input price changes), and
 - d. a forecast of inflation was also applied when the setting the formal regulatory price control (which involved a smoothing of the revenue requirement over the period).
25. A correction is then to be made for the difference between forecast and actual inflation, via two complementary steps.
 - a. *Period to period* – the regulatory asset base will be rolled-forward from one regulatory period to the next based upon actual inflation during the regulatory period in question, rather than the forecasts.
 - b. *Within-period* – during a regulatory period, an adjustment is to be made for the difference between forecast and actual inflation, which for Chorus is done in two steps:
 - i. Updating the forecast of inflation at the level of the revenue cap (i.e., the CPI component of the CPI-X price path applied to each year in the regulatory period after the first) when setting prices or revenues during the regulatory period,¹⁹ and
 - ii. Conducting a wash-up at the end of the regulatory period to correct for the difference between the updated inflation forecasts noted above, and the actual values.

¹⁹ Our understanding is that the updates of inflation forecasts are not applied for the EDBs, rather the ex post wash up corrects for the difference between actual inflation and the original forecast. However, this difference is not material to the issues addressed in this report – the annual inflation update that applies to Chorus alters only the mechanism through which the correction is achieved, and the timing of that correction, and does not change the total correction that results.

26. Importantly, however, the first year for which the corrections referred to in paragraph 25.b take place is for inflation between the first and second years of the regulatory period. There is no correction in relation to inflation forecasts between the “base year” (year -1) and the “gap year” (year 0),²⁰ or between the “gap year” and the first year of the regulatory period.
27. Furthermore, we also observe that the Commission applies two different measures of inflation in its adjustments.
- a. For capital cost allowances, the measure of forecast and actual inflation is based on inflation measured as the change in the Consumer Price Index over the course of a particular year, which we refer to here as the “year on year” inflation measure. In turn, two different measures are relevant.
 - i. For rolling-forward the RAB (and calculating revaluation gains), the Commission applies inflation measured as the change in the December quarter CPI from one year to the next (assuming the use of calendar years).²¹
 - ii. However, for capital cost allowances (i.e., the return on assets and depreciation, net of the revaluation gain), the Commission sets the allowance to be correct at a specific “revenue date”. The measure of inflation that is embedded in the capital cost allowances is the year of inflation between successive revenue dates.²²
 - b. For revenue and expenditure forecasts, the measure of forecast and actual inflation is based on the change in the average of the four CPI indices in one year compared to another year, which we refer to as the “year average” inflation measure. This measure of inflation is also applied in the inflation correction (i.e., the within-period reforecast of inflation, and ex post wash-up, are both based on a year-average measure of inflation).
28. However, we note here that these two measures of inflation are closely related, and the error is small from using one measure of inflation when deriving capital related costs (i.e., the year on year) and then making a correction for inflation based upon the year average measure.²³ Accordingly, we do not recommend that the Commission change from its preference to use both year on year and year average measures of inflation when determining regulatory price controls.

²⁰ The terms “base year” and the “gap year” are the Commission’s standard references to the two years before the commencement of a new regulatory period.

²¹ Similarly, revaluation gains for regulated businesses with a March ending regulatory year are based on the year to the March quarter, June year ending businesses use the year to the June quarter and September year ending businesses use the year to the September quarter.

²² This “year of inflation” represents comprises inflation over the part of the year between the revenue date and end of the previous year, and between the start and revenue date for the current year. We provide the formula for this in section B.2.

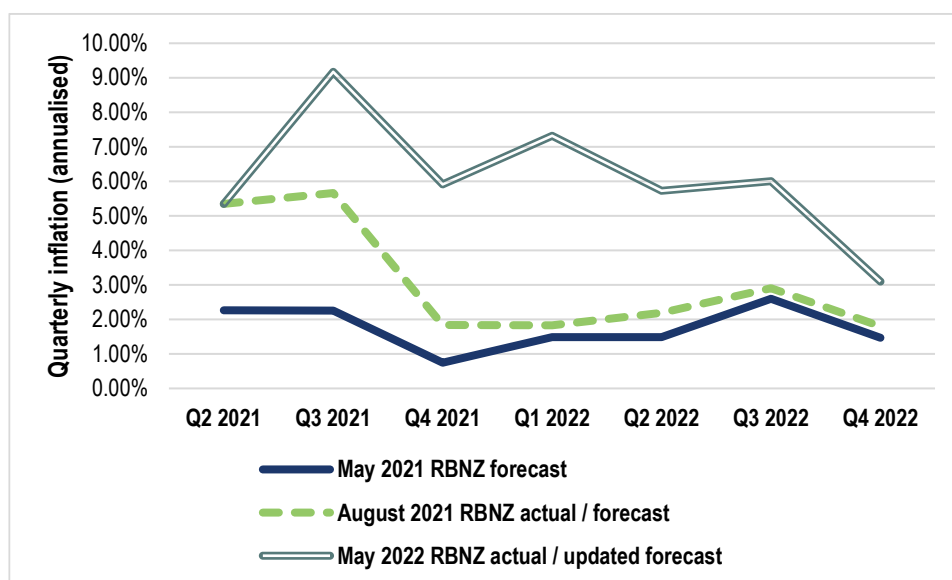
²³ This issue is also addressed in section B.2.

3.2 Source of the gap in inflation coverage

29. As noted above, the first year for which the Commission’s “within-period” correction for inflation applies is between the first and second years of the regulatory period. However, it is clear that there will be forecasts of inflation that are material to the calculation of the revenue requirement that predate the first year of the regulatory period. In particular:
 - a. The opening RAB for the new regulatory period will typically build in forecasts of inflation for 9 months period to the commencement of the regulatory period. An error in this opening value will flow through to all subsequent years.
 - b. In relation to forecasts of operating and capital expenditure, these values will typically build in forecasts of between 6 and 9 months of inflation period to the start of a regulatory period. Like the RAB, an error in the opening values for these items will flow through to successive years.
30. Moreover, the “within period” inflation correction that is applied under the Commission’s standard method does not fully correct for the difference between forecast and actual inflation in relation to all quarters of the first year of the regulatory period. Rather, the mechanics of the year average inflation measure that is applied when making the correction mean that the first quarter for which a full correction is made for the difference between forecast and actual inflation is the first quarter of the second year (Q1 year 2) of the regulatory period. In addition:
 - a. for Q1 year 1 and before, there is no correction for the difference between forecast and actual inflation, and
 - b. for Q2, Q3 and Q4 year 1, only a partial correction is made for the difference between forecast and actual inflation. The extent of correction that is made increases over the year, being approximately 25 per cent for Q2, 50 per cent for Q3 and 75 per cent for Q4 year 1.
31. The effect of the current inflation wash-up – and the existence of the gap in the correction as described above – is most easily established via a simulation, which we do in Appendix B (section B.1).
32. The result, therefore, is that – depending on which precise inflation forecasts were employed when calculating the revenue requirement – there would be four quarters for which there is no correction for inflation, and a further two or three quarters for which there is only a partial correction.
33. The figure below shows the potential divergence between the forecasts of inflation and the actual outcomes during these quarters where there is either no correction or a partial correction, for a firm whose regulatory period commenced with calendar year 2022. In this case, it is assumed that the Commission’s forecasts would be based on either the RBNZ May 2021 inflation forecasts, or the August 2021 inflation forecasts.

34. The figure also shows the most recent RBNZ forecasts (May 2022) as an indication of what the final difference between forecast and actual inflation may be (albeit noting that inflation over the final three quarters of 2022 remains a forecast).²⁴

Figure 1 – Forecast vs actual inflation during the gap in inflation correction



Note: quarterly rates of inflation have been converted to equivalent annual rates.

35. This recent behaviour in inflation shows the potential for substantial changes between forecasts of inflation, and actual outcomes, over even a short period.

3.3 Potential materiality of the gap in inflation correction

36. The question arises as to how material the gap in inflation correction could be, and so whether this warrants a change to how the Commission corrects for inflation.²⁵ This issue is addressed here via a simple simulation. In relation to inflation, it is assumed that:
- the forecasts of inflation applied for all purposes were the RBNZ May 2021 forecasts, and
 - the RBNZ May 2022 inflation forecasts are assumed to represent actual outcomes.
37. The remainder of the assumptions are stylised, but reflective of the approximate cost structure of utility services. The Commission's standard algorithms (including timing factors) have been applied, except that company taxation has been omitted for simplicity.

²⁴ The first observation shown for the August 2021 and May 2022 functions coincide because these values reflect actual inflation over the quarter in question.

²⁵ Whilst the timing of this calculation reflects the experience of Chorus (the first year of Chorus's first regulatory period is calendar year 2022), there are also material differences. In particular, Chorus's expenditure forecasts were based on the RBNZ August 2021 inflation forecasts (although May 2021 was used for capital cost allowances), and Chorus did not have a RAB that needed to be escalated for inflation to the start of the regulatory period (rather, Chorus's RAB was being set for the first time, and this was required to be set as at the start of the regulatory period using a specific method prescribed in the Telecommunications Act).

The objective of the calculation is to establish the difference between the revenue requirement that is calculated on the basis of forecast inflation, and the revenue requirement that is calculated using the (assumed) actual inflation.

- a. In relation to the expenditure forecasts, the “actual inflation” amounts are calculated by simply replacing the inflation forecasts with actual inflation (using the “year average” convention) (see rows 36 to 39).
 - b. In relation to capital cost allowances, the steps in the calculation are as follows:
 - i. a new nominal WACC is derived such that the implied real WACC from the determination is preserved, given actual inflation (rows 32, 33)
 - ii. the RAB is recalculated based on the revaluation gains that are consistent with actual inflation (rows 55 to 60), and
 - iii. the elements above flow through to the calculation of the capital cost allowances, and to a much lesser extent to the other cost allowances via the timing factors (rows 40 to 43, 71 to 73).²⁶
38. The main results are shown by comparing rows 68 and 76, which is dissected further in rows 78 to 83. This shows that, before considering the operation of the inflation wash-up, the recent pattern of inflation could create a shortfall against real financial capital maintenance equivalent to **7 per cent of the total revenue** over the regulatory period. Rows 85 to 90 then consider the operation of the existing inflation wash up, and show that it would still leave a substantial shortfall against the standard of real financial capital maintenance, of just over **6 per cent of the total revenue** over the regulatory period.
39. We conclude that the recent experience with inflation demonstrates that the gap in inflation correction has the potential to leave substantial inflation risk, and that options to remedy this should be explored. Moreover, it would be inappropriate to assume that such an “error” in relation to one regulatory period will be cancelled out by the potential for future “errors” in the reverse direction, for two reasons.
- a. First, equal sized errors across regulatory periods would only cancel out if the size of the relevant business (and its RAB in particular) remains constant in real terms. For Chorus, this will not be the case given that part of its RAB (the financial loss asset) is being depreciated at a reasonably fast rate. We suspect that similar issues may exist in the gas sector.
 - b. Secondly, as shown in this simple simulation (but using the actual recent experience of inflation) the error in relation to any regulatory period could be sufficiently large that there is no reasonable prospect of this being offset by future errors in the reverse direction.

²⁶ The change in capital cost allowances arises due to the RAB being higher (reflecting higher revaluation gains), and so flowing through to a higher return on assets line item and higher depreciation line item. Whilst a higher nominal WACC is used, the effect of this is cancelled out by the higher revaluation gain (i.e., with this latter item being an offset to the revenue requirement).

Figure 2 – Potential materiality of the gap in inflation correction

[1] Year		2020	2021	2022	2023	2024	2025	2026	
[2] Year of regulatory period		-1	0	1	2	3	4	5	
[3]	RBNZ forecast								
[4] Revaluation inflation - forecast	May 2021	-1	1.44%	2.17%	1.76%	2.18%	2.16%	2.12%	2.04%
[5] Revaluation inflation - actual	May 2022	5	1.44%	5.95%	5.53%	2.62%	2.06%	1.77%	1.94%
[6] Opex inflation - forecast	May 2021	-1	1.71%	2.18%	1.63%	2.06%	2.16%	2.15%	2.07%
[7] Opex inflation - actual	May 2022	5	1.71%	3.94%	6.42%	3.37%	2.28%	1.78%	1.89%
[8]									
[9] 1. Inputs and preliminary calculations									
[10] Input assumptions									
[11] Opening asset value		1,000,000							
[12] Depreciation rate		5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	
[13] WACC - nominal, forecast inflation			4.72%	4.72%	4.72%	4.72%	4.72%	4.72%	
[14] Opex forecast - real (\$2020)			55,000	55,000	55,000	55,000	55,000	55,000	
[15] Capex forecast - real (\$2020)		50,000	50,000	50,000	50,000	50,000	50,000	50,000	
[16] X factor after yr 1				0.00%	0.00%	0.00%	0.00%	0.00%	
[17] Days in year			365	365	366	366	365	365	
[18] Revenue - days from the end of the year			148	148	149	148	148	148	
[19] Opex / capex - days from the end of the year			182	182	183	182	182	182	
[20]									
[21] Implied inflation indices, different measures of inflation, different start years, forecast and actual inflation									
[22] Revaluation index - forecast inflation from year -1		1.000	1.022	1.040	1.062	1.085	1.108	1.131	
[23] Revaluation index - actual inflation from year -1		1.000	1.059	1.118	1.147	1.171	1.192	1.215	
[24] Revaluation index - forecast inflation from year 1				1.000	1.022	1.044	1.066	1.088	
[25] Revaluation index - actual inflation from year 1				1.000	1.026	1.047	1.066	1.086	
[26] Revenue / opex / capex index - forecast inflation from year -1		1.000	1.022	1.038	1.060	1.083	1.106	1.129	
[27] Revenue / opex / capex index - actual inflation from year -1		1.000	1.039	1.106	1.143	1.170	1.190	1.213	
[28] Revenue / opex / capex index - forecast inflation from year 1				1.000	1.021	1.043	1.065	1.087	
[29] Revenue / opex / capex index - actual inflation from year 1				1.000	1.034	1.057	1.076	1.096	
[30]									
[31] Preliminary calculations									
[32] WACC - implied real				2.91%	2.49%	2.51%	2.54%	2.63%	
[33] WACC - nominal, actual inflation				8.60%	5.17%	4.62%	4.35%	4.61%	
[34] Discount factor - forecast inflation		1.000	0.955	0.912	0.871	0.832	0.794	0.767	
[35] Discount factor - actual inflation		1.000	0.921	0.876	0.837	0.802	0.767	0.732	
[36] Opex forecast - nominal, forecast inflation			57,115	58,291	59,549	60,828	62,088	63,328	
[37] Opex forecast - nominal, actual inflation			60,837	62,887	64,323	65,471	66,705	68,028	
[38] Capex forecast - nominal, forecast inflation		51,092	51,923	52,991	54,135	55,298	56,444	57,644	
[39] Capex forecast - nominal, actual inflation		51,971	55,306	57,170	58,476	59,519	60,641	61,841	
[40] TF rev - forecast inflation WACC			1.019	1.019	1.019	1.019	1.019	1.019	
[41] TF rev - actual inflation WACC			1.034	1.021	1.019	1.017	1.018	1.018	
[42] TF expenses - forecast inflation WACC			1.023	1.023	1.023	1.023	1.023	1.023	
[43] TF expenses - actual inflation WACC			1.042	1.025	1.023	1.021	1.023	1.023	
[44] Revenue index after yr 1 - forecast inflation			1.000	1.021	1.043	1.065	1.087	1.109	
[45] Revenue index after yr 1 - actual inflation			1.000	1.034	1.057	1.076	1.096	1.116	
[46]									
[47] 2. Building block calculations									
[48] RAB - forecast inflation									
[49] Opening RAB		1,000,000	1,021,725	1,039,606	1,062,146	1,084,919	1,107,864	1,131,000	
[50] Capital expenditure		51,092	51,923	52,991	54,135	55,298	56,444	57,644	
[51] Depreciation		51,086	51,983	53,113	54,252	55,398	56,524	57,644	
[52] Revaluation		21,719	17,942	22,662	22,890	23,045	22,615	22,615	
[53] Closing RAB		1,021,725	1,039,606	1,062,146	1,084,919	1,107,864	1,130,400	1,153,000	
[54]									
[55] RAB - actual inflation									
[56] Opening RAB		1,000,000	1,058,486	1,116,434	1,145,552	1,169,142	1,189,838	1,212,885	
[57] Capital expenditure		51,971	55,306	57,170	58,476	59,519	60,641	61,841	
[58] Depreciation		52,975	55,849	57,283	58,456	59,490	60,644	61,841	
[59] Revaluation		59,490	58,490	29,231	23,571	20,668	23,050	23,050	
[60] Closing RAB		1,058,486	1,116,434	1,145,552	1,169,142	1,189,838	1,212,885	1,235,000	
[61]									
[62] Revenue requirement - forecast inflation									
[63] Return on assets			48,517	49,370	50,440	51,522	52,611	53,705	
[64] Depreciation			51,020	52,129	53,243	54,372	55,477	56,577	
[65] Revaluation offset			-17,609	-22,242	-22,464	-22,618	-22,196	-22,196	
[66] Opex			57,361	58,542	59,804	61,090	62,356	63,644	
[67] Revenue requirement - forecast inflation			139,290	137,799	141,023	144,366	148,247	152,129	
[68] Smoothed revenue requirement - forecast inflation			136,327	139,132	142,135	145,189	148,197	151,197	
[69]									
[70] Revenue requirement - actual inflation									
[71] Return on assets			90,278	57,970	53,272	51,296	55,249	59,546	
[72] Depreciation			54,012	56,124	57,391	58,471	59,546	60,641	
[73] Revaluation offset			-56,566	-28,640	-23,142	-20,313	-22,632	-22,632	
[74] Opex			61,306	63,183	64,594	65,731	66,986	68,241	
[75] Revenue requirement - actual inflation			149,029	148,638	152,116	155,185	159,147	163,129	
[76] Smoothed revenue requirement - actual inflation			145,238	150,133	153,562	156,301	159,247	162,197	
[77]									
[78] (Shortfall) / surplus - pre wash-up			Sum	% total					
[79] Δ Return on assets, net of revaluations			-11,440		-2,803	-2,202	-2,155	-2,078	-2,202
[80] Δ Depreciation			-19,303		-2,991	-3,995	-4,148	-4,099	-4,069
[81] Δ Opex			-22,647		-3,945	-4,641	-4,789	-4,641	-4,630
[82] (Shortfall) / surplus based on unsmoothed revenue requirement			-53,390	-7.0%	-9,739	-10,838	-11,093	-10,819	-10,900
[83] (Shortfall) / surplus, based on smoothed revenue requirement			-53,500	-7.0%	-8,911	-9,211	-9,422	-9,590	-9,771
[84]									
[85] Existing inflation wash-up - from year 1 → year 2 only			Sum	% total					
[86] Smoothed revenue requirement - forecast inflation			136,327	139,132	142,135	145,189	148,197	151,197	
[87] Inflation correction			0.00%	1.29%	1.41%	1.05%	0.86%	0.86%	
[88] Implied wash-up			6,595	0	1,789	2,005	1,522	1,279	
[89] Smoothed revenue requirement including wash up			136,327	140,921	144,140	146,711	149,477	152,197	
[90] Remaining (shortfall) / surplus after wash-up			-46,904	-6.1%	-8,911	-9,211	-9,422	-9,590	-9,771

4. Options to remedy the current gap in inflation correction

4.1 Introduction

40. In our view, with respect to regulatory periods that are yet to commence, it is straightforward to extend the correction for inflation to address the whole of the period for which inflation forecasts are required, with the main choice being a potential trade-off between administrative ease and accuracy. The two main options are:
- to extend the period of forecasts that are addressed via the existing inflation wash up to cover all quarters for which an inflation forecast is required, and
 - to dispense with the existing inflation wash-up and instead to implement a new, comprehensive wash up, where the revenue requirement model is simply re-run with actual inflation replacing the forecasts following the method we employed in Figure 2.
41. These are discussed in turn.

4.2 Option 1 – Extending the existing wash-up

42. This option would involve extending the existing wash up so that there is also an adjustment for the difference between the forecasts of inflation, and actual outcomes, in relation to revenue for the first year of the regulatory period. As a practical matter, the current wash-up would need to be extended to adjust the first-year revenue requirement for the accumulated difference between forecast and actual inflation for the two years prior to the commencement of the regulatory period.²⁷
43. The effect of extending the inflation wash-up for a further two years in the stylised example set out in Figure 2 is shown below. This shows that, given the assumptions of this stylised example, the effect of extending the inflation wash up by a further two years would apply a correction that is very close to the “perfect” amount (i.e., this correction leaves an error that is immaterial).

Figure 3 – Effect of extending the wash up in Figure 2 by a further two years

[1] Year		2020	2021	2022	2023	2024	2025	2026
[2] Year of regulatory period		-1	0	1	2	3	4	5
[91] Extending the standard inflation wash-up back a further 2 years	Sum							
[92] Smoothed revenue requirement - forecast inflation				136,327	139,132	142,135	145,189	148,197
[93] Inflation correction				6.52%	7.89%	8.02%	7.63%	7.44%
[94] Implied wash-up	53,351			8,883	10,971	11,396	11,082	11,019
[95] Smoothed revenue requirement including wash up				145,210	150,103	153,532	156,270	159,216
[96] Remaining (shortfall) / surplus after wash-up	-149	0.0%		-28	-29	-30	-30	-31

44. If this option were to be applied, however, then the Commission would also need to ensure that its forecasts for both capital cost allowances and operating expenditure

²⁷ Whilst the calculation would require adjusting for the difference between forecast and actual inflation for a further two years, an adjustment would only be generated for the quarters for which inflation had been forecast. Where the relevant forecast had already applied actual inflation, there would be no adjustment generated.

allowances were based on the same source of inflation forecasts. That is, while a “year on year” measure could be applied for capital cost allowances, and a “year average” measure for other purposes (including the wash-up), both would need to work from the same set of RBNZ forecasts (assuming that the RBNZ forecasts continue to be used as they currently are). In the stylised example in Figure 2, we have assumed that the RBNZ May 2021 forecasts have been applied for all purposes, and so this condition was met.

45. We acknowledge here, however, that the stylised example assumes that all cost items move in proportion to inflation, which need not be the case. One cost of general application that does not necessarily move with inflation is taxation (this is discussed further in Appendix A). Accordingly, the accuracy of extending the wash up may need to be assessed in the context of specific applications.

4.3 Option 2 – Create a new, comprehensive wash-up for inflation

46. The principal alternative would be to dispense with the existing inflation wash-up and instead re-run the revenue requirement model at the end of the regulatory period based upon actual inflation,²⁸ and to use the difference between the original and new revenue requirement as the wash up amount. The method for re-running the revenue requirement could follow the method that we employed in Figure 2, whereby:
 - a. expenditure forecasts were recalculated to reflect the new forecasts of inflation, and
 - b. a new nominal WACC was derived to be consistent with the implied real WACC in the determination and the new forecast of inflation, and with the new inflation forecasts also flowing through to the RAB revaluations.
47. The main change that could be made against the stylised model would be to allow certain cost items not to vary one-for-one with inflation where this was more appropriate, which would result in any event from including the regulatory tax allowance in the calculations. Moreover, as this method of correcting for inflation would involve a direct calculation of revenue requirement differentials, any mismatch between the “year average” and “year on year” inflation measures would be avoided (although we think this error is very small).²⁹
48. Consequently, this method would provide for a more accurate correction for inflation; however, it would require a greater administrative effort, as the revenue requirement model would need to be re-run. Having said that, if the Commission is already required to re-run the revenue requirement model to give effect to other wash ups (as is the case for Chorus), then the incremental effort of also varying inflation should be small.

²⁸ Other potential options also exist. For example, the existing inflation wash up could be retained to correct for the difference between forecast and actual inflation from year 1 onwards, and a wash up could be performed to adjust for the effect of the difference between forecast and actual inflation on the revenue requirement for the first year of the regulatory period. Our calculations in relation to Figure 2 suggest that this option would leave only an immaterial amount of inflation risk.

²⁹ Different sources of inflation forecasts could also be applied if desired (i.e., in the context of Figure 2, the RBNZ May 2021 forecasts could be applied for some purposes, and the RBNZ August 2021 forecasts for other purposes).

A. Adjusting revenue is equivalent to adjusting capital costs

49. The purpose of this appendix is to demonstrate, via a simple model, that a correction for the difference between forecast and actual inflation in relation to capital cost allowances can be made via an adjustment to revenue or prices. This model is set out in Figure 4.
50. The assumptions in the model are set out in rows 2 to 6, and the remaining rows show the capital cost components of the revenue requirement calculated first on the basis of forecast inflation, and then calculated on the basis of actual inflation. Both of these calculations apply the standard timing-factor adjustments, but ignore taxation for simplicity. A five-year regulatory period has been assumed, and a material inflation shock has been assumed in two of the years (years 2 and 4, see rows 4 and 5).
51. The effects of changing the revenue requirement between using forecast inflation to using actual inflation are as follows.
- First, the nominal WACC changes to preserve the implied real WACC that was set in the determination, given the rate of actual inflation (rows 6 and 8).
 - Secondly, the new nominal WACC then flows into the timing factors (rows 18 to 21) and the return on assets line items (compare rows 30 and 42).
 - Thirdly, the new inflation forecast changes the RAB revaluation gain (compare rows 26 and 32 to rows 38 and 44), which then changes the opening RAB for the subsequent years (compare rows 24 and 35), which flows in turn into depreciation (compare rows 25 and 31 to rows 37 and 43) and into the return on assets line items, discussed already above. The higher revaluation gain also flows directly into the revenue requirement (i.e., as a higher offset).³⁰
52. Comparing rows 33 and 45 shows that applying actual inflation in the calculation leads to a materially higher revenue requirement.
53. The main result is in row 47, which shows that, if you commence with the “forecast inflation” capital cost allowance, and then adjust this total allowance for the difference between forecast and actual inflation, precisely the same result is obtained as the “actual inflation” capital cost allowance.
- Importantly, the inflation adjustment that is required is for inflation over the year to the “revenue date” in each successive year. In this model, the revenue date is assumed to be 59 per cent of the way through a year (this is the effect of assuming that revenue is received 148 days prior to the end of the year).

³⁰ Note that, putting aside the effect of timing factors, the effect of applying the higher nominal WACC due to higher inflation is offset precisely by the resulting higher revaluation gain. The increase in the capital cost allowances stems from the higher inflation values generating a higher RAB over the period.

- b. This means that the inflation between successive “revenue dates” comprises 41 per cent of the prior regulatory year and 59 per cent of current regulatory year.

Figure 4 – Correcting capital cost allowances for inflation via a change to revenue

[1] Year	1	2	3	4	5
[2] Depreciation rate	7.80%	7.90%	8.10%	7.60%	9.00%
[3] Opening RAB	1,000.00				
[4] Inflation - forecast (to end of year)	2.00%	2.00%	2.00%	2.00%	2.00%
[5] Inflation - actual (to end of year)	2.00%	4.00%	2.00%	7.00%	2.00%
[6] Nominal WACC - as used in determination	5.06%	5.06%	5.06%	5.06%	5.06%
[7] Real WACC - implied by inflation forecasts	3.00%	3.00%	3.00%	3.00%	3.00%
[8] Nominal WACC - recalculated based on actual inflation	5.06%	7.12%	5.06%	10.21%	5.06%
[9] Inflation index - forecast (to end of year)	1.000	1.020	1.040	1.061	1.104
[10] Inflation index - actual (to end of year)	1.000	1.020	1.061	1.158	1.181
[11] Inflation index - forecast (between revenue dates)	1.000	1.020	1.040	1.061	1.104
[12] Inflation index - actual (between revenue dates)	1.000	1.020	1.052	1.082	1.136
[13]					
[14] Days in year	365	365	365	365	365
[15] Revenue days from the end	148	148	148	148	148
[16] Opex / capex / tax days from the end	182	182	183	182	182
[17]					
[18] TFRev - forecast inflation	1.020	1.020	1.020	1.020	1.020
[19] TFExp - forecast inflation	1.025	1.025	1.025	1.025	1.025
[20] TFRev - actual inflation	1.020	1.028	1.020	1.040	1.020
[21] TFExp - actual inflation	1.025	1.035	1.025	1.050	1.025
[22]					
[23] RAB - forecast inflation					
[24] Opening RAB	1,000.00	940.44	883.47	828.15	780.51
[25] Depreciation	79.56	75.78	72.99	64.20	71.65
[26] Revaluation gain	20.00	18.81	17.67	16.56	15.61
[27] Closing RAB	940.44	883.47	828.15	780.51	724.47
[28]					
[29] Revenue requirement - forecast inflation					
[30] Return on assets	49.60	46.64	43.82	41.07	38.71
[31] Depreciation	77.98	74.28	71.55	62.93	70.23
[32] Revaluation gain offset	-19.60	-18.44	-17.32	-16.23	-15.30
[33] Capital component of MAR - forecast inflation	107.98	102.49	98.04	87.76	93.64
[34]					
[35] RAB - actual inflation					
[36] Opening RAB	1,000.00	940.44	900.79	844.38	834.83
[37] Depreciation	79.56	77.27	74.42	68.67	76.64
[38] Revaluation gain	20.00	37.62	18.02	59.11	16.70
[39] Closing RAB	940.44	900.79	844.38	834.83	774.88
[40]					
[41] Revenue requirement - actual inflation					
[42] Return on assets	49.60	65.12	44.68	82.88	41.41
[43] Depreciation	77.98	75.14	72.95	66.01	75.12
[44] Revaluation gain offset	-19.60	-36.58	-17.66	-56.82	-16.37
[45] Capital component of MAR - actual inflation	107.98	103.68	99.97	92.07	100.16
[46]					
[47] Capital component of MAR - forecast inflation, with inflation correction	107.98	103.68	99.97	92.07	100.16

54. Two further comments are relevant.

55. First, it was noted that the correct inflation adjustment for the capital cost allowances is inflation measured over the year between successive revenue dates. In contrast, the adjustment the Commission currently makes (albeit with a gap) is based on the “year average” measure of inflation. However, it turns out that the error created by using this different measure of inflation to do the inflation correction is small (this issue is discussed at length in Appendix B, section B.2).

56. Secondly, an implicit assumption in the calculations above is that all cost components vary one-for-one with inflation. Whilst this assumption is correct for the RAB, return on assets and depreciation, it will not be correct for all costs, and the cost item that is of general relevance where this need not hold is taxation.
- a. This arises because the taxation system operates on a historical cost basis, so that nominal profits are taxed (rather than real profit), nominal interest is deductible (rather than only the real component) and the asset deductions permitted for tax purposes (i.e., tax depreciation) are not revalued for inflation.
 - b. Having said that, the effect of higher inflation on modelled taxation is indeterminate because interest deductions become more valuable with higher inflation (as the inflation component of interest is deductible), whereas tax depreciation allowances become less valuable (because asset values for tax purposes are not revalued, as noted earlier).
57. Thus, it becomes an empirical issue as to whether simply adjusting revenue for inflation provides a sufficiently accurate correction for the difference between forecast and actual inflation.

B. Operation of a “year average” correction for inflation

B.1 Effect of commencing the wash up with the second year of the regulatory period

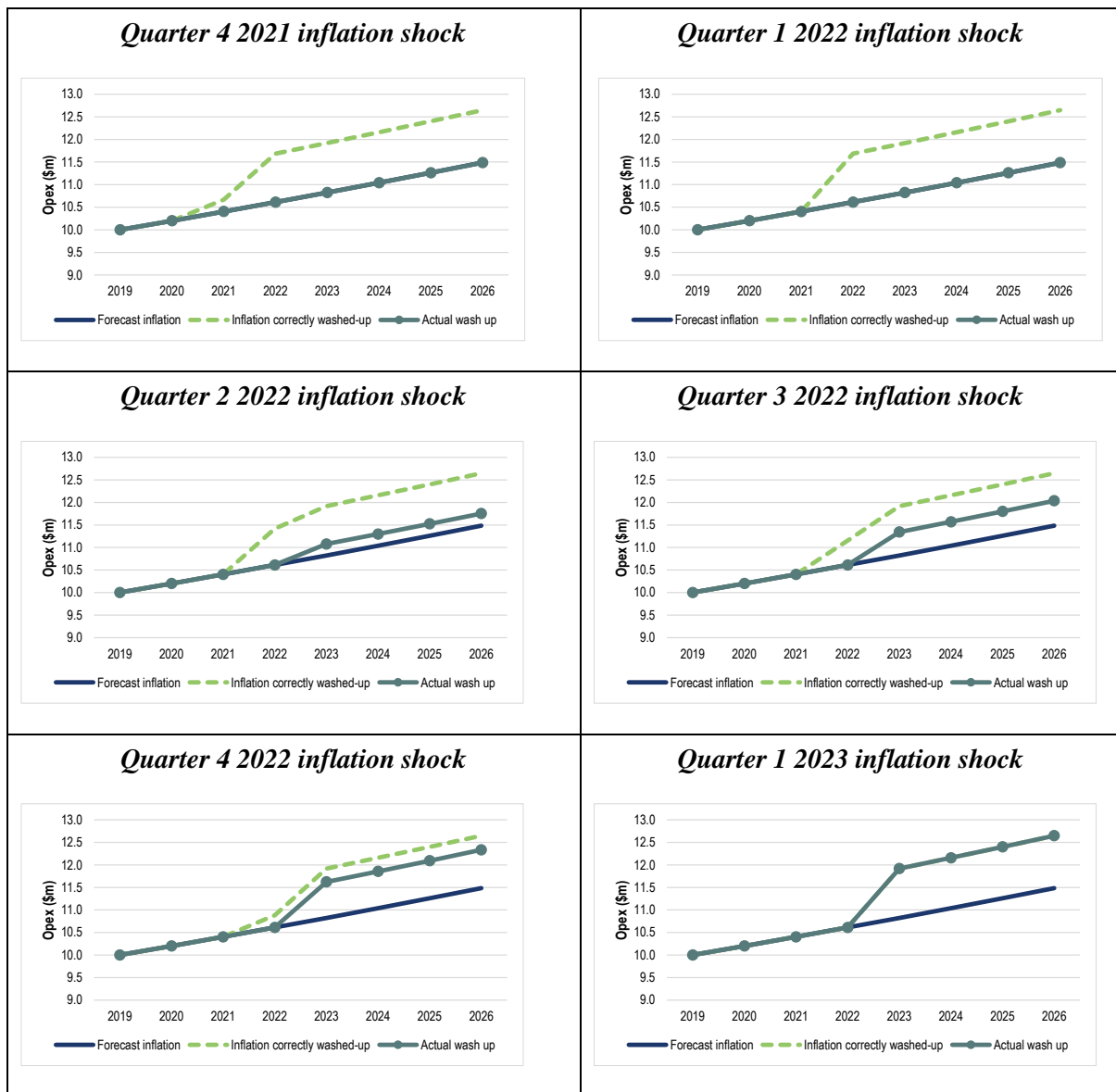
58. This Appendix assume that the regulatory period is a five-year period commencing with calendar year 2022.³¹
- a. It is assumed that the first year for which a correction for inflation is done (via the wash-up) is in respect of 2023, which will correct for the difference between forecast and actual inflation between 2022 and 2023.
 - b. It is also assumed – following the Commission’s standard model – that the correction will be based on the “year average” measure of inflation.
59. The objective is to establish the effectiveness of the current wash-up mechanism. In particular, the focus is upon whether, for all quarters for which a forecast of inflation was required, the appropriate correction would be made if an inflation shock occurred in any of these quarters.
60. The simplest means to test the effectiveness of the current wash-up mechanism is to conduct a simple simulation, the results of which I present in the figure below. In this simulation we assume the following:
- a. There is an allowance of \$10 million per annum – labelled here as an operating expense – that is assumed to be constant in real terms, and so increases with inflation (forecast and actual).
 - b. Inflation is forecast to be 2 per cent in annualised terms in all relevant quarters.³² The resulting nominal-dollar allowance for the cost item referenced above is indicated by the unbroken dark blue line.
 - c. Actual inflation is assumed to match the forecast in all quarters except one, where a rate of inflation of 50 per cent (in annualised terms) is assumed.³³ The quarter in which the shock is assumed is varied, commencing with Q4 2021 and ending with Q1 2023. The nominal value of the revenue or expense amount based on actual inflation is indicated by the broken green line.
 - d. The allowance for the cost item after the operation of the inflation wash-up is also shown. As noted above, the wash-up is assumed to operate for the first time to correct for the difference between forecast and actual inflation between 2022 and 2023, based on the “year average” measure of inflation. The post-wash-up allowance is shown in the teal-coloured line with circular markers.

³¹ This matches the experience of Chorus, except that Chorus has a 3 year regulatory period.

³² That is, forecast inflation for the quarter is: $(1 + 2\%)^{1/4} - 1 = 0.5\%$.

³³ That is, forecast inflation for the quarter is: $(1 + 50\%)^{1/4} - 1 = 10.7\%$.

Figure 5 – Effectiveness of the existing inflation wash-up



61. The following conclusions can be drawn from the above simulations.
- For all quarters up to and including Q1 2022, the existing wash up does not make any correction for the difference between forecast and actual inflation. This is indicated by the fact that the dark blue and teal lines coincide.
 - For Q2 2022 to Q4 2022 the wash up provides a partial correction for the difference between forecast and actual inflation. This is indicated by the fact that the teal line sits between the dark blue and green lines. In addition, the extent of correction increases throughout 2022, with approximately 25 per cent of a shock in Q2 corrected for, a 50 per cent correction for a shock in Q3 and a 75 per cent correction for a shock in Q4.

- c. The first quarter for which a full correction is made for the difference between forecast and actual inflation is Q2 2023. This is indicated by the fact that the teal line and green lines coincide. A correction is then made for the full difference between forecast and actual inflation for the remainder of the regulatory period.

B.2 Effectiveness of a “year average” inflation correction for capital cost allowances

62. As noted in the body of the report, the correction that is made for the difference between forecast and actual inflation is based on the “year average” measure of inflation, which is defined as the change in the average of all four CPI values from one year to the next. That is:

$$Inflation_{2022 \text{ to } 2023} = \frac{CPI_{Q1,2023} + CPI_{Q2,2023} + CPI_{Q3,2023} + CPI_{Q4,2023}}{CPI_{Q1,2022} + CPI_{Q2,2022} + CPI_{Q3,2022} + CPI_{Q4,2022}} - 1$$

63. In contrast, when correcting for the difference between forecast and actual inflation in relation to capital cost allowances, the correct measure of inflation is the rate of inflation between two successive “revenue dates”.³⁴ The equivalent measure of inflation between 2022 and 2023 is as follows:

$$Inflation_{2022 \text{ to } 2023} = \left(\frac{CPI_{Q4,2022}}{CPI_{Q4,2021}} \right)^{148/365} \left(\frac{CPI_{Q4,2023}}{CPI_{Q4,2022}} \right)^{217/365}$$

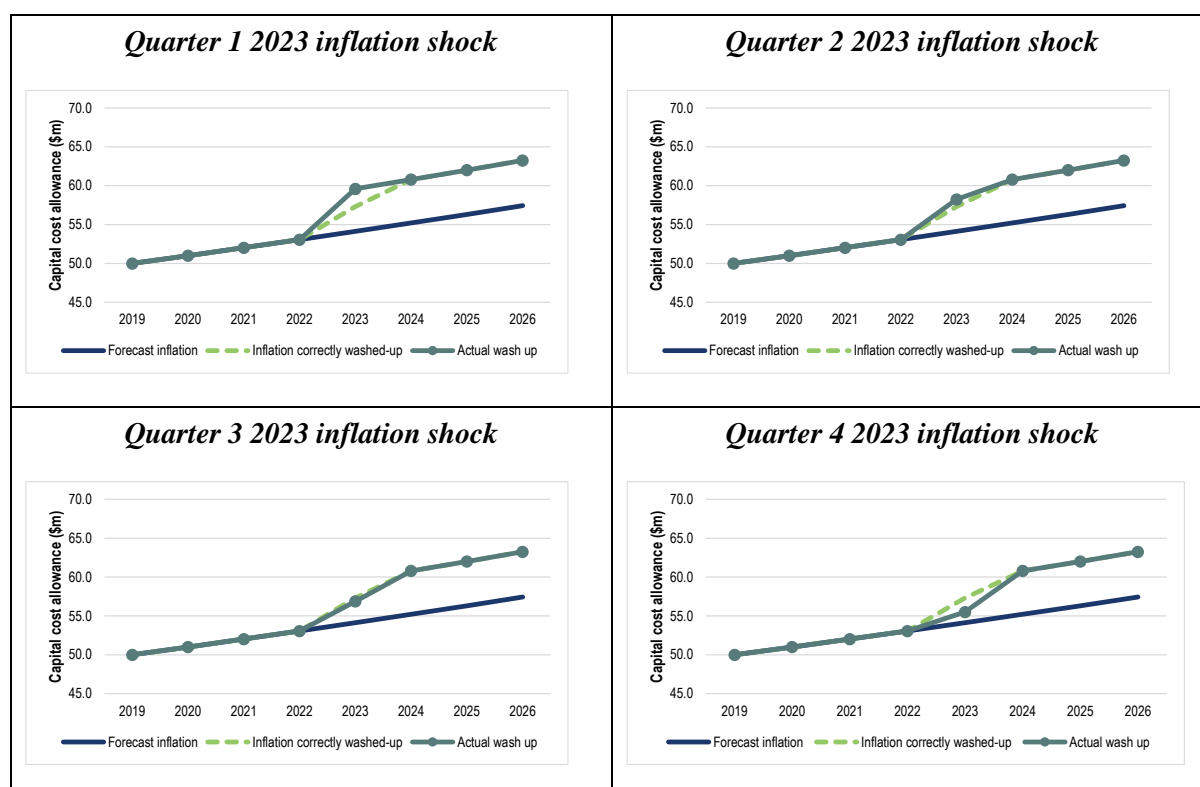
64. The important question, therefore, is whether applying a wash-up that is based on the year average measure of inflation is sufficiently close to the perfect wash up – namely one that reflects inflation between revenue dates – to be considered effective in relation to capital cost allowances. Again, this is a question that can be answered through a simple simulation.
65. The figure below shows the results of re-running the model described in section B.1, except that the cost item is the capital cost allowance (assumed to be \$50 million in real terms) that is assumed to vary with annual inflation between successive revenue dates. As such:
- The unbroken blue line shows the nominal dollar capital cost allowance, based on forecast inflation calculated using the “year to revenue date” measure of inflation
 - The broken green line shows what the nominal dollar capital cost allowance would be based on actual inflation, again calculated using the “year to revenue date” measure, and

³⁴ The “revenue date” is the day within the year that the regulated firm is assumed to receive its revenue, which then flows through to the calculation of the revenue requirement. For most (if not all) regulated businesses, the Commission assumes that revenue is received 148 days before the end of the year (which is consistent with a firm that invoices monthly in arrears and gets paid on the 20th day of the next month). This timing assumption is applied here.

- c. The teal line with circular markers shows the nominal dollar capital cost allowance after the inflation wash up, where the wash up is based on the “year average” measure of inflation.

66. The figures show the effects of an inflation shock in 2023 given that all quarters in this year are fully incorporated into the wash up.

Figure 6 – Effectiveness of the wash up for capital cost allowances



67. The observations that can be drawn from the above simulation are as follows.
- An inflation wash-up based on the “year average” measure of inflation provides the correct adjustment in all years after the year in which the inflation shock occurred. Thus, any error in the correction is short-lived.
 - In the year that the inflation shock occurs, whether the correction is too high or too low depends on the quarter in which the inflation shock occurs.
 - If an inflation shock occurs in the first or second quarters, the correction will be too high (indicated by the teal line with circular markers being above the broken green line), and the correction will be too low if the shock occurs in the third and fourth quarters.
 - However, these effects are small – even though a very large shock to inflation was modelled (10.7 per cent for the quarter, or 50 per cent in annualised terms), the maximum error in the capital cost allowance was small (a shock in quarter 1 results in an error of 4 per cent in the first year only).

68. Accordingly, we conclude that correcting capital cost allowances for inflation based on the “year average” measure of inflation is sufficiently close to the “perfect” correction to be considered appropriate.