Remaining life for the FLA asset

Report for Chorus

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1. Introduction and summary

1.1 Scope of report

1. You have asked for my advice on whether the Analysys Mason (AM) approach for calculating the weighted average remaining life of the financial loss asset:

   a. meets the requirements of clause 2.2.10(1)(d)(i) of the Input Methodologies, and if not

   b. meets the requirements of clause 2.2.10(1)(d)(ii) of the Input Methodologies.

1.2 Summary of advice

1.2.1 Overview

2. My principal conclusions are as follows.

   a. The AM method for calculating the weighted average remaining life is compliant with clause 2.2.10(1)(d)(i) of the Input Methodologies because its calculation delivers a weighted average remaining life with the IAV values used as weights, specifically the weighted harmonic average remaining life. The Input Methodologies do not prescribe the specific averaging method that is to be applied.

   b. This method for deriving the weighted average remaining life for the FLA should be the preferred method since it gives a depreciation profile closer to that of the underlying core fibre assets during RP1. I show this mathematically, and information that I have received from Chorus demonstrates this empirically.

3) The AM method is also consistent with s162(a) and (d) and 166(2)(b).

1.2.2 Compliance with clause 2.2.10(1)(d)(i)

3. In my view, the AM method for deriving the weighted average remaining life for the FLA is consistent with clause 2.10.1(d)(i) of the Input Methodologies.

   a. Whilst the AM method involved using (straight line) depreciation as the weighting factor in its weighted average remaining life calculation, it is straightforward to demonstrate that its calculation is mathematically equivalent to calculating the weighted harmonic average remaining life, with the IAV values applied as weights.

   b. As clause 2.10.1(d)(i) merely prescribes that a weighted average remaining life is to be calculated with the IAV values used as weights, but does not specify the specific form of the average (for example, that a weighted arithmetic average is to be applied), I conclude that the AM method is consistent with clause 2.10.1(d)(i) of the Input Methodologies.

1.2.3 Compliance with clause 2.2.10(1)(d)(ii)

4. More generally, if there was a question as to the formal compliance with the Input Methodologies, and so regard is required to clause 2.10.1(d)(ii), then the principal question should be which of the averages produces a stream of depreciation for the aggregated FLA that is the closest to what would have been produced if the FLA had been separated to match the underlying assets (in proportionate terms) and with the remaining lives of the individual IAV assets applied to the components of the FLA (that is, if there was no aggregation preformed and so no requirement to calculate a weighted average remaining life).

   a. It can be shown analytically that, if straight line depreciation is applied, the weighted harmonic average remaining life will produce a stream of depreciation that is identical to the depreciation that would be produced on the basis of the underlying assets, until the point where the short-lived assets commence reaching the ends of their economic lives.[1]

   b. Accordingly, for RP1, it would be expected that the harmonic mean would be superior on the accuracy criterion to the arithmetic average. From the information that I have reviewed from Chorus, this finding is supported by Chorus's actual position.

   c. In relation to RP2 and beyond, the position is less obvious on an *a priori* basis as shorter lived IAV assets will reach the ends of their lives. However, it would be open for the Commission to review this aspect of the Input Methodologies over the intervening period and implement any changes deemed appropriate. A simple change that would minimise the difference between the depreciation produced for the aggregated FLA and what would be calculated for the underlying assets would be to reset the remaining life for the FLA at a new calculation of the weighted harmonic average remaining life of the remaining IAV assets at the commencement of each regulatory period.

5. In addition, when considering the merits of the weighted average remaining life that AM calculated as part of an alternative depreciation method:

   a. As I noted in my previous report (and drawing upon analysis undertaken by NERA), the presence of a material value for the FLA presents an elevated risk of asset stranding for Chorus given that this asset would be unlikely to need to be replicated by a competitor to Chorus.[2] This suggests that selecting a remaining life for this asset that avoids under-depreciating the asset in any period would advance section 162(a), whilst not creating outcome that would be inconsistent with section 162(d).

   b. More generally, the conclusion of my earlier report (and again drawing upon analysis undertaken by NERA) was that Chorus was likely to face material uncompensated

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1 Using a simulation I have established that, if depreciation is calculated using the tilted annuity method, then the individual asset and grouped depreciation calculations are not identical if the weighted harmonic average is applied, but the difference is immaterial.

2 Incenta Economic Consulting (2021), Advancing the return of capital in relation to regulated fibre assets, May, para.58.

stranded asset risk,[3] and so any opportunity to advance the recovery of capital that did not compromise Chorus's near-term competitive position should be pursued as this would advance section 162(a) whilst not creating outcome that would be inconsistent with section 162(d), and so advance the purpose statement. In this context, if Chorus's proposal was adjusted to apply the longer life to the FLA (i.e., the weighted arithmetic average remaining life rather than the weighted harmonic average remaining life), then this would create an opportunity for the recovery of capital to be advanced, and which it would be appropriate to pursue as this would advance the purpose statement for the reasons provided earlier. The logical mechanism to recover this additional capital would be to apply the shorter remaining life for the FLA (i.e., the weighted harmonic average remaining life), as Chorus has proposed.

c. Thirdly, advancing the recovery of the FLA will not adversely affect the promotion of competition (which may be relevant under section 166(2)(b)) because, as noted above, this is not an asset that a competitor to Chorus would be likely to need to replicate.

[3] Incenta Economic Consulting (2021), Advancing the return of capital in relation to regulated fibre assets, May, para.58 set out the evidence that Chorus is subject to substantial stranded asset risk beyond what is compensated for through the 10 basis points per annum *ex ante* allowance.

2. Further elaboration

2.1 Harmonic vs. arithmetic means

6. Whilst Analysys Mason's actual calculation of the weighted average remaining life used depreciation as the weighting variable, it is straightforward to demonstrate that this is mathematically identical to the weighted harmonic average remaining life (WHARL), with IAV values used as weights.[4] The formula for the WHARL is as follows (*t* denotes year t and *i* denotes asset i, there are *I* assets):

$$WHARL_t = \frac{\sum_{i=1}^{I} IAV_t^i}{\sum_{i=1}^{I} \frac{IAV_t^i}{RL_t^i}}$$

7. The Commission appears to interpret clause 2.2.10(1)(d)(i) of the Input Methodologies as referring to the weighted arithmetic average remaining life (WAARL), whose formula is as follows:

$$WAARL_t = \frac{\sum_{i=1}^{I} RL_t^i . IAV_t^i}{\sum_{i=1}^{I} IAV_t^i}$$

8. I observe that these formulae show that both calculations produce an average remaining life, and that both use the IAV values as weights as required by clause 2.2.10(1)(d)(i). I note further that clause 2.2.10(1)(d)(i) does not mandate the application of a weighted arithmetic average over other valid weighted averages that use the required weights, such as the weighted harmonic average. Furthermore, the harmonic version of averages and weighted averages are widely used in finance purposes because, like in the current case of establishing the remaining life, they often provide the correct average.

9. I therefore conclude that the AM calculation is compliant with clause 2.2.10(1)(d)(i) of the Input Methodologies.

2.2 The harmonic average is the correct average

10. As I noted earlier, if there is to be a choice between the two methods for deriving the weighted average remaining life, then the principal criterion for judging between the methods should be the accuracy with which the depreciation for the "grouped" assets (with the weighted average remaining life applied) reflects the aggregate depreciation that would have been calculated for the individual assets and with the individual lives applied. In the case of the FLA, the individual assets in this case refer to the counterfactual where the FLA would be notionally divided into assets that match the composition (in proportionate terms) of the IAV, and with the lives of those individual assets applied to depreciate the resulting subsets of the IAV.

4 I demonstrate this in the Appendix.

11. Against this criterion, I find that the weighted harmonic average remaining life produces the correct depreciation value, until the shorter-lived assets reach the ends of their lives and so the composition of the group changes. I demonstrate this in the Appendix.

12. I further observe that the error that is created over time as shorter-lived assets reach the ends of their lives can be remedied by resetting the remaining life of the FLA at a new calculation of the weighted harmonic average remaining life of the underlying IAV assets at periodic intervals. I observe that this calculation is simple, and that Chorus will be required to keep separate information in relation to the IAV assets in any event in order to comply with clause 2.2.6 in any event.

A. Mathematical demonstrations referred to in the report

A.1 Definitions

13. The variables used in this appendix are defined as follows:

    a. IAV_t^i = regulatory value (written down) of asset *i* at the start of year *t*

    b. RL_t^i = remaining life of asset *i* at the start of year *t*

    c. R_t^i = rate of depreciation for asset *i* in year *t*

    d. D_t^i = depreciation of asset *i* in year *t*

14. Straight line depreciation is assumed. All variables are also assumed to be specified in constant price terms (that is, in terms of the general price level prevailing at a common point in time). It follows from the definitions and assumptions set out in the above paragraphs that:[5]

$$D_t^i = \frac{IAV_t^i}{RL_t^i} = IAV_t^i \cdot R_t^i, \text{ and}$$

$$R_t^i = {}^{1}/_{RL_t^i}$$

$$RL_{t+1}^i = RL_t^i - 1, \text{ and}$$

$$IAV_{t+1}^i = IAV_t^i - D_t^i = IAV_t^i(1 - R_t^i) = IAV_t^i\left(1 - {}^{1}/_{RL_t^i}\right)$$

A.2 Weighting by depreciation is equivalent to a weighted harmonic average

15. The weighted average remaining life that AM has calculated – using depreciation as weights – was as follows:

$$RL_t^* = \frac{\sum_{i=1}^{I} RL_t^i . D_t^i}{\sum_{i=1}^{I} D_t^i}$$

16. Substituting in the expression for D from above, yields:

[5] These definitions – and the associated formulae – all assume that the asset in question has at least 1 year of service life remaining. In practice, depreciation is the lesser of the value provided by the relevant formulae and the written down value of the asset at the start of the year in question, so that the written down value of the asset cannot be less than zero. The implications of assets becoming fully depreciated for the formulae that I derive are addressed separately below.

$$RL_t^* = \frac{\sum_{i=1}^{I} RL_t^i . \frac{IAV_t^i}{RL_t^i}}{\sum_{i=1}^{I} \frac{IAV_t^i}{RL_t^i}}$$

17. This simplifies to:

$$RL_t^* = \frac{\sum_{i=1}^{I} IAV_t^{i\,i}{}_t}{\sum_{i=1}^{I} \frac{IAV_t^i}{RL_t^i}}$$

18. This expression is the formula for the weighted harmonic average remaining life, with the IAV values used as weights.

A.3 The harmonic average is the correct average, until assets expire

19. It is assumed that a group of assets will be created (spanning assets *i* = 1 to *I*). The objective is to derive a remaining life value for the group of assets for year *t* (denoted RL_t^*) such that, when this life is to the aggregate value of assets in a class, generates the same depreciation value as the sum of the depreciation values that are calculated for each asset individually. That is:

$$\frac{1}{RL_t^*} \sum_{i=1}^{I} IAV_t^i = \sum_{i=1}^{I} \frac{IAV_t^i}{RL_t^i}$$

20. Starting with the right-hand side, if we substitute the depreciation rates for the individual assets, then this becomes:

$$\sum_{i=1}^{I} \frac{IAV_t^i}{RL_t^i} = \sum_{i=1}^{I} IAV_t^i \cdot R_t^i$$
$$= \sum_{i=1}^{I} IAV_t^i \cdot R_t^i \cdot \left(\frac{\sum_{i=1}^{I} IAV_t^i}{\sum_{i=1}^{I} IAV_t^i} \right)$$
$$= \frac{\sum_{i=1}^{I} IAV_t^i \cdot R_t^i}{\sum_{i=1}^{I} IAV_t^i} \cdot \sum_{i=1}^{I} IAV_t^i = R_t^* \cdot IAV_t^*$$

21. The result immediately above implies that the accurate depreciation value for year *t* for the group of *I* assets can be obtained by applying the weighted average depreciation rate for year t (denoted R_t^*) to the aggregate (written down) value of the assets at the start of year *t* (denoted IAV_t^*), with the individual asset values used as the weights to calculate the depreciation rate.

22. It follows from this that the accurate depreciation value for year *t* will be calculated if a remaining life for the group of assets is used that is calculated as the reciprocal of the weighted average depreciation rate set out above. This reciprocal of the weighted average

depreciation rate, however, is simply the weighted harmonic average remaining life (using IAV values as weights), as follows:

$$RL_t^* = 1/\frac{\sum_{i=1}^{I} IAV_t^i \cdot R_t^i}{\sum_{i=1}^{I} IAV_t^i} = \frac{\sum_{i=1}^{I} IAV_t^i}{\sum_{i=1}^{I} IAV_t^i \cdot R_t^i} = \frac{\sum_{i=1}^{I} IAV_t^i}{\sum_{i=1}^{I} {IAV_t^i}/{RL_t^i}}$$

23. In addition, subject to the caveat below, the remaining life for the group of assets calculated according to the weighted harmonic average (with IAV values used as weights) will reduce by "1" each year.

24. Starting with the expression above and projecting it one year forward implies that:

$$RL_{t+1}^* = \frac{\sum_{i=1}^{I} IAV_{t+1}^i}{\sum_{i=1}^{I} {IAV_{t+1}^i}/{RL_{t+1}^i}}$$

25. However, it is also the case that:

$$RL_{t+1}^i = RL_t^i - 1, \text{ and}$$

$$IAV_{t+1}^i = IAV_t^i \left(1 - {1}/{RL_t^i}\right)$$

26. Substituting these expressions into the formula above yields:

$$RL_{t+1}^* = \frac{\sum_{i=1}^{I} IAV_t^i \cdot \left(1 - \frac{1}{RL_t^i}\right)}{\sum_{i=1}^{I} IAV_t^i \cdot \left(1 - \frac{1}{RL_t^i}\right) \cdot \left(\frac{1}{RL_t^i - 1}\right)}$$

$$\therefore RL_{t+1}^* = \frac{\sum_{i=1}^{I} IAV_t^i}{\sum_{i=1}^{I} {IAV_t^i}/{RL_t^i}} - 1 = RL_t^* - 1$$

27. The caveat to this is that the expression above assumes that the remaining life for each individual asset in the group is at least 1 year and, in particular, that no asset has become fully depreciated. It is reasonably straightforward to show that the simple expression above will overstate the decline in the "accurate" remaining life of the group (and indeed that the accurate remaining life may increase rather than decline as individual assets expire) after the time that individual assets in the group would have become fully depreciated.