Report prepared for Vector Limited

Estimating the WACC percentile - comments on further evidence

Kieran Murray, Tony van Zijl

30 September 2014

sapere research group

About Sapere Research Group Limited

Sapere Research Group is one of the largest expert services firms in Australasia and a leader in provision of independent economic, forensic accounting and public policy services. Sapere provides independent expert testimony, strategic advisory services, data analytics and other advice to Australasia's private sector corporate clients, major law firms, government agencies, and regulatory bodies.

Wellington	**Auckland 1**	**Auckland 2**
Level 9, 1 Willeston St PO Box 587 Wellington 6140 Ph: +64 4 915 7590 Fax: +64 4 915 7596	Level 17, 3-5 Albert St PO Box 2475 Auckland 1140 Ph: +64 9 913 6240 Fax: +64 9 913 6241	Level 1, 441 Queen St PO Box 2475 Auckland 1140 Ph: +64 9 354 4388
Sydney	**Canberra**	**Melbourne**
Level 14, 68 Pitt St GPO Box 220 NSW 2001 Ph: +61 2 9234 0200 Fax: +61 2 9234 0201	Unit 3, 97 Northbourne Ave Turner ACT 2612 GPO Box 252 Canberra City, ACT 2601 Ph: +61 2 6267 2700 Fax: +61 2 6267 2710	Level 2, 65 Southbank Boulevard GPO Box 3179 Melbourne, VIC 3001 Ph: +61 3 9626 4333 Fax: +61 3 9626 4231

For information on this report please contact:

Name: Kieran Murray

Telephone: +64 4 915 7592

Mobile: +64 21 245 1061

Email: kmurray@srgexpert.com

Contents

Introduction

1. The Commerce Commission (Commission) has invited further submissions on specific topics related to its review of the weighted average cost of capital (WACC) percentile to be applied to electricity lines and gas pipeline services.[1] This report responds to the issues raised in:

- Professor Dobbs' report 'Proposed amendment to the WACC percentile for the allowed rate of return: Comments on the application of the Dobb [2011] model', 17 September 2014 (for ease of reference, hereafter referred to as the 'Dobbs Commentary')
- NZIER's report 'Valuing investments in network reliability: An approach to estimating the value of reliability in electricity networks subject to WACC IM, 9 September 2014 (for ease of reference, hereafter referred to as the 'NZIER 9 September report').

Dobbs report

Issues raised

2. The Commission asked Professor Dobbs to comment on the relevance and use of his model in assisting the Commission determine the WACC percentile. The Commission asked Professor Dobbs to comment specifically on Frontier's:

- interpretation and application of the Dobbs framework
- assumptions when re-calibrating the model to reflect New Zealand electricity lines services
- conclusions.

3. The Commission subsequently asked Professor Dobbs to comment on earlier work by Dr Lally and NZIER; these further comments were incorporated as additions to his report.[2]

4. Professor Dobbs comments on the following matters:

- Frontier's implementation of the Dobbs model
- the weight put on consumer surplus vis a vis profit in the welfare criterion
- the 'goodness of fit' of the model to the electricity and gas transmission and distribution sectors
- the treatment of willingness to pay when demand is assumed inelastic

[1] Commerce Commission, *Further work on cost of capital input methodologies: invitation for submissions on further evidence*, 19 September 2014.

[2] Dobbs Commentary, page 3.

- how much quantitative significance should be placed on the model's predictions.

5. We respond on each matter below.

Frontier's implementation

6. Professor Dobbs compliments Frontier on its implementation of his model, remarking that "the implementation (programming) is very well done indeed'. He notes that Frontier took considerable care to validate the model in terms of reproducing results from the original model. Professor Dobbs observes that the code appears to be producing the kinds of numbers one would expect, given the input parameter values being used.[3]

7. We agree that these compliments are well earned by Frontier. Frontier's careful work has produced an assessable version of the Dobbs model. In doing so, Frontier have removed an aspect of uncertainty from the evidence and analysis available to the Commission. Most expert reports submitted to the Commission, since it initiated further work on the cost of capital input methodologies, have referred to Professor Dobbs' 2011 paper[4] and made inferences as to the implications of this work for setting a regulatory WACC for electricity and gas network businesses.[5]

8. Frontier's work has confirmed what most experts surmised in their submissions; the Dobbs model, applied to the electricity and gas sectors, would support setting a WACC percentile significantly higher than the current 75th percentile; it would not support lowering the percentile as proposed by the Commission in its Draft Decision.

Weighting of consumer and producer surplus

9. Professor Dobbs observes that the results of his model are likely to be sensitive to the weightings of consumer and producer surplus.[6] This view is consistent with the advice of other experts, for example Professor Vogelsang earlier advised the Commission that the difference in outcomes between adopting a consumer welfare approach and a total welfare approach can be huge.[7]

10. Unfortunately, Professor Dobbs is unable to comment on whether either the weighting applied in the modeling reflects the weights the Commission would apply

---

3 Dobbs Commentary, paragraph 38.

4 Dobbs I. M., 2011, *Modelling welfare loss asymmetries that arise from uncertainty in the regulatory cost of finance*, Journal of Regulatory Economics, 39(1) 1 – 29.

5 We commented on the Dobbs analysis in our 5 May 2014 report, *Setting the WACC percentile for Vector's price-quality path*, section 5.1.

6 Dobbs Commentary, paragraph 3.

7 Vogelsang, *Review of New Zealand Commerce Commission 'Proposed amendment to the WACC percentile for electricity lines services and gas pipeline services",* July 31, 2014, paragraph 18.

to consumer and total welfare, as the weighting applied by the Commission in its Draft Decision is unknown.[8] Professor Dobbs observes that 'regulators typically weight consumer surplus more highly than profits', but does not comment on what weighting would reflect the Part 4 Purpose Statement. This is not intended as a criticism of Professor Dobbs as it would seem he was not asked by the Commission to consider the weighting in the model against the core test for an Input Methodology (IM) established by the Commission in its 2010 Reasons Paper; that is, he was not asked what weighting would promote outcomes consistent with outcomes produced in workably competitive markets such that the section 52A(1)(a) to (d) requirements are met.

11. Professor Dobbs did emphasize the "real problem with focusing purely on consumer surplus within this type of model"[9] as has been advocated by several submitters.[10] The problem with using a consumer surplus objective function, when modeling the WACC percentile, is that in the absence of new investment, "the optimal solution is to reduce the AROR to zero".[11]

12. Professor Dobbs' comments shows why Covec's argument that "it is inconceivable that any regulator seeking to estimate the WACC would accidentally end up at zero" misses the point.[12] As Professor Dobbs explains, the issue is not that a regulator would set WACC at zero, but that:

> *In terms of the model, moving from putting equal weight on consumer surplus and profits to a position in which there is increased weight on consumer surplus is effectively putting some weight on being able to exploit sunk assets.*[13]
>
> *To put it another way, if there were no new investment, and if significantly lower (or zero) weight is put on profit in the welfare index, the optimal AROR would be significantly below the median WACC.*[14]

13. The Commission has already found that exploiting sunk assets, by setting the WACC for those assets below a reasonable return, would not be consistent with the purpose statement.[15] It follows that the appropriate WACC percentile should not be modeled assuming a consumer surplus test as this would, as Professor Dobbs observes, place some weight on the regulator being able to exploit sunk assets.

---

8 See comments Kieran Murray, Tony van Zijl, *Proposed amendments to the WACC percentile – Commerce Commission's draft decision*, 29 August 2014, section 4.2.3.

9 Dobbs Commentary, paragraph 20.

10 See for example the reports by Covec on behalf of BARNZ.

11 Dobbs Commentary, paragraph 20.

12 Covec, *WACC percentile issues*, report prepared for BARNZ, 28 August 2014, page

13 Dobbs Commentary, paragraph 20.

14 Dobbs Commentary, footnote 7.

15 Commerce Commission (2010) *Input methodologies (electricity distribution and gas pipeline services): reasons paper.* (Reasons Paper) December 2010, paragraph H1.25.

The ‘goodness of fit’ of the model

14. Professor Dobbs notes that his model was originally constructed with the telecommunications sector in mind,[16] and asks whether the structure of the model fits well to the electricity and gas transmission and distribution sectors.[17] In this section we consider the main structural elements of the model.

Investment categories

15. The model assumes that there are three categories of services:[18]

- category one is ‘existing (legacy) services’
- category two is new services which will be launched in the coming regulatory review period or not at all
- category three services are those that might be launched in the coming regulatory period or deferred to a future regulatory period.

16. The model assumes the provider of these services is essentially a monopoly.[19] This assumption is one of the reasons investment can be deferred (category three) as the firm has control over investment timing – no other firm can ‘jump in’ and launch the new service should the provider defer the investment. This assumption - that services regulated under Part 4 can be modeled as being provided by a monopoly - would seem uncontroversial.

17. In constructing his original model, Professor Dobbs assumed that the bulk of investment would be category one, with some category three, whilst category two would probably not be important – since most investment was likely to be deferrable (category three) rather than now or never. Professor Dobbs included category two mainly because it was, analytically, the basis for developing the analysis for category three.[20]

18. We agree with Professor Dobbs that category two is likely to be less significant. The assumption that the bulk of investment would be undertaken in relation to existing services, with some category three (deferrable investment), and that category two would likely not be important seems to reasonably represent the investment pattern in electricity distribution networks. In Table 1 we show the investment undertaken by Vector in its electricity networks during the year ended March 2014 by category:[21]

---

16 Dobbs Commentary, paragraph 26.

17 Dobbs Commentary, paragraph 27.

18 Dobbs Commentary, paragraph 9.

19 Dobbs Commentary, paragraph

20 Dobbs Commentary, footnote 3, page 3.

21 This information is taken from schedule 6 of the Vector Information Disclosure, available at http://vector.co.nz/documents/101943/102878/Electricity+Information+Disclosure+2014+Schedules+1+-+10+%283%29.pdf/f56bb16b-bec8-4640-b923-42d5fa02a032

Table 1 Vector investment year ending March 2014

Capital expenditure category	% of investment
Customer connection capex	18.2%
System growth capex	26.6%
Asset replacement and renewal capex	33.5%
Relocations capex	12.3%
Reliability, safety and environment capex	3.5%
Non-network capex	5.9%

Source: Vector Ltd Information Disclosure 2014, schedule 6a.

19. The categories 'system growth', 'asset replacement', 'relocations' and 'reliability' comprise around 75% of investment. A substantial portion of this investment would relate to existing services and this is consistent with the Dobbs framework which assumes the bulk of the investment is in relation to existing services.

Deferrable investment

20. The original model assumes that category one investments are subject to a service obligation that must be maintained and increments in investment must be made in response to demand for that service over time. That is, the model does not allow for quantity rationing or degradation in reliability of the existing service.[22]

21. There are no service obligations for electricity or gas networks, in the sense Professor Dobbs uses the term (a legal requirement to invest to maintain a specified minimum level of service). However, there is a basic amount of investment that will be undertaken if WACC is underestimated. Legal requirements around safety and reputational effects, committed projects, as well as incentives for SAIDI and SAIFI under the price quality path, mean some investment would still proceed as if there were a service obligation.[23] Hence, the category one assumption does reflect an attribute of investment decision-making in relation to electricity and gas networks.

22. However, a greater portion of investment expenditure in electricity and gas networks is likely to be deferrable than would be the case if a service obligation applied. In a statement provided to the Commission in 2010, Mr Ryno Verster, now Acting

22 Dobbs Commentary, paragraph 11.

23 See Kieran Murray, Tony van Zijl, *Setting the WACC percentile for Vector's price quality path*, 5 May 2014, section 4.2.4.

Group General Manager Asset Investment for Vector Limited, explained the consequences of a 20% reduction in investment in network augmentation and a 25% reduction in network integrity expenditure, at a minimum, with scenarios for additional deferments (a further 20% to 25% of investment in network augmentation).[24] These scenarios clearly involved deferments of investment in existing services.

23. The assumption in the model that none of category one investments are deferred would likely mean that (this aspect of) the model underestimates the optimal WACC uplift for the electricity and gas sector. If investment in existing services were to be modeled as deferrable, then the model would calculate an additional uplift for the ongoing delivery of existing (category one) services.[25] However, this tendency to understate the WACC percentile may be mitigated by the extent to which investment assumed to be "'new investment' is really just strengthening reliability and capacity of an already existing services, rather than a launch of a new service."[26] This aspect of the model is discussed further below in relation to 'peak load pricing'.

Quantum of investment

24. Professor Dobbs assumed that investment in category three, in his base case, would equate to 10% of the entity's regulated asset base. This is a higher quantum of investment than is likely to occur on an annual basis for electricity and gas networks.

25. In calibrating the model for the electricity and gas sectors, Frontier assumed a lower quantum of investment. Frontier calculated that the annual investment by Transpower equates to about 5 per cent of its asset base, and assumed for its modeling that investment in category three would equate to about 1 per cent of Transpower's asset base (that is, about 20% of annual investment).[27]

26. Frontier's assumptions seem broadly applicable to electricity network businesses. For instance, Vector's 2014 Regulated Asset Base (RAB), is $2,618.9 million and value of assets commissioned in 2014 was $143 million, indicating that annual investment is about 5.5% of the asset base. As noted above, Vector has previously provided to the Commission scenarios in which 20% or more of planned investment could be deferred.

27. Hence, the structure of the model which assumes that some investment on existing services would continue but some investment would be deferred is a reasonable fit to electricity distribution services. The assumptions adopted by Frontier, that investment equates to about 5% of a network company's asset base and about 20%

24 Statement of Ryno Verster, Manager of Engineering: Asset Investment for Vector Limited, 2010, paragraph 1.18.

25 Dobbs Commentary, paragraph 11.

26 Dobbs Commentary, paragraph 16.

27 Frontier Economics, *Application of a loss function simulation model to New Zealand: A report prepared for Transpower*, August 2014, page 17.

of that investment could be deferred, reflect a reasonable approximation of sector decision-making.

Dobbs model is not a 'peak load pricing model'

28. Professor Dobbs emphasizes that his model is "not a peak load pricing model of the type often used in electricity supply in dealing with electricity demand and reliability".[28] As Professor Dobbs observes, the "model (and Frontier's use of it) supposes there is a simple demand for a 'product or service' (and this is true both for existing and new investment."[29]

29. This assumption of a 'simple demand' is a reasonable approximation of investment drivers for an electricity distribution network for the purposes of modeling the WACC percentile. This is because:

- non-coincident demand drives investment more than system coincident peak demand across networks over time[30]
- where an attribute of a service is necessarily common to a large group of customers, such as the quality of supply across a distribution network, the optimal investment at the margin should not be considered entirely separately from investment in existing assets – for example, a new connection may lower the average quality received by other users because of the additional congestion.[31]

30. The assumption by Frontier of a 'simple demand' seems to us a good fit with the characteristics of the sector and addresses Professor Dobbs' query as to whether 'cross-elasticity' may be a major issue in applying the model to the electricity and gas network sectors.[32] The conservative assumptions by Frontier in relation to 'new investment' (discussed below), and the tendency for the model to otherwise underestimate WACC by not applying an uplift to investments to maintain existing assets, suggests this is an area for refinement rather than of concern

31. The model structure does however suggest that estimates of price at which demand would cease to connect to the network may be preferable to estimates of the value of loss of load in modeling the demand curve. We discuss this point further below.

---

28 Dobbs Commentary, paragraph 11.

29 Dobbs Commentary, paragraph 11.

30 Vector Ltd, *Amendment to the WACC percentile cross-submission*, 29 August 2014, paragraph 29.

31 See the discussion in Kieran Murray, Tony van Zijl, *Proposed amendments to the WACC percentile – Commerce Commission's draft decision*, 29 August 2014 section 6.1

32 Dobbs Commentary, paragraph 16.

Treatment of willingness to pay when demand inelastic

32. The demand for electricity is generally regarded as being relatively inelastic, though less inelastic in the longer run as users can find substitutes and alter their consumption behavior over time. Frontier cite a survey of own-price elasticity of demand estimates by Fan and Hyndman (2011) and the use of that work by the Productivity Commission in adopting an elasticity range of -0.2 to -0.4 in the short term and -0.5 to -0.7 in the long term. Frontier adopt a base case of -0.3 and scenarios of -0.1 and -0.7.

33. We cited this same literature (Fran and Hyndman) in our 4 May 2014 report and adopted a range of -0.2 to -0.7.[33] We agree that the elasticity estimates adopted by Frontier properly reflect the available literature on the own-price elasticity of demand for electricity. If the demand curve is modeled with a choke price at which consumers would switch to substitutes (discussed in following paragraphs), we would adopt the long term elasticity estimates of -0.5 to -0.7.

34. One difficulty with modeling iso-elastic demand, as discussed by Professor Dobbs in his review, is that consumer surplus becomes unbounded. Frontier address this by truncating the demand function. Frontier consider a range of choke prices, and adopt $20,000 / MWh as the base case. The assumption is that after the choke price, demand is zero. A truncated demand function is reasonably common practice in modeling electricity markets – the same logic lies behind price caps imposed in some wholesale electricity markets.[34]

35. Professor Dobbs suggests that a long-run willingness to pay (that is, the cost of substitutes) may be a preferable basis for setting the choke price, rather than the short-run value of loss of load. We agree. The Electricity Authority utilizes a figure of $3,000 MWh (derived from the cost of peaking plant) when modeling electricity pricing in situations of wholesale market power (when a generator with uncontracted capacity must run to meet demand, which it refers to as net pivotal).[35]

36. The derivation of the price at which consumers would disconnect from the electricity networks is subject to debate. However, by adopting the Authority's estimate of the price at which consumers, with notice, would switch to alternative arrangements would ensure consistency of approach between modeling potential interventions in the wholesale market (which potentially impact on investments in

---

33 See Kieran Murray, Tony van Zijl, *Setting the WACC percentile for Vector's price quality path*, 5 May 2014, section 5.2.2.

34 The Australian wholesale market is subjected to a price cap of $12,900 / MWh, the Singapore market is subject to a cap of $5,000 / MWh, and ERCOT in Texas has a cap of $5,000 /MWH and will raise the cap to $9,000 / MWh in 2015.

35 See discussion by the Electricity Authority in its final undesirable trading situation decision, available at https://www.ea.govt.nz/code-and-compliance/uts/undesirable-trading-situations-decisions/uts-26-march-2011/final-undesirable-trading-situation-decision-and-proposed-actions/

substitutes to network investment) and modeling used in setting prices for network investments.[36]

37. Dr Lally and NZIER argue that linear demand may be a more reasonable assumption than iso-elastic demand. We disagree. The demand being modeled is for electricity and gas network services. As Professor Dobbs' personal example illustrates, individuals are likely to remain attached to the grid up until some cut off point when they disconnect from the network. An iso-demand function with a choke price best represents this feature of electricity and gas sectors.

38. Professor Dobbs also observes (and shows quantitatively) that a choice of a linear demand curve will alter, perhaps substantially, the total area under the demand curve. However, the model reports the difference between the areas at different WACC percentiles. Hence, adopting a linear demand curve is likely to have a much less dramatic effect on the calculated percentile than on the change to the area under the demand curve. In short, we would expect that a linear demand curve assumption would result in a lower WACC percentile than Frontier's choke point assumption, but the effect would be relatively modest.

How much quantitative significance should be placed on the model's predictions

39. Professor Dobbs raises a concern about the extent to which the model can be used as a quantitative guide as to the best choice of percentile to set for the allowed rate of return. That is, while the model articulates why a significant uplift is warranted, he expresses the view that it is unclear how much *quantitative* significance should be placed on the model predictions.

40. Professor Dobbs gives two sets of reasons for this caution:

- there are reasons for considering that the uplift should be greater (as there are sources of uncertainty explicitly ignored in the model) and reasons for why it should be smaller (because there are other ways of influencing investment decisions)
- there are questions of goodness of fit of the model to the electricity and gas network sectors.

41. All models are necessarily a representation of the real world. The parameters of the model could no doubt be refined with further analysis (as Frontier recognize). However, as discussed above, the model is a reasonably good fit to the characteristics of investment in the electricity and gas networks

42. The model is not sufficiently specified to prescribe precisely the percentile to be adopted by the Commission. The Commission will need to be satisfied that the percentile it sets is such that the WACC IM, in combination with the other IMs,

---

36 In arriving at its estimate of $3,000 / MWh, the Authority noted it was below the amount at which North Island demand had offered to curtail demand at short notice of $4,000 MWh, see final undesirable trading situation decision, ibid.

promotes outcomes consistent with outcomes produced in workably competitive markets such that the section 52A(1)(a) to (d) requirements are met. However, the modeling does provide strong support to raising the percentile and does not support lowering the percentile. In this regard the modeling is entirely consistent with:

- our own quantitative estimates prepared for Vector in our 5 May 2014 report
- the conceptual analysis provided by Professor Vogelsang, once it is recognized that investment at the margin is unlikely to be optimal from society's perspective
- the Oxera analysis once corrected for the probability estimates.[37]

NZIER report

43. In its 9 September 2014 report, NZIER present an analysis of system average interruption duration index (SAIDI) data and system average interruption frequency index (SAIFI) data. NZIER include this analysis, and slightly expanded conclusions, in its 12 September 2014 report.[38]

44. NZIER interpret its analysis as showing that residential consumers "place a very low value on outage" at 41 cents per minute of outage. NZIER suggest that this estimate shows that the loss values adopted for use in submissions are just not reflective of the real world New Zealand situation.[39] The comment 'loss values adopted for use in submissions' appears to refer to the $20,000 MWh value of lost load (VoLL) figure used by the Electricity Authority, which is mentioned in many expert submissions and used by Frontier in scenario one of its modeling.[40]

45. If we have understood NZIER correctly, then they appear to misread their own analysis as 41 cents per minute is not a "very low value". At 41 cents a minute, each household loses $24.6 per hour ($0.41 x 60 minutes). An average household in New Zealand uses about 8000 kWh per year, or on average, 0.9132kw per hour (8,000

37 Covec in its cross-submission attempt to revise the Oxera numbers to arrive at a lower WACC percentile; to achieve this result they need to make the incredible assumptions that for each additional dollar received by a lines company when WACC is set above the mid-point, the lines company invests an addition $1.23 (at the 75th percentile), that none of this unprofitable investment delivers any value to consumers, and that around 10% of current investment by lines business reflects these assumptions.

38 NZIER, *The WACC uplift question: A brief review of the balance between intuition and evidence supporting the WACC uplift*, 12 September 2014.

39 NZIER, 9 September 2014, section 2.5; 12 September 2014, paragraphs 54, 55.

40 The value of lost load (VoLL) is a measure of the economic value given to an amount of electricity that is prevented from being delivered to consumers (that is, 'unserved') as a result of a planned or unplanned outage of one or more components of the electricity supply chain. Currently, the VoLL is specified in clause 4 of schedule 12.2 of the Electricity Industry Participation Code (Code) as being $20,000/MWh.

divided by 8760 hours (24 x 365)). A cost of $24.6 for losing 0.9132 kw, therefore equates to $26.9382 for 1 kWh, or $26,938 MWh.[41]

46. At the other end of the consumption scale, NZIER also estimate a load weighted value of outage for the largest customers at over $200,000 MWh; a figure that is 10 times the highest value assumed by Frontier in its modeling.

47. In arriving at these estimates, NZIER appear to exclude from its analysis all 'planned outages'.[42] We accept that an 'unplanned outage' will in most circumstances result in higher costs than a planned outage, because with a planned outage individuals and firms can take steps to minimize the costs to them of the interruption. However, the costs of planned outages are not zero as NZIER seem to assume.

48. NZIER's method and the conclusions it draws from its analysis illustrate why specialist analysis of this nature should be undertaken by the specialist regulator, the Electricity Authority, rather than by the Commission in setting WACC. The estimate of value of lost load is used in managing the electricity system and its importance justifies careful analysis and review.

---

41 Weighting these calculations for the typical household consumption pattern would alter the figures. For instance, if households were assumed to use electricity for only 16 hours a day, the estimate would be $17,800 per MWh.

42 NZIER, 9 September 2014, section 2.1.1.