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Econometric cost models for PR19 consultation response
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13 March 2018

Dear Ynon,

Consultation on econometric cost models for PR19: proposed cost models

Thank you for the opportunity to recommend cost models to be considered for inclusion in the forthcoming econometric cost model consultation. We welcome Ofwat's ongoing engagement on cost assessment and your decision to formally consult in this area. Please find enclosed our proposed models in the Wholesale Water and Residential Retail price controls to be considered as part of the consultation.

Background

The wholesale water cost models presented in this submission have been developed by NERA for Bristol Water. The residential retail models have been developed by Economic Insight, as a joint project between Bristol Water and Wessex Water, reflecting our joint billing operation. Permission has been granted from respective parties for the inclusion of these models in the consultation and they have reviewed our submission. We have attached to this email a copy of the reports from NERA and Economic Insight, which set out their approach to developing econometric models in more detail.

The models included within this submission reflect the materials that we have presented to you previously. In September 2017, Economic Insight presented on key considerations to be included in the modelling of retail costs, to the Retail Cost Assessment subgroup meeting in London. In October 2017, representatives from NERA and Bristol Water met with Ofwat in Birmingham to discuss our approach to modelling wholesale water costs and share our interim findings. We will continue to offer our support where needed and we hope that this underlines our commitment to working constructively with Ofwat to support the development of robust cost models for use in PR19.

Approach to identifying wholesale cost models

We recognise and appreciate that the cost model assessment is an important component of the price review process. An important differentiator in our proposed cost models is the method by which we have selected our cost drivers using Monte Carlo analysis, providing a robust and traceable methodology. With this in mind we would like to recommend that you consider using a Monte Carlo tool to assist in the identification of cost drivers as part of your model development process for PR19. As you may recall from our discussion in October, the NERA wholesale models were developed using Monte Carlo analysis to identify suitable cost drivers and statistically robust models. We believe that this represents an important and innovative approach to modelling which has many advantages over the more traditional, and commonly practiced, general-to-specific approach to cost modelling. In particular, it removes the reliance on judgements to determine which variables to include and exclude from models and therefore represents a more balanced, industry level perspective of what good models could look like. By failing to embrace this approach, the final suite of models may rely on perceptions of what a good model and functional form looks like; we have seen from some of the debate in the model development phase of diametrically opposed views as to what model approach and variables are appropriate. Ultimately, modelling involves these judgements as an outcome, but we can avoid this *a priori* if the more objective and probabilistic Monte Carlo approach to cost driver identification and model development is adopted. We provide further information on this approach for your consideration as an appendix to this letter.

Approach to identifying retail cost models

We recognise for residential retail a smaller pool of relevant cost drivers exists, which has led to a focus on scale, scope and bad debt costs for efficiency analysis. The difference between single and dual service customers is an essential consideration. The work carried out for us by Economic Insight suggests that meter penetration also is a significant cost driver. However, there does not seem to be a significant link to regional wages. Although economic intuition suggests there ought to be a relationship between cost and quality, it is not surprising that the modelling does not demonstrate this for retail costs, as there is a significant cost of poor quality in retail services, including those driven from wholesale service failures. We note that PWC made similar observations in their report to Ofwat on debt management and other retail costs (September 2017).

Concluding observations

Our models cover the full range of water wholesale and retail top down and granular models. Our modelling suggests that top down approaches are likely to remain the most informative, particularly in wholesale water given the significant materiality of water resource and water network plus explanatory factors on water resource and water network plus costs. We have not suggested enhancement expenditure models; as you note, enhancement expenditure is company specific and we anticipate few examples of enhancement expenditure that cannot be modelled as part of botex, or in areas such as metering where unit costs are intuitively appropriate.

We think that your intention to undertake further post-consultation model development and to test the shortlisted models with companies' forthcoming wholesale cost and business plan data is a welcome approach to transparency. During this stage of model development, indicative information on cost adjustment claims will also be available and we believe this could provide a useful further source of information to cross-check the validity and appropriateness of the candidate models for PR19.

We look forward to the publication of the consultation on econometric cost models for PR19 at the end of March. In the meantime, please do not hesitate to let me know if you have any immediate questions or if we can be of further assistance. For transparency, we have published our submission on our website.

Yours sincerely,

Iain McGuffog
Director of Strategy and Regulation

Enc.: BRL – PR19 Cost Model Submission; BRL – Variance Charts Submission; BRL – NERA Wholesale Water Cost Model Report; BRL-WSX - Economic Insight Residential Retail Cost Model Report.

Appendix – The Monte Carlo approach to Cost Driver Identification

Executive Summary

Bristol Water has been working with NERA to develop candidate cost models consistent with the developing PR19 regulatory framework. As part of this work, NERA has developed a Monte Carlo analysis to assist in the identification of cost drivers. By adopting this approach NERA has both removed the possibility of bias informing the selection of cost drivers and the need for judgements to be spelled out regarding the decision to include and omit variables in the more traditional general-to-specific approach to modelling. The Monte Carlo approach therefore offers many merits and sets our wholesale cost models apart from those developed under a general-to-specific approach.

This note provides a recommendation for the inclusion of Monte Carlo analysis in Ofwat's model development process for PR19 and sets out the key methodological steps that NERA undertook.

Background

Identifying appropriate cost drivers to accurately capture the costs of a water company's operations is a critical step in the development of robust models. A method for model selection commonly used in econometric modelling is the general-to-specific approach, which involves first including all variables in the model and then dropping variables based on diagnostic tests and statistical significance in an iterative process. This approach however has limitations. The general-to-specific approach requires judgements to be made as to which variables to drop and this can lead to important drivers of companies' costs being excluded from models. Furthermore, where multicollinearity between cost drivers exists (which can often lead to counterintuitive coefficient estimates) the general-to-specific approach provides no guidance to the modeller on which cost driver(s) it is appropriate to omit from the group of closely correlated variables.

Given the above limitations of the general-to-specific approach, the candidate wholesale water cost models presented in this submission have been developed using an alternative, Monte Carlo simulation, method to cost driver identification.

The Monte Carlo approach to Cost Driver Identification

Monte Carlo analysis can be used to help identify a short list of the most important cost drivers that are likely to produce economically and statistically robust models. The set-up for the Monte Carlo analysis involved running of lots of regressions (4000 per value chain element: Water Resources, Network Plus, Aggregate), each with a random selection of cost drivers. Each regression was then assessed based on its respective performance in the following statistical tests:

- Ramsey RESET test should be passed at the 5% significance level;
- Adjusted R^2 of at least 20%; and
- Coefficients should have the expected sign.

From the remaining regressions that passed the above screening criteria, the procedure then involved identifying which of the potentially relevant explanatory variables are most

important for improving the overall fit of the model and supporting the statistical robustness of the model. Those candidate variables that are most conducive to estimating robust models (based on the above criteria) and improving model fit were shortlisted.

In practice this was achieved using separate OLS models (one per value chain element), which regressed the adjusted R^2 from the 4000 iterations of the Monte Carlo model against dummy variables (one for each candidate cost driver). Coefficient estimates for this regression can be interpreted as the proportional impact that including the given explanatory variable has on the model's explanatory power (i.e. its adjusted R^2) – a high coefficient means the respective cost driver explains a high proportion of the costs when included in models. The proportion of models in which each variable had a statistically significant coefficient was also considered to capture a similar effect.

Also a separate logit regression was used to test how the inclusion of each cost driver affects the likelihood of the model passing the above selection criteria – a higher odds ratio means the inclusion of a particular driver improves the likelihood of obtaining a robust model.

This approach has therefore provided three key pieces of information on each candidate cost driver to inform the selection of which cost drivers should be included in cost modelling for each value chain element (Water Resources, Network Plus, Aggregate):

- Likelihood of the coefficient on the cost driver being statistically significant;
- How good the cost driver is at explaining costs when included in models (its explanatory power); and
- Likelihood of model's passing selection criteria when the cost driver is included.

Cost drivers which performed best in all three areas were shortlisted for inclusion in the models presented in this pro forma, and a range of alternative models were developed by applying a general-to-specific model selection process using this narrower set of potential explanatory variables.

Conclusion and Recommendation

This approach to identifying cost drivers is designed to improve the statistical properties of the end models they are included in. It also ensures that models are designed to be 'good' from an industry perspective and not bias certain drivers, which may make an individual company look more favourable than others. Crucially, this approach tests whether cost drivers actually, as opposed to theoretically or conceptually, exhibit a statistical relationship with costs, which leads to the selection of economically and statistically more robust models.

Given the advantages that the Monte Carlo approach to cost modelling exhibits in comparison to the general-to-specific approach, we would like to recommend that Ofwat considers the incorporation of this method in their development of models for PR19.