Comments on CEPA's Methodological Approach in its PR19 Econometric Benchmarking Models for Ofwat

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Expression of Interest

Within the context of this consultation, I firstly note that I and my Centre for Productivity and Performance colleagues Dr Alessandra Ferrari and Dr Maria Nieswand, have been working increasingly closely on regulatory cost assessment with Anglian Water since 2017. This partnership began with our independent review of the first stage models Anglian produced and was published as a detailed 32 page appendix to Anglian Water's initial cost assessment report published in September 2017.[1] It deepened with work continued by myself and Dr Maria Nieswand, in which we actively engaged with Anglian's operational managers to gain from their understanding of the determinants of costs, before playing a much more active and consultative role in aiding Anglian Water's regulatory managers efforts to improve their regulatory cost models. These efforts culminated in Anglian Water's updated water industry cost modelling report, which was published in March 2018.[2]

Given this relationship with Anglian Water, I will not provide direct comment on the various models produced by both other companies, and for Ofwat by CEPA, but instead refer Ofwat to the comments on cost modelling made by my colleagues and I, as well as the models produced in the second Anglian Water cost modelling report. Stated differently, I am suggesting that the entire content of Anglian Water's two cost modelling reports as well as the reviews provided within them by my colleagues and I should be considered part of the submission to the current consultation.

Beyond this, the purpose of this consultation response, which I make in a personal capacity, is to raise some important concerns with regard to the approach to modelling that CEPA detailed in its current cost assessment report for Ofwat.[3]

Fundamental Issues With Regard to Regulatory Cost Determination in the 2019 Price Review

Before proceeding I note that our September 2017 independent review of Anglian Water's initial cost water modelling, raised three fundamental issues that we saw with regard to reconciling an academic approach to regulatory cost assessment to the approach necessary within the constrains of the 2019 Price Review. We therefore briefly state these concerns and how the relate to this consultation.

1. **Concerns with the appropriateness of both Botex and Totex modelling, which falsely aggregate operating costs with capital investment, and therefore do not accurately reflect the true economic cost of regulated activities.**

   As our September 2017 review noted, we accepted the constraints of Ofwat's regulatory framework, and therefore supported Anglian assertion that botex modelling as more appropriate than totex modelling given its exclusion of enhancement capital expenditure.

[1] http://www.anglianwater.co.uk/_assets/media/cost-modelling-report.pdf
[2] http://www.anglianwater.co.uk/_assets/media/AW_Cost_Modelling_Report_March_2018_MAIN_REPORT.pdf
[3] https://www.ofwat.gov.uk/wp-content/uploads/2018/03/CEPA-cost-assessment-report.pdf

Given this, and that CEPA appears to have focused on botex modelling, I support Ofwat's apparent decision to move away from reliance on totex modelling.

2. **Concerns with Disaggregated Cost Assessment and Cost Interactions**

Quoting directly from our September 2017 review of Anglian's modelling (pp. 48-9): "*Our second caveat relates to the need for better consideration of the role of cost interactions when defining and modelling disaggregated units for cost assessment. As discussed heavily in both the main text and the academic annex A (*which I wrote*) of CEPA (2011) the presence of significant cost interactions between disaggregated units of assessment can result in considerable biases if not controlled for properly. Moreover, as there is considerable evidence that such cost interactions may exist in the water industry, cost assessment and regulatory price determination at inappropriate levels of disaggregation may result in perverse incentives"*[4]

I therefore raise the need for considerable caution with regard to the appropriateness of highly disaggregated models that do not and/or may not adequately capture the impact of cost interactions from other activities. Such an approach assumes that complex multiple output systems can be fully separated, which I believe to be an unrealistic assumption. Thus, at a minimum, some concern and greater reflection should take place before it is deemed appropriate to really set prices based on cost assessment that is done below the level of disaggregation that Ofwat has committed to setting its price caps.

However, given the need to properly capture cost interactions in disaggregated modelling, it is encouraging that CEPA has received Ofwat's support to generate cost assessment models for "water resource plus" and "bioresource plus". Moreover, we note that these could be better named "water abstraction and treatment" and "sewage treatment, sludge treatment and disposal", and map directly to the most common disaggregation of water and sewerage services that is actually produced by disaggregated companies in other countries.[5] (Saal, et al: 2013) Thus, I would be very supportive of an approach to modelling and price capping that involved the following maximum disaggregation of wholesale services , while also properly testing and controlling for cost interactions between them:

- water abstraction and treatment
- water distribution
- wastewater collection
- Sewage treatment, sludge treatment, and disposal

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4 http://webarchive.nationalarchives.gov.uk/20150603202056/https://www.ofwat.gov.uk/future/monopolies/fpl/prs_web20110616costassess

5 https://www.degruyter.com/view/j/rne.2013.12.issue-1/rne-2012-0004/rne-2012-0004.xml

I therefore strongly, encourage Ofwat to continue to pursue modelling at this level . But while this level of cost modelling disaggregation would be most appropriate, it is unclear how Ofwat would employ it in price setting given that it has already committed to a different level of disaggregation for price controls.

3. Concerns with Developing Appropriate Cost Driver Based Cost Assessment Models

The final fundamental concern that was raised in our September 2017 review of Anglian's initial modelling, effectively raised concerns with regard to whether the cost modelling approach that had been developed by Anglian Water and the PR19 Cost Assessment Working Group was ". . .an approach built on careful consideration of appropriate model specifications and the interactions of variables within them." (p. 50)

As I believe that the methodological approach detailed in CEPA's current cost modelling report for Ofwat suggests that inappropriate specifications will be judged superior to more robust specifications, the remainder of this document highlights these concerns.

Comments on CEPA's Methodological Approach

The remainder of the comments in this consultation response pertain solely to the methodological approach laid out by CEPA in its current modelling for Ofwat.[6] Related to this, I refer the interested reader to CEPA's (2011) report for Ofwat "Cost-Assessment-Use of Panel and Sub-Company Data"[7] and particularly to Annex A. Annex A was drafted by myself, as I was integrally involved in CEPA's first cost modelling report for Ofwat during the 2014 Price Review. This Annex was designed to provide an academic assessment of water and sewerage cost modelling, and particularly highlights the complex issues that must be considered in order to adequately model: "*the production of both water and sewerage services (which) involves a complex process that is not easily characterized by a single output*" (CEPA, 2011 p. 97) Moreover, the Annex summarized relevant conclusions for regulatory cost assessment to be drawn from an academic literature that commonly models water industry costs as a multiple output function of water volumes, customer connections, and transportation.

Seven years later, and in the context of the 2019 Price Review, the need to adequately capture the implications of multiple output production and cost interactions highlighted in this 2011 CEPA Annex remains relevant. Moreover, it is my belief that the modelling regime implemented by CEPA in its current work for Ofwat sacrifices this important aspect of appropriate water and sewage industry cost modelling, in favour of adherence to an overly restrictive approach to multicollinearity that may often effectively preclude the ability to adequately model cost interactions between different aspects of the vertical supply chain in water and sewage supply.

[6] https://www.ofwat.gov.uk/wp-content/uploads/2018/03/CEPA-cost-assessment-report.pdf

[7] http://webarchive.nationalarchives.gov.uk/20150603202056/https://www.ofwat.gov.uk/future/monopolies/fpl/prs_web20110616costassess

Thus, my experience in carrying out academic and regulatory cost assessment as well as teaching the subject, suggests that a careful balance must be struck between on the one hand the benefits of increased model complexity aimed at explaining cost interactions and legitimate differences between firms and on the other hand the resulting cost in the tractability, explicability, and reliability of the statistical inference in the resulting model. In sum, the inclusion of a (or several) jointly statistically significant, conceptually appropriate variables (given an engineering, accounting, economic, and/or regulatory understanding of what drives costs) may improve model specification as indicated by Ramsey Reset and other model tests, but still fall foul of CEPA's modelling principles, which I believe are designed to excessively limit the use of potentially collinear, but still important, variables.

Given this, I wish to highlight the following aspects of CEPA's current methodological statement, that are of particular concern, and which are likely inhibit appropriate cost assessment modelling.

1. Section 4.2.2 of the current CEPA report for Ofwat appears to put forward a modelling framework that suggests that scale, density and system characteristics are fully separable and can be captured by distinct variables. However, if we consider the case of Integrated or Network Plus Water, actual scale economies (as the relationship between increasing the overall system scale, and just a single output, and costs) result from a complex interaction between network length, volumes, and customer connection numbers and location. Attempting to model scale separately with a single output variable, and not allowing for cost interactions between activities therefore deliberately precludes modelling approaches that can better capture the true determinants of water system costs. Moreover, this does not necessarily involve a strictly academic "translog" cost model: all it requires are adequate controls to capture cost interactions between system characteristics and outputs**. In sum**, **It is the conceptual and explanatory quality of the model that matters, and not adopting an *a priori* modelling approach which assumes that a single output variable and other explanatory variables can and must be used to explain what are complex multiple output systems. Such a modelling approach incurs a high risk of excluding appropriate models that would better capture legitimate reasons for differences between firms' expenditures.**

2. In Section 4.2.1, CEPA firstly discuss Cobb-Douglas models when in fact they mean log log specifications: Cobb-Douglas models are specific academic economic cost functions with very specific theoretical functional forms. To be clear, not a single model presented in this consultation is a Cobb-Douglas cost function model. It is also true that none of the models presented in this consultation are translog cost function models, which also have very specific economic theory requirements. Instead some of the models include variables which are squares of logged variables, and some include interactions between the logs of different variables. Given this, I welcome CEPA's willingness to consider the inclusion of squared log variables, which are critically important to capture nonlinear relationships, although they appear to have made limited use of such variables. However, there does not appear to be any theoretical, practical or reasonable justification for an *a priori* restriction on the use of all interactive log variables: Including such variables is a widely accepted method of allowing for and potentially capturing cost interactions between variables.

Thus, for example, including logged density (connections/length), and thereby effectively imposing a specific restriction on what can be easily mathematically demonstrated to really be a log log relationship of expenditure modelled on mains length and connections is allowed by CEPA's approach, despite the fact that this specification does not properly allow for a potentially nonlinear impact of density. In contrast, the more flexible and possibly more appropriate alternative method of testing this effect by including ln(connections)ln(mains length) is eliminated by *a priori* exclusion. Similarly, despite Ofwat having spent considerable effort and resources in developing alternative sparsity and density measures that can be used in interesting and appropriate ways to capture the complex impact of population settlement patterns on firm costs, CEPA's models make little to no use of this data. As this exclusion has the implication of deliberately excluding a more flexible means of capturing cost interactions that will vary between firms, such an *a priori* restriction has no justification, particularly when we consider that PR 2019 involves modelling complex multiple output network activities. **In sum, it is the conceptual and explanatory quality of a model that matters, and not the difficulty or unwillingness to explain relatively more flexible models that will potentially better explain the complex determinants of firm expenditures in a network industry.**

3. On page 42 of their report, CEPA state that they do not include any variables which were more than 90 percent correlated to each other, which given the definition of VIF is broadly equivalent to excluding variables with VIF>5. On page 42 they then go on to state that "… it is standard practice to consider that models with VIF>10(mean and max) could present multicollinearity issues". Unequivocally, this approach is unnecessarily restrictive, and thereby deliberately and arbitrarily excludes the potential inclusion of statistically significant variables that are legitimate and important potential determinants of differences in firm's costs, that may be necessary when modelling the complex cost determinants within a network industry. Moreover, simple reference to the Stata reference manual section on VIF tests (p. 2275) indicates that "*some choose a more conservative threshold value of 30*" i.e. the arbitrary use of an effective VIF criteria of less than 5 suggests that an appropriate assessment of the trade-off between improved and statistically significant model specifications, and the resulting statistical costs created by increased multicollinearity, did not form part of the modelling strategy employed by CEPA**. In sum, it is the conceptual and explanatory quality of the model that matters, and not an arbitrary exclusion of variables based on what appears to be a draconian approach to multicollinearity.**

4. In section 4.2.2 CEPA also indicates a further *a priori* modelling restriction as it only considers models with a maximum of six explanatory factors, with little to no justification provided. This again seems too restrictive as it is perfectly possible that further variables may provide relevant information about difference between firm costs. Moreover, as there are 107 observations for the water models and 60 for the wastewater models that CEPA reports, the relationship between available degrees of freedom and the inclusion of appropriate variables does not seem to have been considered by CEPA. A more appropriate modelling framework would allow the inclusion of variables that are statistically and conceptually appropriate regardless of the total number included**. In sum, it is the**

conceptual and explanatory quality of the model that matters, and not an arbitrary restriction on the number of variables included in it that should matter.