Private & Confidential
Sonia Brown
Ofwat
21 Bloomsbury Street
London
WC1B 3XD

12 December 2014

Dear Sonia,

PwC review of Welsh Water's debt management cost models

Under the terms of Service Order SER/0379, you asked PricewaterhouseCoopers LLP ("us") to carry out a review of the econometric analysis undertaken on behalf of Dŵr Cymru ("Welsh Water") by Oxford Economic Research Associates Ltd ("Oxera"). This analysis was used to support a debt management cost adjustment submitted by Welsh Water in its October Representations to Ofwat for Asset Management Period Six ("AMP6") which is the period from 2015/16 to 2019/20.

In their May 2014 submission, Welsh Water's proposed debt management cost adjustment was not supported by any econometric modelling. Welsh Water subsequently submitted a model in October 2014 to corroborate their earlier analysis. We advised Ofwat on the robustness of this modelling. This letter describes the comments provided by us to Ofwat.

Analysis submitted, October 2014

Welsh Water stated that the high levels of deprivation and bills in its area lead to higher costs for managing debt (for example, as a result of increased customer contacts and debt recovery processes). They submitted econometric modelling to support their adjustment claim which included analysis by Oxera that used a cross-industry panel data model to estimate an adjustment to their Cost to Serve.

In their analysis for Welsh Water, Oxera presented four models which were based on the dataset and framework that they had previously used on behalf of Welsh Water for modelling doubtful debt. All of the models used debt management costs as the dependent variable and included average bills and the number of unique customers as explanatory variables. Either unemployment or deprivation was used in combination with these variables[1]. The four different variants of the modelling approach are listed below:

[1] Note that when we refer to deprivation in this letter this relates to a bespoke measure of deprivation that was developed by Experian for Welsh Water. This measure is designed to replicate the income domain of the Index for Multiple Deprivation (which is published by the Office for National Statistics) as it is a measure of the proportion of working age people in receipt of income related benefits. The Experian measure was developed because the ONS data does not cover Wales and, therefore, does not allow areas in England and Wales to be compared on a like-for-like basis.

- Model 1: Deprivation used as an additional explanatory variable, and a fixed effects regressor;
- Model 2: Unemployment used as an additional explanatory variable, and a fixed effects regressor;
- Model 3: Unemployment used as an additional explanatory variable, and a random effects regressor;
- Model 4: Unemployment and time dummies used as additional explanatory variables, and a random effects regressor.

These models were used to generate a proposed adjustment value of £1.3m per annum in 2010/11 prices, based on an average value from the four modelling approaches. In total, eight estimates for the adjustment value were estimated because, in addition to using four different modelling approaches, the adjustment was calculated using two different methods, consistent with previous analysis produced by Oxera. One method was based on comparing the costs predicted by the model for Welsh Water based on its current deprivation/unemployment and bill profile, to the costs predicted by the model Welsh Water with industry average levels of bills and deprivation/unemployment. The second method compared the latter hypothetical model value to Welsh Water's actual debt management costs in 2012/13. The lower of the figures derived from the two methods for each of the four models was used to estimate the £1.3m average in order to provide a conservative estimate.

The modelling was not used to produce forecasts; instead an efficiency challenge of 5% per annum in nominal terms was applied to the estimated adjustment value in each year of AMP6.

Comments and results from statistical tests

We note several issues with the specific analysis produced by Oxera:

- There are some issues with the significance of the coefficients (see annex for more details). On Model 1 the unique customer variable is only significant at the 20% level and deprivation is only significant at the 15% level. On Model 3, the average bill variable is insignificant[2].
- Oxera have not applied the smearing factor when converting logarithmic values to numeric values[3]. We have tested the implications of applying the smearing factor to Oxera's analysis and doing so reduces the estimated average adjustment value from £1.3m to £1.2m per annum (in 2010/11 prices)[4].
- The models performed relatively well on the statistical tests. However, on Model 2 the Sargan-Hansen test suggests that a random effects regressor should be used rather than a fixed effects regressor. The opposite is the case on Model 4 where a random effects regressor is used whilst the Sargan Hansen test suggests that a fixed effects approach should be used. We note that in the case of Model 2, Oxera do also present the random effects results (Model 3).

[2] The standard significance thresholds applied in econometric analysis are 1%, 5% and 10%.
[3] The smearing transformation is a mathematical adjustment applied to avoid bias when transforming a logarithmic value to a number.
[4] Note that in doing this test we left all other aspects of the Oxera methodology unchanged other than to apply the smearing adjustment.

- The modelling analysis made no attempt to forecast the potential debt management adjustment going forward. Debt management costs may be expected to be different in AMP6 than in 2012/13 as a result of changes in the external environment (including bill levels and unemployment/deprivation), and improvements in the efficiency of companies' debt management practices. Instead of using the model to produce a forecast, Welsh Water has assumed a 5% nominal reduction to debt management costs in each year of AMP6 as an efficiency challenge. On the basis of this comparator, the 5% per annum reduction may serve to provide a conservative estimate.
- We are not aware of any forecasts for debt management adjustments which can be used to corroborate the 5% assumption. However, we note that forecasts for doubtful debt costs, which use the same external drivers (i.e. bills, unemployment, deprivation) have generally pointed to a declining future cost profile in real terms and a broadly flat profile in nominal terms over AMP6.
- The approach used broadly follows the earlier Oxera approaches used for Welsh Water's doubtful debt modelling and therefore shares its limitations. We focus on new issues above, but a detailed description of these issues can be found in PwC's letter on Welsh Water's previous submission[5].

Summary

On balance, we considered that the quality of modelling evidence Welsh Water provided on the debt management adjustment was broadly commensurate to its previous analysis on doubtful debt costs.

Whilst each of the models had some technical issues, the overall approach appeared to be valid, and at several steps in the estimation process conservative assumptions had been taken (notably in the choice of the adjustment values used in the averaging and the significant efficiency challenge that had been applied). This provided greater confidence that the overall estimates were reasonable.

Yours Sincerely

PricewaterhouseCoopers LLP

[5] see "PwC review of Dŵr Cymru's doubtful debt cost models" PwC, 30 May 2014.

Annex – results of statistical tests

Summary of statistical test results – (test values given in parentheses)

Test	Oxera Model 1: Experian Deprivation, fixed effects	Oxera Model 2 and 3: Unemployment, fixed and random effects	Oxera Model 4: Unemployment, random effects and time dummies
Significance of variables	Deprivation only significant at 15% and unique customers only significant at 20%.	Average bills are insignificant in Model 3.	Pass at 10%
Ramsey RESET test for model specification	Passed using fitted value of independent variables (0.481) Failed using fitted value of dependent variable (0.000)	Passed using fitted value of independent variables (0.623) Failed using fitted value of dependent variable (0.011)	Passed using fitted value of independent variables (0.593) Passed using fitted value of dependent variable (0.764)
Linktest model specification test	Passed (0.292)	Passed (0.225)	Passed (0.222)
Breusch-Pagan test for heteroskedasticity	Failed (0.000)	Failed (0.000)	Failed (0.000)
White test for residual normality after Panel regression	Passed (0.5973)	Passed (0.2794)	Passed (0.1301)
Breusch-Pagan test on the validity of a random effects or pooled OLS approach	RE preferred to OLS (0.000)	RE preferred to OLS (0.000)	RE preferred to OLS (0.000)
Sargan-Hansen test – on the validity of a random effects or fixed effects approach	FE preferred to RE (0.004)	RE preferred to FE (0.441)	FE preferred to RE (0.032)

A model specification test (Ramsey RESET) had mixed results, with part fails on Model 1, 2 and 3 and a pass on Model 4. However, the results of this test cannot be relied upon as they are not valid when heteroskedasdicity tests are failed (as is the case in these models). But if taken at face value for Models 1-3, the results suggest the models may have the wrong functional form (e.g. it may be the case that is should not be linear). This can also be indicative of omitted variables.

A different model specification test (Linktest) was passed, which contradicted the result of the Ramsey RESET test for Model 1 and Model 2. In circumstances where specification tests are contradictory, it is often recommended to seek an alternative specification.

We performed tests on whether the statistical properties of model residuals (i.e. the difference between the actual and modelled values) were consistent with those expected under a given modelling approach. The models all passed the White test for normality of the residuals.

A further test on the statistical properties of residuals (heteroskedasdicity) was also failed for both models. This was controlled for by the use of robust standard errors in the regressions.

There is a standard test for panel data models only (the Breusch-Pagan test) to identify whether a random effects model is more appropriate than an Ordinary Least Squares (OLS) model. This test confirmed that the random effects approach was preferable to the OLS approach.

Further tests can be used to assess whether a fixed effect panel approach is preferable to a random effects panel approach. Under heteroskedasticity (which tests show was present in all models), it is necessary to use the Sargan-Hansen test to determine whether a random effects or fixed effects model is more appropriate. The Sargan-Hansen test results were mixed and suggest that the wrong regressor is used for model 2 and model 4. Using the wrong regressor will bias the model coefficients and therefore the estimates it produces.