

Report to New Zealand Commerce Commission

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In this report I provide comments on modelling of industrial and commercial electricity use (and associated revenue) in New Zealand undertaken by the New Zealand Commerce Commission (NZCC). My comments cover:

- The time-series modelling of the relation between industrial and commercial electricity use and GDP, and the application of findings from that modelling to inform making an assumption on the elasticity of industrial and commercial electricity use to changes in GDP to be applied in forecasting;
- Problems with panel modelling of the relation between industrial and commercial electricity use and GDP that was previously undertaken by NZCC, and further developments in that modelling; and
- The choice between using results from the time-series and panel modelling approaches as a basis for making an assumption on the elasticity of industrial and commercial electricity use to changes in GDP to be applied in forecasting.

Time-series modelling

- The NZCC develop a time-series model for industrial and commercial electricity use that has as explanatory variables: GDP, a dummy variable for post-2007, and the interaction of GDP with the post-2007 dummy variable. The results from this model are used to inform the judgement by the NZCC that the appropriate elasticity of industrial and commercial electricity use to changes in GDP is 0.5.
- In my opinion the time-series modelling of the relation between GDP and industrial and commercial electricity use by the NZCC has been done in an appropriate way. Based on visual inspection of the data, it does seem important to take into account in the modelling the possibility of a change in the relation between GDP and industrial and commercial electricity use that commences from around 2007 to 2009. This has been done in the correct way by allowing for a shift in the level of electricity usage and a change in the relation between electricity usage and GDP. I have tested specifications that use dummy variables with alternative starting dates, and this does not make an appreciable difference to the estimated relation between GDP and industrial and commercial electricity use.
- How to apply the results from the time-series modelling to arrive at an elasticity of industrial and commercial electricity use with respect to GDP to be applied in forecasting requires judgement. Suppose it was thought that the influence of the post-2007 dummy variable and its interaction with GDP was due to some permanent change in the demand for electricity by industrial and commercial users in New Zealand. In that case it would be appropriate to fully incorporate the ‘post-2007*GDP’ effect into the assumed elasticity for

forecasting electricity use. That elasticity would therefore be 0.27 (0.65 minus 0.38). By contrast, if it was thought that the influence of the post-2007 dummy variable and its interaction with GDP was due to short-term factors that would not affect demand for electricity from 2015 onwards, then it would be appropriate to not include the 'post-2007*GDP' effect in the assumed elasticity for forecasting. That elasticity would therefore be 0.65. My understanding of the arguments made by the NZCC is that they believe the post-2007 change in industrial and electricity use that has been observed primarily reflects short-term influences on demand that will be reversed in the near term. Therefore the size of the change in relation between GDP and industrial and commercial electricity use will weaken over time. If that belief is correct, then in my opinion it is appropriate that the elasticity to be used in forecasting the effect of changes in GDP on industrial and commercial electricity use should only partially incorporate the 'post-2007*GDP' effect. The exact choice of elasticity by the NZCC should primarily reflect its belief about what proportion of the post-2007 effect on the relation between GDP and industrial and commercial electricity use will be reversed over the forecast period. However, there are other factors which suggest that it is appropriate for the NZCC to take a conservative approach in adjusting for the post-2007 effect. First, given that there is some uncertainty about the causes of the post-2007 effect, and hence about its future path, it seems preferable to adopt an approach to choosing the assumed elasticity that will avoid large changes in subsequent reviews. Second, the NZCC has also undertaken separate time-series modelling of the relation between GDP and industrial electricity use and between GDP and commercial electricity use. That modelling does not find a significant change in the relation between GDP and electricity use in the post-2007 time period.

- The separate modelling of industrial electricity use and commercial electricity use that is undertaken by the NZCC finds a quite large difference in the estimated elasticities with respect to GDP. This raises the possibility that, if there are large differences between distributors in the composition of their electricity supply (between commercial and industrial users), it would be most appropriate to use a separate elasticity for forecasting future electricity supplied by each distributor. That elasticity for each distributor would be a weighted average of the estimated elasticities for commercial use and industrial use where the weights were the shares of the distributor's supply going to each type of customer. The NZCC also recognise the potential merit of this approach, however, indicate that it is not feasible due to a lack of data on the share of each distributor's supply going to each type of customer.

Panel modelling

- In its draft decision the NZCC had relied on a panel model to estimate an elasticity of total revenue with respect to GDP. That elasticity then informed the judgment made by NZCC on the assumed elasticity to use in forecasting electricity use. Submissions to the NZCC regarding the draft decision raised a variety of criticisms of that modelling. Two major criticisms were that:

- (1) Problems with mapping the available data on GDP by region to the regions for distribution of electricity (WE, p.13) could bias the estimated elasticity; and

(2) The estimated elasticity was not robust to changes in the sample period (Castalia, p.3; Frontier, p.6) and the changes in the estimated elasticity in samples including more recent years were counter-intuitive when evaluated against recent patterns of change in electricity usage and GDP; and appeared to be sensitive to the sample of EDBs included (Castalia, p.6; Frontier, pp.6-7).

- My understanding is that in response to these criticisms NZCC undertook a range of developments in its panel modelling of the relation between total revenue from electricity supply and total GDP. First, it applied a new method for matching regional-level GDP data to individual distributors. This method involves attributing a share of the GDP of each region to each distributor supplying that region in proportion to its share of the electricity distribution in that region. Second, data for extra years (2013 and 2014) were available and included in the modelling. Third, a new source of data on regional-level GDP (from Infometrics) was used. Fourth, some extra or different adjustments were made to line charge revenue in order to arrive at a measure of constant price revenue: using CPI+X to adjust to constant prices, and excluding transmission charges.

- Making these changes (mainly using the new method of mapping GDP to distributors) had two significant effects. First, the explanatory power of the model is substantially increased (R-squared is now above 0.8). Second, the estimated elasticity of total revenue to GDP is now much more robust to changes in the sample period. For example, whereas with the old panel model adding one extra year of data increased the elasticity from 0.52 to 0.73, with the new panel model adding two extra years of data (2013 and 2014) changes the estimated elasticity by only about 0.1. Nevertheless, it is still the case that the estimated elasticities increase as more recent years of data are added, and are well above the previous estimate of 0.52. In my opinion these features of the estimated elasticity are due to not taking into account in the panel modelling the possibility of a change in the relation between GDP and total revenue commencing from around 2007 to 2009 (as has been done in the time-series analysis). It would have been important to take that step if it had been decided by NZCC to use the panel model as the basis for deriving the elasticity to be used in forecasting the relation between GDP and electricity use.

Choice between time-series and panel modelling

- I understand that the NZCC has made the decision to use results from the time-series modelling approach as the basis for making an assumption on the elasticity between GDP and industrial and commercial electricity use that will be applied in forecasting.

- In my opinion this is an appropriate decision. There are several main advantages of the time-series approach. First, using this approach means that it is possible to focus the empirical analysis on electricity use for industrial and commercial users. Second, the approach allows measurement of the relation between electricity use and GDP over a longer time period. This seems especially important given the possibility of a change in the relation between GDP and electricity use in the late 2000s. Third, the approach removes the difficulty of making a valid match of regional-level GDP data to individual electricity distributors. Together these advantages should result in a more robust estimate of the effect of GDP on industrial and commercial electricity use. The main potential disadvantage of the

approach is that it ignores variation in the data on GDP and industrial and commercial electricity use between individual electricity distributors. The estimate from time-series modelling will only reflect the effect of time-series variation in GDP on industrial and commercial electricity use, and will not incorporate the cross-section effect of variation in GDP between electricity distributors. However, given that the application for which the modelling is being done is to be able to forecast the effect of changes over time in GDP on industrial and commercial electricity use, I do not see this as a major drawback.