ÉTUDE DE FACTEUR DE PRODUCTIVITÉ MULTIFACTORIELLE (PMF)

Facteur X

1. Références : (i) Pièce C-AQCIE-CIFQ-0009, p. 55;
(ii) Pièce C-AQCIE-CIFQ-0009, p. 95;
(iii) Pièce C-AQCIE-CIFQ-0050, p. 4, 5 et 48.

Préambule :

(i) « […] *An informal review identified several possible reasons for the recent decline in U.S. transmission PMF growth. These included 1) higher capex in order to access remote renewable resources, increase capacity to serve growing economies (e.g., in the sunbelt states), eliminate load "pockets" in bulk power markets, and replace aging facilities 2) new service quality standards, 3) the Energy Policy Act of 2005 which, as noted in Section 2.2, authorized the FERC to provide special incentives for transmission capex, and 4) increased use by the FERC of formula rate plans for power transmission, which weakened utility cost containment incentives* ». [nous soulignons]

(ii) « […] *The revenue cap index for HQT's current MRI applies to CNE revenue. The X factor should then be based on productivity trends in the use of CNE inputs (e.g., labor and materials). The Régie could base X on the 1.74 % annual decline in CNE productivity over the fifteen most recent years of the sample period or the 0.68 % decline over the full sample period. The decline in CNE productivity may be due in part to short-term circumstances such as the enforcement of new reliability standards. In this regard, it is notable that the decline in CNE productivity decline was especially pronounced from 2007 to 2010, shortly after passage of the EPAct. In the nine years from 2011 to 2019 CNE productivity growth has averaged a 0.57 % decline, which is similar to that for the full-sample trend. PEG reported 0.83 % average annual growth in the CNE productivity of Hydro One transmission in its recent MRI proceeding. The Régie should also consider the 0 % productivity growth target which Ontario regulators have chosen.*

[…]

Recollecting our discussion in Section 2 of the special circumstances of U.S. transmitters in recent years, we lack the evidence at this time to conclude that the unusually negative PMF growth of U.S. transmitters will be applicable to HQT in the five years of any succeeding MRI ». [nous soulignons] [note de bas de page omise]

(iii) « *Informed by their productivity research, each consultant discussed the appropriate X factor that would apply only to the Company's CNE revenue.*

- *Brattle proposed to base X on the -3.38 % CNE productivity trend that it calculated for its full sample period.*
- *PEG stated that the Régie has a choice between 0% (the choice of the Ontario Energy Board), -0.68 % (the CNE productivity trend we calculated over our full sample period), and -1.74 % (the CNE productivity trend we calculated over the most recent fifteen years of our sample period).*

  The following recommendations were made by the consultants in the event that the formule d'indexation for a succeeding MRI applies to capital cost as well as CNE.

- *Brattle stated that the X factor should depend on the inflation measure. They recommend -1.04 % if the inflation measure is a power transmission input price index and -2.82 % if the Canadian indice implicite de prix du produit intérieur brut ("IIPPIB") is instead used as the sole inflation measure.*
- *PEG stated that the Régie should choose between 0 %, -0.62 %, and -2.26 % as an X factor depending on how much supplemental capital revenue the Régie intends to provide, in this and future MRIs. We did not, like Brattle, comment on how our numbers would change if the IIPPIB were the inflation measure in the formule d'indexation.*

[…]

Other options include a 0 % PMF growth target and continuing the current annual target for CNE productivity until the end of the current plan ». [note de bas de page omise]

Demandes :

1.1. En lien avec les références (i), (ii) et (iii), veuillez indiquer si les circonstances et les particularités propres à l'industrie américaine d'électricité (Industrie) ont motivé la recommandation de PEG d'un Facteur X de 0 %. Veuillez élaborer.

Réponse :

PEG has not expressly recommended an X factor of 0% for HQT. However, the Ontario Energy Board's standard approach is worth consideration. In an application to capital revenue as well as CNE revenue, a 0% X factor would clearly need to be combined with supplemental capital revenue, as it is in Ontario. In an application to *CNE* revenue, the rationale would be that the modestly negative -0.68% trend in the *CNE* productivity of U.S. power transmitters over PEG's full sample period is due chiefly to temporary circumstances such as increased reliability standards. PEG also notes that the sum of a -0.68% *CNE* productivity growth target, a 0.60% base stretch factor, and 0.10% stretch factor adder is approximately zero.

1.2. En lien avec la référence (iii), veuillez préciser à quel taux PEG réfère lorsqu'il mentionne que la Régie pourrait continuer selon le « *current annuel target for CNE productivity* ».

Réponse :

PEG is referring to the 0.57% rate that the Régie approved for the Company's *CNE* revenue in D-2019-060. In addition to a 0% X factor, this also merits consideration for *CNE* productivity for the last year of the current *MRI* if the Régie believes that the recent *CNE* productivity trend of U.S. power transmitters is irrelevant to the situation

of HQT. PEG also notes that the sum of a 0% *CNE* productivity growth target, a 0.60% base stretch factor, and a 0.10% stretch factor adder is 0.70%.

1.3. La Régie comprend du premier paragraphe de la référence (ii) que les résultats de croissance négative de PMF des transporteurs américains durant les récentes années peuvent s'appliquer au présent MRI d'Hydro-Québec Transport (Transporteur). La Régie comprend du deuxième paragraphe cité à la référence (ii) que, selon la preuve actuelle, il serait difficile de conclure que ces résultats s'appliqueraient au MRI du Transporteur de deuxième génération.

1.3.1. Veuillez confirmer ou corriger la compréhension de la Régie.

Réponse :

PEG believes that it is difficult, based on available evidence, to determine the appropriate X factors for HQT in either its current *MRI* or a prospective second-generation *MRI*. The chief problem is determining whether the productivity growth challenges facing sampled U.S power transmitters in recent years are similar on balance to those that HQT will face in the next few years. Please see our responses to Option Consommateurs DDRs 2, 3, 4, and 9 for further discussion of the X factor issue.

1.3.2. Selon votre réponse à la sous-question précédente, veuillez expliquer pourquoi la preuve actuelle ne permet pas de conclure que les résultats de l'étude PMF s'appliqueraient au MRI du Transporteur de deuxième génération. Veuillez élaborer sur le meilleur moyen pour remédier à cette situation.

Réponse :

Please see the response to Régie DDR-1.3.1.

Étude économétrique de comparaison des coûts

2. Références :
(i) Pièce C-AQCIE-CIFQ-0009, p. 4;
(ii) Pièce C-AQCIE-CIFQ-0009, p. 91;
(iii) Pièce C-AQCIE-CIFQ-0009, p. 101;
(iv) Pièce B-0049, p. 53, réponse 13.5.2.

Préambule:

(i) « There were 46 U.S. utilities in the sample for the econometric research. The total cost and capital cost models had considerably more explanatory power than the CNE model.

Total Cost
We compared HQT's total cost thus calculated to the cost projected by our econometric total cost benchmarking model. From 2017-19, the three most recent years for which data are available, HQT's total cost was 67 % above the benchmark value on average. This is commensurate with a bottom quartile ranking for the U.S. sample.

Capital Cost
We compared HQT's capital cost to the cost projected by our econometric capital cost benchmarking model. From 2017 to 2019, HQT's capital cost exceeded the benchmarks by 55 % on average. This is commensurate with a bottom quartile ranking.

CNE
We compared HQT's CNE to the cost projected by our econometric CNE benchmarking model. From 2017 to 2019, the CNE of HQT was 121 % above the benchmark value on average. This is also commensurate with a bottom quartile ranking in the U.S. sample ». [nous soulignons] [note de bas de page omise]

(ii) « *We used our three econometric transmission cost models to benchmark the transmission costs of HQT during the years for which suitable data on its operations are available. We focused on the 2017-2019 period for several reasons :*

- *Due to data limitations, capital cost could not be calculated before 2001. When using a monetary method it is desirable to benchmark costs that are at least ten years older than the first year for which they are calculated;*
- *Consistent data on the CNE of HQT are only available starting in 2007;*
- *HQT has used U.S. GAAP accounting only since 2015;*
- *The recent years are more relevant for setting the stretch factor;*
- *We lack forecasts of future costs and business conditions which would permit us to benchmark such costs. However, this can in principle be done in HQT's next demande tarifaire* ». [nous soulignons]

(iii) « *The choice between these approaches has been debated several times in recent Ontario Energy Board proceedings. To diffuse controversy in this proceeding, we have adopted in this study the general approach that has been favored by utility witnesses in Ontario. Specifically, we have used an OLS estimator with robust standard errors available in the Stata statistical software package* ». [nous soulignons]

(iv) « *13.5.2. Veuillez indiquer si l'utilisation de la méthode d'estimation avec effets fixes présente un problème méthodologique.*

Réponse : In our opinion, there are no methodological problems with the fixed-effects estimator. As discussed in response to question 13.2, a key strength of fixed effects estimators is that it controls for omitted variable bias resulting from those variables that are hard for a researcher to measure but which have an impact on the dependent variable and correlated with the independent variables. The fixed-effect estimator is commonly used in econometric analysis when panel data sets are available. Not using a panel data estimator and instead applying Ordinary Least Square (OLS) to a panel data is not good econometric practice ». [nous soulignons]

Demandes :

2.1. La Régie note des références (i) et (ii) que PEG a considéré une courte période d'analyse (années 2017 à 2019) dans son analyse de comparaison des coûts.

2.1.1. Veuillez indiquer si les résultats obtenus de cette analyse peuvent être sensibles aux choix de la période d'analyse.

Réponse :

PEG wishes to emphasize that the issue here is which years of the Company's cost to benchmark and not which years of data to use in econometric model estimation. Their focus on the three most recent years is motivated by a) a desire for relevance to the revenues proposed for the years of the *MRI* and b) a

desire to smooth the effect of cost oscillations. PEG's benchmarking results are not highly sensitive to the choice of the benchmarking period. A Spearman Rank Correlation test of the total cost benchmarking rankings with 2017-2019 and 2008-2019 benchmark periods show the results are highly statistically correlated. This is to say that the models result in a similar ranking order of the benchmarked companies.

2.1.2. Dans le cas où PEG pourrait utiliser une période d'analyse plus longue, par exemple de 2004 à 2019, veuillez élaborer sur la performance du Transporteur durant cette période comparativement à l'Industrie.

Réponse :

While the overall sample begins in 2004, the requisite data prior to 2008 for HQT were not available so that is when its sample begins. Using the 2008-2019 period, HQT has an average total cost benchmarking score of 74% compared to 67% for the last three years.

2.2. En lien avec les références (iii) et (iv) et compte tenu de l'utilisation des données de panel dans l'étude économétrique, veuillez indiquer si l'utilisation de la méthode d'estimation « Ordinary Least Square (OLS) » avec des écarts types robustes produit des résultats non biaisés et précis.

Réponse :

The accuracy of econometric estimates of the parameters of business condition variables (the so-called slope parameters) in a cost model depends on their precision (i.e., their tendency to be close to their true values) as well as their bias. PEG believes that their use of ordinary least squares with pooled data (sometimes called « pooled OLS ») in this study strikes a reasonable balance between bias and precision. It is also easy for parties to understand and has ample precedent.

To the extent that some relevant business condition variables were excluded from the econometric work and these were correlated with some of the variables that are included, PEG acknowledges that there will be some bias (not necessarily against HQT) in the slope parameter estimates. However, PEG has tried to reduce this problem by including numerous relevant business conditions in its models. PEG has also tried hard to avoid bias from poorly-measured variables.

Furthermore, the precision of slope parameter estimates matters as well as their bias and this depends in part on the variation in the values of variables in the sample. By using a fixed effects estimator, which removes each company's mean value for each variable from its data, Brattle ignored valuable information on how the levels of cost and business condition variables varied *between* utilities in each year of the sample period. This explains the low statistical significance of many of the parameter estimates in Brattle's featured cost models. There is simply not enough variation in each company's data, once the company averages have been removed, to produce statistical confidence in most of Brattle's coefficient estimates. Using fixed effects also prevented Brattle from developing a model with second order (quadratic and interaction) terms for the scale variables. This is unfortunate since the inclusion of these terms tends to reflect actual cost relationships to scale more accurately. Neglecting the between-company variation is thus a central problem with Brattle's econometric analysis. Furthermore, Brattle mismeasured two of the business condition variables in their models and this created a different source of bias.

Note, finally, that the accuracy of benchmarking using an econometric model does not just depend on the accuracy of slope parameter estimates. The model, when it is fitted with these estimates, is often used to predict the company's cost and this prediction is the benchmark. Cost performance is the difference between predicted and actual cost.

In the case of fixed effects (and random effects), the econometric results can be used in several ways to fashion cost predictions. The gap between each year's predicted and actual cost is called the regression residual. Brattle's predictions of the Company's cost include the *average value* of their regression residuals. Including the Company's average residual in the cost prediction naturally brings predicted cost much closer to the actual cost. The result is that Brattle's benchmarks control for the cost impact of any excluded relevant variables but *also* reflect HQT's average level of inefficiency during the sample period. The goal of benchmarking is not to predict HQT's actual cost as accurately as possible. It is instead to predict as accurately as possible the cost that typical utility managers (not HQT's *actual* managers) would incur if faced with the Company's business conditions.

It is not surprising that Brattle's random effects models produce very similar results to their fixed effects models, as they suffer from the same flaws. The random effects models allow for about 10% of the total available between-company variation in the data, but the rest of the problems – lack of quadratic terms and adding the average error term to the cost prediction – are identical in all of Brattle's models.

Pooled ordinary least squares is a tested, established, acceptable estimator for econometric benchmarking of utility cost performance. PEG produced an overall reasonable model and used correct benchmarking practices. PEG acknowledges that HQT's extreme score gave them pause, and believes that HQT has some attributes which are challenging to benchmark accurately given data and information constraints. However, it is also quite possible that HQT is a chronically poor cost performer. Other estimators also produce bottom quartile results for the Company.

2.3. Veuillez commenter la réponse suivante de Brattle citée à la référence (iv) : « *Not using a panel data estimator and instead applying Ordinary Least Square (OLS) to a panel data is not good econometric practice* ».

Réponse :

PEG disagrees with Brattle's statement. A panel dataset does not require a panel data estimator, and the particular way in which Brattle has used their panel data estimator is controversial. PEG notes that a number of studies and papers exist on the topic of econometric cost benchmarking. These studies typically use panel data. Several of these studies use ordinary least squares as the baseline against which other estimators are compared. If the results are similar, the pooled OLS estimator may be preferred since this statistical procedure is more readily understood by a wider audience. Generally, an alternative estimator should offer solid evidence that it is a clear improvement over pooled OLS. Stochastic frontier analysis ("SFA") is another econometric method frequently used for comparison. Random effects estimators have also been used but, importantly, when these are used for prediction the average regression residual for a company (also referred to as the "company-specific" or "time-invariant" error term) is not added to predicted cost as Brattle has done in their study. PEG has not found any papers that used fixed effects estimators for cost performance benchmarking the way that Brattle has.

Frontier Economics[1] prepared an analysis of total cost benchmarking for Ofgem, Great Britain's energy utility regulator. They tested random effects and pooled OLS models. They state (with emphasis added) on page 20 that

> **« The "efficiency score" for each [distributor] is calculated as the relative distance of that [distributor] with respect to the most efficient [distributor].** ***In the Random Effects regression the "efficiency score" is based on the estimated systematic, time invariant component of the error term for each DNO, i.e. the lower the time invariant component of the error term the higher the estimated efficiency for a DNO.*** **In Pooled OLS the "efficiency score" is based on the full residual. »**

PEG calls attention to the italicized portion of this comment. Frontier uses the time-invariant error term to benchmark costs *specifically* because that term contains a company's average inefficiency. Brattle takes that very same term from their own model, adds it to predicted cost, and then measures efficiency as the difference between predicted and actual cost. Measured cost performance then reflects the deviation of HQT's actual inefficiency from its average inefficiency. Note also that PEG's estimation procedure and benchmarking method is considered by Frontier to be valid econometric practice.

A 2019 Consultation document by Ofgem[2] considers pooled OLS, random effects ("RE"), and stochastic frontier analysis ("SFA"). They note that OLS has attractive features for straightforward interpretation, but includes some statistical noise in the benchmarking scores. They state on page 11 that with RE estimators, they can benchmark using the time-invariant effect (with emphasis added): « With RE it is possible to exploit the panel nature of the data (ie explicitly accounting for the fact that comparators are observed over time) and thus to identify the company effect within the error term, and *this effect can be interpreted as inefficiency*. » Once again, we see that the company-specific effect in RE models (and in FE models, though they are not considered for use by Ofgem) which Brattle adds to predicted cost is in fact interpreted as the company's inefficiency.

The Australian Energy Regulator ("AER") performs yearly econometric power distribution cost benchmarking studies using various estimators. They have an ongoing process of benchmark model development and review which distributors participate in. In the 2014 economic benchmarking assessment of the operating expenditures of New South Wales and Australian Capital Territory distributors[3], the AER calculated and compared results for three different benchmarking methods: econometrics with feasible generalized least squares ("FGLS") that corrects for serial correlation, SFA, and data envelopment analysis ("DEA"). They found a high degree of similarity in the ranking orders produced by each model. When testing the FGLS model, they used two different functional forms. For the FGLS model with second-order terms, they used the full difference between predicted cost and actual cost to benchmark the utilities, as PEG does and as Ofgem does with their pooled OLS model. For the FGLS model using an alternative functional form without second order terms, they assigned a binary ("dummy") variable to each utility. This dummy variable is the functional equivalent of

[1] Frontier Economics (2013). Total cost benchmarking at RIIO-ED1 –Phase 2 report – Volume 1. A report prepared for Ofgem.
[2] Ofgem, 2019. Consultation: RIIO-2 tools for cost assessment.
[3] Australian Energy Regulator, Denis Lawrence, Tim Coelli, and John Kain. "Economic Benchmarking Assessment of Operating Expenditure for NSW and ACT Electricity DNSPs." (2014).

Brattle's « company-specific term » which Brattle *added* to their predictions. The AER instead uses these company-specific terms - alone - to benchmark the utilities because these terms reflect inefficiency. The AER has continued to compare the model results using different specifications each year, and by the 2019 report[4] had abandoned the DEA method and continued testing and comparing the FGLS and SFA models.

Facteur S

3. Référence : Pièce C-AQCIE-CIFQ-0009, p. 96.

Préambule:

« *Our econometric benchmarking research for AQCIE-CIFQ suggests that the stretch factor for the current CNE revenue cap index should be no less than **0.60 %.** This is the stretch factor that would be chosen in Ontario based on a similar benchmarking score. Our current results suggest that the stretch factor for any future comprehensive revenue cap index would also be no less than **0.60 %.** The Régie is, of course, under no obligation to base its stretch factors on the Ontario Energy Board's schedule.*

[…]

The Régie should increase the stretch factor to reflect the unusually weak performance incentives in the U.S. power transmission industry over the sample period. The incentive power of the proposed plan is not remarkably strong due to the comparatively short four-year term and the earnings sharing mechanism. However, we have seen that the incentive power of U.S. transmission regulation was significantly weakened by the FERC's use of ROE premia and formula rate plans.

*Based on our incentive power research, we recommend a stretch factor adder of at least **0.1 %** should the Régie base X on productivity results for the full sample period. An adder of at least **0.3 %** is recommended if X is based on results for the most recent fifteen years* ». [nous soulignons]

Demandes:

3.1. Veuillez indiquer le nombre d'années de la période utilisée en Ontario dans d'analyse comparative des coûts pour le choix d'un Facteur S de 0,60 %.

Réponse :

In Ontario Energy Board *MRI* proceedings, stretch factors typically reflect cost performance in the three most recent historical years and any future years for which benchmarking results are available. The sample periods of the econometric benchmarking studies have varied between witnesses and from proceeding to proceeding. In general, these studies tend to use data for at least fifteen recent years to estimate econometric model parameters. Stretch factor adders are not considered for power distributors.

PEG's mention of a stretch factor adder cited above pertained to the sample period for the transmission *productivity* study. The longer the sample period, the less necessary it

[4] Australian Energy Regulator, Lawrence, D., Coelli, T. and Kain, J., 2019. Economic Benchmarking Results for the Australian Energy Regulator's 2019 DNSP Annual Benchmarking Report.

is to have a stretch factor adder to account for the weak performance incentives of sampled utilities. This is so because the use of formula rates by U.S. transmitters has increased over time and return on equity incentives were increased after passage of the Energy Policy Act of 2005.

3.1.1. Selon votre réponse à la question précédente, veuillez élaborer sur le nombre d'années requis dans une analyse de comparaison des coûts pour obtenir des résultats reflétant mieux la réalité de la performance des coûts d'un transporteur d'électricité par rapport à une industrie donnée.

Réponse :

Please see the response to Régie-3.1.

3.2. Veuillez indiquer si la recommandation de PEG d'un Facteur S additionnel oscillant entre 0,10 % et 0,30 % s'applique à la fois pour le présent MRI du Transporteur et celui qui inclurait les dépenses en capital dans la formule d'indexation.

Réponse :

PEG clarifies that it applies to both.

- **Increased use of formula rates in power transmission regulation weakened incentives to contain both *CNE* and capital cost.**
- **The Energy Policy Act of 2005 authorized premium rates of return on certain transmission capex. This would specifically have weakened capex containment incentives. PEG's geometric decay approach to measuring capital cost is particularly sensitive to capital cost surges. Thus, if anything there would be a greater need for a stretch factor adder if the revenue cap index applied to capital as well as *CNE* revenue.**