BEFORE THE
POSTAL RATE COMMISSION
WASHINGTON, D.C. 20268-0001

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POSTAL RATE AND FEE CHANGES, 2000

Docket No. R2000-1

RESPONSE OF WILLIAM H. GREENE
TO NOTICE OF INQUIRY NO. 4,
ITEMS (b) through (f)
ON BEHALF OF
THE UNITED STATES POSTAL SERVICE

August 21, 2000

RESPONSE OF UNITED STATES POSTAL SERVICE WITNESS GREENE TO NOTICE OF INQUIRY NO. 4, ITEMS (b) through (f)

QUESTION:

(b) Parties are asked to indicate whether rejection of the hypotheses described in a) establish that Model A is statistically superior to the models nested within it, such as the "pooled" and the "random effects" models. Similarly, parties are asked to indicate whether the rejection of the hypotheses described in a) establish that Model B is statistically superior to the models nested within it, such as the "pooled" and the "random effects" models.

RESPONSE:

(b) Model A is a fixed effects linear regression model. The alternatives indicated are the linear random effects model and a pooled model with no site specific effects. The question first asks whether "rejection of the hypotheses described in a) establish that model A is statistically superior to the models nested within it, such as the "pooled" and "random effects" models."

The random effects model is not nested in model A. That is what necessitates the Hausman statistic which Dr. Bozzo used in his study rather than something more conventional such as an F statistic. As such, it is not possible sharply to answer this question. However, we can say that rejection of the pooled and random effects models by the standard tests (irrespective of the nesting issue) implies that both of them produce inconsistent estimators of the other parameters of the model. By this construction, which seems to be the overriding criterion in this case, the answer is "yes." A is superior because in this instance, model A provides consistent (lack of persistent bias) estimates of the parameters of the model while the alternatives do not. That is the implication of the rejection.

The question then asks "parties are asked to indicate whether rejection of the hypotheses in a) establish that Model B is statistically superior to the models nested within it.

The same issue about nesting applies. In addition, the question does not make clear whether the correct model to use as a yardstick for these tests is A or B. Assuming that B is the departure point, the exact same reply applies to B as to A in the previous reply. The issue of "statistically superior" still needs to made clear, but by the consistency rule above, the more general model is better. Model B is more general than the pooled and random (time) effects models. Both of these rejected models impose restrictions, and incorrect (rejected) restrictions produce biased and inconsistent parameter estimators.

QUESTION:

(c) Parties are asked to discuss whether Models A and B are nested within one another, and whether rejection of the hypotheses described in a) provide statistical grounds for preferring either of these models over the other.

RESPONSE:

(c) Models A and B are not nested within each other. Both are nested within a Model C which is

$$y_{it} = \beta_0 + \delta_i + \lambda_t + x_{it}\beta + \varepsilon_{it}$$

where the δ_is sum to zero and the λ_ts sum to zero -- this just shifts things so there is an overall constant and the time or site specific effects just show the difference from the overall constant. The term nesting as used in econometrics applies to the situation in which one model, the one which is nested within the other, can be obtained by restricting the parameters of the larger model. In this case, model A is obtained by assuming that λ_t equals zero for all t, while model B results if δ_i equals zero. However, no restriction on model A produces Model B, nor the reverse. The second part of this question asks whether "rejection of the hypotheses described in a) provide statistical grounds for preferring either of these models over the other." This question is a bit ambiguous. I interpret it to ask whether rejection of the random effects or the pooled model in the context of Model A provides a statistical basis for -preferring model B over A, and vice versa. The answer is no. Rejection of the hypotheses provides a statistical basis for preferring the model which was maintained. Thus, in the context of Model A, rejection of the pooled and random effects model provides a statistical basis for preferring model A, and says nothing direct at all about model B. Indeed, it argues against B, since B would aggregate the site specific effects into a single constant, which is precisely the hypothesis that was rejected. The same argument applies in reverse if we depart from model B. The answer to this question is *no*.

RESPONSE OF UNITED STATES POSTAL SERVICE WITNESS GREENE TO NOTICE OF INQUIRY NO. 4, ITEMS (b) through (f)

QUESTION:

(d) Parties are asked to discuss whether witness Bozzo's rejection of the hypotheses applicable to Model A is sufficient to establish that Model (A) yields a valid estimate of β, which determines the magnitude of volume variability.

RESPONSE:

(d) The question asks whether witness Bozzo's rejection of the hypotheses applicable to model A is sufficient to establish that model A yields a valid estimate of β, which determines the degree of volume variability. This question contains, unfortunately, a subtle ambiguity. Model A is the most general of the three models suggested, in the sense that if the correct model is

$$y_{it} = \beta_0 + \delta_i + x_{it}\beta + \varepsilon_{it}$$

where β_0 is a common, overall constant while δ_i is a site specific constant, shifted in such a way that the average of the δ_is is zero, then the fixed effects formulation is robust in the sense that it will provide a "valid" estimate of β whether the fixed effects, the random effects, or the pooled model is actually the right model. The pooled estimator will only do so if $\delta_i = 0$ for all i while the random effects estimator will only do so if the values of δ_i are uncorrelated with x_{it}. But, the fixed effects estimator is consistent in all cases. The subtle ambiguity is that it has been assumed at the outset that the model above is already complete. If there is a $z_{it}\theta$ missing from the right hand side of the model, then the analyst might, ignoring this fact, carry out tests which would lead them to Model A, but, in fact, none of the three estimators is consistent in this case. The result here is that to answer the question, it must be agreed upon at the outset that model A as stated is a complete model already. In point of fact, it seems very likely that for this case, the missing $z_{it}\theta$ would be the time effects discussed in the next question.

RESPONSE OF UNITED STATES POSTAL SERVICE WITNESS GREENE TO NOTICE OF INQUIRY NO. 4, ITEMS (b) through (f)

QUESTION:

(e) Parties are asked to discuss whether rejection of the hypotheses applicable to Model (B) is sufficient to establish that Model B yields a valid estimate of β, which determines the magnitude of volume variability.

RESPONSE:

(e) The answer to this question is the same as that to (d), but the argument is more compelling in this case. Considering the specifics of this case, rejecting the random and fixed effects models in the context of B would only be sufficient to validate the estimator of β in model B if it were agreed that there were no site specific effects missing from the model. Based on the empirical evidence presented, this seems very unlikely. So, once again, the answer is no, it is not sufficient.

QUESTION:

(f) Parties are asked to discuss whether, even with the rejection of the hypotheses described in a), there may be theoretical grounds for concluding that a rejected model could provide a better estimate of variability than either Model A or B.

RESPONSE:

(f) Are there theoretical reasons why a rejected model could provide a better estimate of variability than either model A or B? There is one way. Strictly in the narrow context of A or B, both the rejected models, pooled and random effects models, provide inconsistent estimators of the parameter in question, while the parent model provides a consistent estimator. However, in such a case, an analyst might weight the possibility that the inconsistent estimator is more precise in the sense of having a smaller variance than the consistent one. By this construction, the rejected estimator might be preferred. Intuitively, what this means is that the "accepted" (fixed effects) estimator is generally right on average, but has a moderately high probability of being wrong by a fairly large amount. At the same time, the rejected estimator is demonstrably wrong all the time, but not wrong by all that much. So, we trade a small amount of bias for a reduction in imprecision. This phenomenon is called, in fact, the "precision" of the estimator, and it is possible that the biased estimator could be more precise.

This type of tradeoff tends to be worth serious consideration in fairly small samples, and can be deduced when the test statistics that lead to rejection or nonrejection of the hypotheses tend to be borderline—for example, a t statistic for testing the hypothesis that a coefficient is zero comes out at 1.7. With respect to this specific case, the samples are extremely large and the test statistics are huge. Based on the empirical evidence, I conclude, and recommend, that the possibility is not even close. The effect we would observe here, based on the huge test statistics, is that the rejected estimator is not biased by a small amount. It is off by a very large amount, and under this circumstance, questions of the possibly smaller variance are moot.

Could a rejected model provide a better estimate of a parameter than a maintained one? Yes. Could the pooled or random effects model provide a better estimate of the volume variability in this particular case than the fixed effects model? No.

A final conclusion, I feel that the questions raised in the context of models A and B in this NOI are too narrow. The appropriate model for the Commission to be considering is my model C.

DECLARATION

I, William H. Greene, declare under penalty of perjury that the foregoing is true and correct, to the best of my knowledge, information, and belief.

Dated: 8/21/00