

Appendix: Response to Information Request

1 Formula Used for Question 5

The first-stage variance of the current estimator and the alternative form of the first-stage variance of the proposed estimators are

$$V(\hat{t}) = N^2 \left(1 - \frac{n}{N}\right) \frac{S_1^2}{n}$$

$$V(\hat{t}_{ratio}) = N^2 \left(1 - \frac{n}{N}\right) \frac{1}{n} (S_1^2 - 2R\rho S_1 S_x + R_i^2 S_x^2)$$

Because of the differences in stratification mechanisms between the current and proposed, the comparison has to be made at the national-level. This means that the predicted reduction in variances computed here exclude any effects due to the difference in stratification.

The percentage in reduction of the ratio estimator is

$$\begin{aligned} \% \text{ Reduction in CV} &= \frac{CV(\hat{t}_{ratio}) - CV(\hat{t})}{CV(\hat{t})} \\ &= \frac{CV(N\hat{t}_{ratio}) - CV(N\hat{t})}{CV(N\hat{t})} \\ &= \frac{N \times SE(\hat{t}_{ratio}) / \hat{t}_{ratio} - N \times SE(\hat{t}) / \hat{t}}{N \times SE(\hat{t}) / \hat{t}} \\ &\approx \frac{SE(\hat{t}_{ratio}) - SE(\hat{t})}{SE(\hat{t})} \\ &= \frac{\sqrt{-2R\rho S_1 S_x + R_i^2 S_x^2}}{\sqrt{S_1^2}} \end{aligned}$$

where $R = \frac{\hat{t}}{\hat{X}} = \frac{\hat{t}}{\hat{X}}$ and ρ is the actual correlation. The approximate equality follows from the assumption that $\hat{t}_{ratio} \approx \hat{t}$. Please refer to cells N19 and N25 for the predicted reduction in CVs of Pieces and Revenue in the excel file associated with this response.