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Is Free Trade Good For The Environment?

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QUESTIONS & ANSWERS

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http://pacific.commerce.ubc.ca/antweiler/public/ACT-Q+A.pdf

In this document we have collected responses to questions that have been put forward to us about our research paper. Additional information about our paper is also contained in a technical appendix that can be downloaded from the web at http://pacific.commerce.ubc.ca/download/appendix.pdf

1 Calculation of Elasticities

Below is a brief explanation on how we obtain our estimates of the various elasticities. Consider the case where we have log emissions ($\ln z$) on the left hand side and per-capita income (y) on the right hand side in linear and square term. Our estimation procedure yields estimates for the coefficients β_0, β_1 and β_2, along with corresponding standard errors. We then apply the Delta method (see for example William Greene's textbook *Econometric Analysis*, 3rd.ed., pages 278-80) to obtain estimates and standard errors of the elasticities we are interested in. Starting with the (truncated) estimating equation

$$\ln z = \beta_0 + \beta_1 y + \beta_2 y^2 \tag{1}$$

the corresponding elasticity can be calculated as

$$\eta = \frac{\mathrm{d}z}{\mathrm{d}y}\frac{y}{z} = \left[z(\beta_1 + 2\beta_2 y)\right]\frac{y}{z} = \beta_1 y + 2\beta_2 y^2 \tag{2}$$

The elasticities reported in the tables are evaluated at overall sample means $\bar{\bar{y}}$, while for figures 2 and 3 we use each country's mean (across time)

$$\bar{y}_c \equiv \frac{1}{T_c}\sum_{t=1}^{T_c} y_{ct} \tag{3}$$

in order to obtain country-specific elasticities. In the case of table 1, column 1, this procedure is of course trivial as $\beta_2 = 0$ and one only needs to multiply the estimate of β_1 with an appropriate sample mean.

The sample mean we use in the above calculation is not the one reported in table B1; hence the confusion. The figures in table B1 report averages across all 2,555 observations. However, as we were aware that our sample is quite concentrated with a large number of observations from the United States, we were quite naturally worried that using the simple mean

$$\bar{y} = \left[\sum_{c=1}^{N}\sum_{t=1}^{T_c} y_{ct}\right]\left[\sum_{c=1}^{N} T_c\right]^{-1} \tag{4}$$

would give too much weight to the richest country in our sample. (See our technical appendix, available on my web site, for a detailed description of the composition of our data set.) We thus opted to employ a more conservative approach by using the average of country averages, that is

$$\bar{\bar{y}} \equiv \frac{1}{N}\sum_{c=1}^{N}\left[\frac{1}{T_c}\sum_{t=1}^{T_c} y_{ct}\right] = \frac{1}{N}\sum_{c=1}^{N}\bar{y}_c \tag{5}$$

instead of the simple mean $\bar{y}$. The difference between $\bar{\bar{y}}$ and $\bar{y}$ accounts for the discrepancy between your calculation and the numbers in the paper.

To obtain $\eta = -0.905$ as the estimate of the technique elasticity in table 1, column 1, the estimate $\beta_1 = -0.982$ has to be multiplied with $\bar{\bar{y}} = 0.922$. Below is a table with the relevant sample means for the most important other variables.

Variable	Mean $\bar{\bar{x}}$
Economic Intensity ($m per km^2)	4.614
GNP per capita (3-year moving average, lagged)	0.922
Capital Abundance (K/L)	5.733
Openness	0.560
Relative Per-Capita Income	1.702
Relative Capital Abundance	1.401

Note that the difference between the different types of means is largest for the economic intensity measure. This is due to the relatively large contribution of rural sites from the U.S. Had we used the simple mean we might have seriously understated the scale effect. In the end, focusing on country-specific results along the lines of figures 2 and 3 is thus quite important, and it is of course one of the key insights of the paper: trade's effect on pollution concentrations has to be conditioned on country characteristics.