Online Appendix to: Who Benefits from State Corporate Tax Cuts? A Local Labor Markets Approach with Heterogeneous Firms: Comment

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A Re-stating Hanemann (1984)'s result

In this section, we restate the result by Hanemann (1984) to make it match SZ conceptual framework and notations more directly.

Definition and setup. Consider a discrete choice by agent j involving $c = 1, ..., C$ options. We denote $V_c^F = v_c + \zeta_{jc}$ the value of c for agent j where v_c is a common value to all agents in the economy—i.e. the nonstochastic component of the value associated with choice c—and ζ_{jc} is an idiosyncratic taste shock. For simplicity, we will omit the subscript j from now on. We define with A_c the set of values of the vector ζ such that the option c yields to highest value to the agent, i.e. $A_c \equiv \{\zeta \mid V_c^F > V_{c'}^F, \forall c'\}$.

Let ζ be a vector of i.i.d. random variables distributed Type 1 Extreme Value with scale/dispersion parameter σ. Note that $\mathbb{P}(\zeta \in A_c)$ is the probability that option c is actually chosen which we denote, as in SZ's firm problem, with E_c.

Adaptation of Hanemann (1984), equation (3.15).

$$\mathbb{E}\left\{e^{t\zeta_c} \mid \zeta \in A_c\right\} = \Gamma(1-\sigma t) \times \beta_c^{\sigma t}; \quad \text{where } \beta_c^{-1} = \mathbb{P}(\zeta \in A_c). \tag{A1}$$

Translation in SZ setting. Based on equation (A1), and on the definition of z_c provided in equation (8) in the main text, we simply set $t = -(1+\varepsilon^{PD})$ and denote the scale parameter σ^F, to obtain the result presented in equation (9) in the body of the text and which we reproduce here:

$$z_c = \mathbb{E}_\zeta\left[\exp\left(\left(-\varepsilon^{PD} - 1\right)\zeta_{ijc}\right) \mid c\right] = \Gamma\left(1 + (\varepsilon^{PD}+1)\sigma^F\right) \times E_c^{(1+\varepsilon^{PD})\sigma^F}.$$

B Simulation results

In this section, we provide simple simulation results illustrating the finding by Hanemann regarding the link between z_c and E_c.

We consider a set of location $c = 1, ..., C$ where we set $C = 50$. We attribute a value v_c to each location c which is defined as $v_c = c/C$. Accordingly, the support of v_c is $[1/C, 1]$.

There are N^{sim} discrete choices operated overall. For each chooser $n = 1, ..., N^{\text{sim}}$, we draw a vector e_n of C values from an Extreme Value Type I distribution with scale parameter σ^F. The sum of v_c and the idiosyncratic shock e_{cn} determines the value of location c: $V_{cn} = v_c + e_{cn}$.

We collect two objects from each simulation: i) the chosen location based on $c^{\max} = \arg\max_{c'} V_{c'n}\ \forall c' = 1, ..., C\}$; and ii) the associated draw $e_{c^{\max}n}$.

We compute the sample equivalent to E_c and z_c across our N^{sim} choices:

$$E_c^{\text{sim}} = \frac{1}{N^{\text{sim}}} \sum_{n=1}^{N^{\text{sim}}} \mathbb{1}\{c = \arg\max_{c'} V_{c'n}\} \tag{A2}$$

$$z_c^{\text{sim}} = \left(\sum_{n=1}^{N^{\text{sim}}} \mathbb{1}\{c = \arg\max_{c'} V_{c'n}\} \right)^{-1} \times \left(\sum_{n=1}^{N^{\text{sim}}} \mathbb{1}\{c = \arg\max_{c'} V_{c'n}\} \times \exp((-1 - \varepsilon^{PD}) e_{cn}) \right). \tag{A3}$$

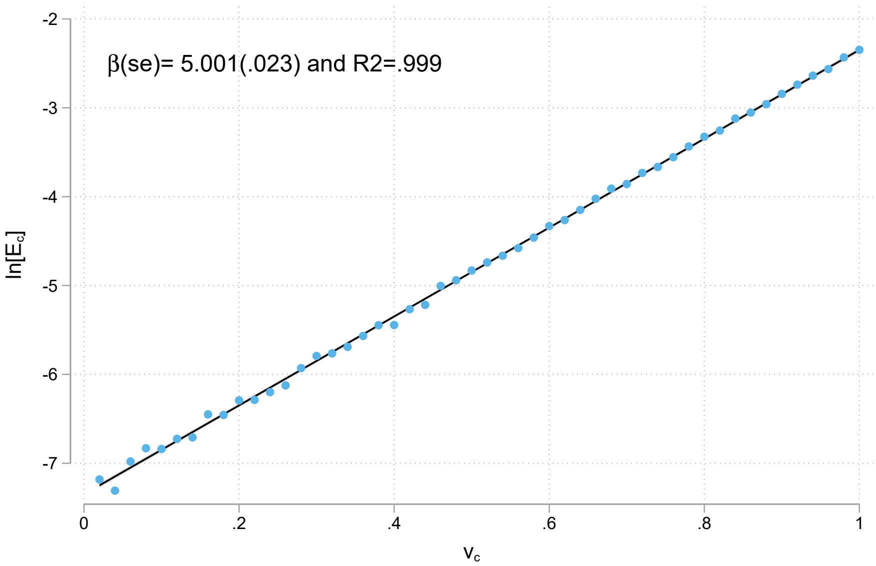
We set the parameters of the simulation are as follows: $C = 50$, $N^{\text{sim}} = 100,000$, $\sigma^F = 0.2$, $\varepsilon^{PD} = -2.5$.

We display the result of our simulation graphically. We start by showing that the relationship between $\ln E_c^{\text{sim}}$ and v_c features the theoretical slope of $1/\sigma^F$ as implied by the multinomial logit formula (see Figure A1).

Figure A2 confirms the negative relationship between $\ln z_c$ and $\ln E_c$ with a slope virtually identical to its theoretical value given the value of the parameters considered ($(1 + \varepsilon^{PD})\sigma^F = -0.30$).

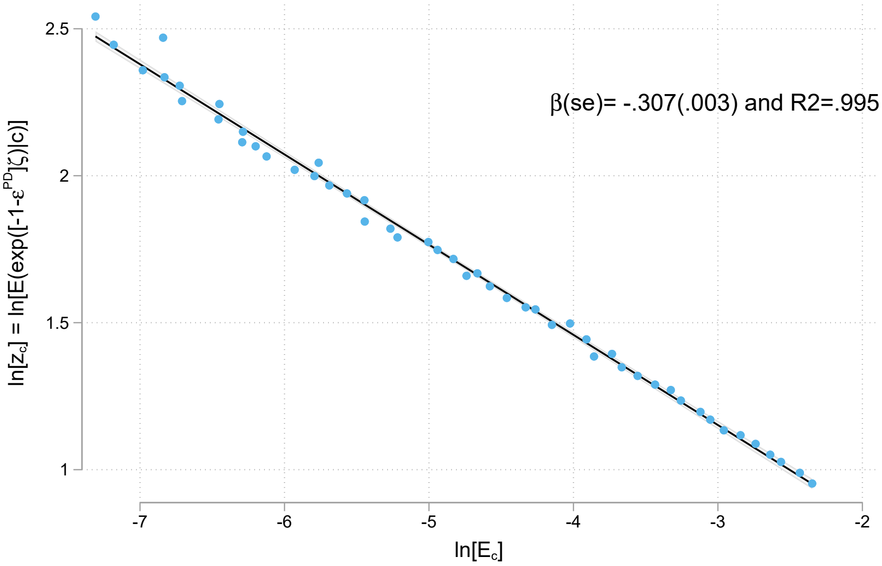
Finally, A3 confirms the negative relationship between $\ln z_c$ and v_c with a slope virtually identical to its theoretical value given the value of the parameters considered ($(1 + \varepsilon^{PD}) = -1.5$).

Figure A1: Scatter of $\ln E_c$ against v_c



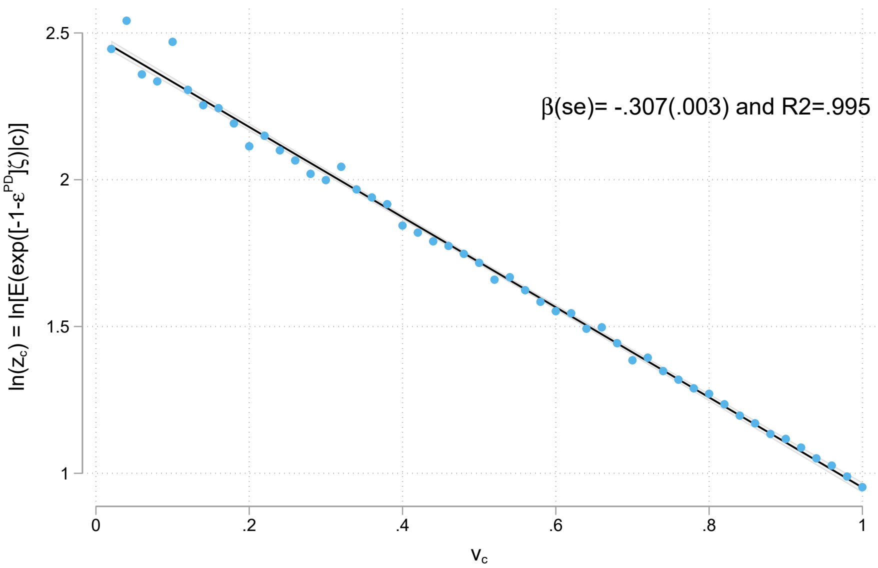
NOTES: This figure plot $\ln E_c^{\text{sim}}$ against v_c. Parameters of the simulation are as follows $C = 50$, $N^{\text{sim}} = 100,000$, $\sigma^F = 0.2$, $\varepsilon^{PD} = -2.5$.

Figure A2: Scatter of $\ln z_c$ against $\ln E_c$



NOTES: This figure plot $\ln z_c^{\text{sim}}$ against $\ln E_c^{\text{sim}}$. Parameters of the simulation are as follows $C = 50$, $N^{\text{sim}} = 100,000$, $\sigma^F = 0.2$, $\varepsilon^{PD} = -2.5$.

Figure A3: Scatter of $\ln z_c$ against v_c



NOTES: This figure plot $\ln z_c^{\text{sim}}$ against v_c. Parameters of the simulation are as follows $C = 50$, $N^{\text{sim}} = 100,000$, $\sigma^F = 0.2$, $\varepsilon^{PD} = -2.5$.

C Additional results and tables

C.1 Implications for ε^{PD} of reduced-form estimates.

As acknowledged by the authors on page 2612, an additional issue with the use of the original equation (18SZ) for identification is that solving for $\gamma(1+\varepsilon^{PD})$ yields the following equation (the second equation page 2599 of SZ):

$$\gamma\left(\varepsilon^{PD}+1\right)=\left(\frac{\beta^N-\beta^E}{\beta^W}+1\right). \tag{A4}$$

Given the estimates presented in Table 4 of SZ, the ones used in the computation of the incidence in SZ's Table 5, yields a positive number as β^N is consistently found to be larger than β^E.

As SZ write: *"Having determined the incidence on wages, the incidence on profits is straightforward; it combines the mechanical effects of lower corporate taxes and the impact of higher wages on production costs and scale decisions."* Given that the mechanical effect of a change in the log of net-of-tax-rate is simply 1, it is natural to expect the sum of the mechanical effect and the impact of higher wage on profit to be lower than 1, i.e. $\dot{\pi}_c < 1$, as long as the change in wages $\dot{w}_c$ is larger than the output elasticity ratio $\frac{\gamma}{\delta}$. Surprisingly, column (1) of SZ's Table 5 shows that the overall change in profits is higher than the mechanical effect, despite Table 4 showing that $\beta^W = 1.45 > \frac{\gamma}{\delta} = 0.9$. This surprising result stems from using equation (A4) in order to identify $\gamma\left(\varepsilon^{PD}+1\right)$.

The implication that $\gamma\left(\varepsilon^{PD}+1\right) > 0$ is at odds with the assumption that the product demand elasticity is below -1 (see page 2588). The assumption that $\varepsilon^{PD} < -1$ is necessary for monopolistic competition to admit a solution with positive prices. Therefore, when ignoring the compositional margin, interpreting the reduced-form results through the theoretical formula for local labor elasticity leads to an incompatibility. In Table A2, we list the values of structural parameters implied by the reduced-form results based on SZ's formulas (reported in the last row of their Table 1). We see that estimates for parameters pertaining to the labor demand side of the economy $(\varepsilon^{PD}, \sigma^F)$ display the wrong sign. On the contrary, following the baseline calibration of Table 3, $\varepsilon^{PD} = -2.5$ and $\gamma = 0.15$, and applying the corrected formula for σ^F, we obtain consistently positive values.

Hence, accounting for the compositional margin loses the identification of the term $\gamma\left(\varepsilon^{PD}+1\right)$ but also bypasses the resulting incompatibility between the reduced-form results and the theoretical model.

C.2 Structural form of the model

Here we specify the differences with respect to SZ regarding the structural form of the model. Equilibrium changes in wages, population, rents and number of establishments are stacked in vector $\mathbf{Y}_{c,t}$ while changes in taxes are stacked in $\mathbf{Z}_{c,t}$.

$$\mathbf{Y}_{c,t} = \begin{bmatrix} \Delta \ln w_{c,t} \\ \Delta \ln N_{c,t} \\ \Delta \ln r_{c,t} \\ \Delta \ln E_{c,t} \end{bmatrix}, \mathbf{Z}_{c,t} = [1 - \tau^b_{c,t}].$$

Denoting $\mathbf{e}_{c,t}$ a structural error term, we obtain what SZ refer to as the "structural form":

$$\mathbf{AY}_{c,t} = \mathbf{BZ}_{c,t} + \mathbf{e}_{c,t} \text{ where } :$$

$$\mathbf{A} = \begin{bmatrix} -\frac{1}{\sigma^W} & 1 & \frac{\alpha}{\sigma^W} & 0 \\ 1 & -\frac{1}{\varepsilon^{LD}} & 0 & 0 \\ -\frac{1}{1+\eta} & -\frac{1}{1+\eta} & 1 & 0 \\ \frac{\gamma}{\sigma^F} & 0 & 0 & 1 \end{bmatrix}, \mathbf{B} = \begin{bmatrix} 0 \\ \frac{1}{\varepsilon^{LD}\sigma^F(\varepsilon^{PD}+1)} \\ 0 \\ \frac{\delta}{\sigma^F} + \frac{1}{-\sigma^F(\varepsilon^{PD}+1)} \end{bmatrix} \tag{A5}$$

We highlight in blue the terms that are different with respect to SZ. ε^{LD} is included in SZ initial derivation but its expression as a function of structural parameters should follow (11) as a opposed to (9SZ). $\frac{\delta}{\sigma^F}$ was omitted from the expression.

C.3 Tables

Table A1: Tests of model-based restrictions on reduced-form estimates.

Reduced form estimates from:	Table 4 SZ column 1	Table 4 SZ column 5	Table 4 SZ column 6
$R = \beta^N + \beta^W - \beta^E + 1$	2.65	2.30	1.55
χ^2: $R = 0$	4.98	3.63	9.89
p-value: $R = 0$	0.03	0.06	0.00

NOTES: This table shows nonlinear test implied by equation (24).

Table A2: Implications of reduced-form estimates for structural parameters under SZ formulas

Reduced form estimates from:	Table 4 SZ column 1	Table 4 SZ column 5	Table 4 SZ column 6
Preference Dispersion σ_W	.26	.64	1.12
	(.17)	(.98)	(1.71)
Productivity Dispersion σ_F	-.09*	-.23	-.44
	(.05)	(.21)	(.44)
Housing Supply η	3.88	.64	1.09
	(5.24)	(1.1)	(1.15)
Product Demand (ε^{PD})[a]	7.59	5.66	4.8
	(6.25)	(4.76)	(3.15)
Productivity Dispersion (σ_F)[b],	0.14*	0.33	0.93
accounting for comp. margin	(0.08)	(0.35)	(0.87)

NOTES: This table shows the estimates of structural parameters based on the formulas provided in the last row of Table 1 of SZ. The different columns show different values which correspond to different empirical specifications displayed in Table 4 of SZ.
[a] Note that regarding ε^{PD}, the formula used in this table—which come from Table 1 last row of SZ—do not necessarily match the equation (18SZ) in section III.B from which it derives. Equation (18SZ) implies: $\varepsilon^{PD} = \frac{\beta^N+(1-\gamma)\beta^W-\beta^E}{\gamma\beta^W}$. Instead, Table 1 last row expresses ε^{PD} as: $\frac{\beta^N+\beta^W-\beta^E}{\gamma\beta^W}$ which corresponds to $\varepsilon^{PD}+1$.
[b] The formula for σ^F in this line is based on the corrected version of the total elasticity of establishment growth to local business tax (see equation 15) which implies: $\sigma^F = \frac{\delta-(1+\varepsilon)^{-1}-\gamma\beta^W}{\beta^E}$ with parameters $(\delta/\gamma, \gamma, \varepsilon^{PD})$ calibrated as in baseline of Table 3. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table A3: Revisiting Estimates of Economic Incidence Using Reduced-Form Effects: Based on Estimates of Specification (5) of Table 5

		(1) SZ Table 5 col.5	(2) SZ BL param.	(3) $\varepsilon^{PD} = -4$	(4) $\varepsilon^{PD} = -5$
Panel A. Incidence	Workers	.98	.98	.98	.98
		(.84)	(.84)	(.84)	(.84)
	Landowners	1.86	1.86	1.86	1.86
		(1.56)	(1.56)	(1.56)	(1.56)
	Firm owners	1.54*	.86***	.71	.62
		(.92)	(.25)	(.5)	(.67)
Panel B. Incidence share	Workers	.22*	.26	.28	.28
		(.12)	(.17)	(.18)	(.2)
	Landowners	.42**	.5**	.52**	.54**
		(.17)	(.2)	(.22)	(.24)
	Firm owners	.35***	.23	.2	.18
		(.09)	(.18)	(.23)	(.26)
χ^2 : Joint test $S_W = 1$ and $S_F = 0$		76.27	19.33	16.29	14.98
P-value: Joint test $S_W = 1$ and $S_F = 0$		0.00	0.00	0.00	0.00
	ϵ^{PD}		-2.5	-4	-5
	γ		0.15	0.15	0.15
	γ/δ	0.9	0.9	0.9	0.9
	Housing share α	0.3	0.3	0.3	0.3

NOTES: This table shows the estimates of the economic incidence expressions. Results are produced based on the coefficients from specification (2) displayed in Table 4 in SZ unless otherwise specified. Regressions use population as weights (see SZ Table 5 notes for more details). Standard errors clustered by state are in parentheses. Results are produced based on the coefficients from the specification (5) of Table 4 in SZ unless otherwise specified. Column (1) reproduces the results from Table 5 Column (5) of SZ—which are based on SZ formula $\dot{\pi}_c = 1 + \left(\frac{\beta^N - \beta^E}{\beta^W} + 1\right)\left(\beta^W - \frac{\delta}{\gamma}\right)$ (see SZ Table 1). Column (2) takes the original formula for the incidence on firm owners $\dot{\pi}_c = 1 + \gamma\left(\varepsilon^{PD} + 1\right)\left(\dot{w}_c - \frac{\delta}{\gamma}\right)$ and calibrate parameters ε^{PD} and γ based on the baseline values chosen by SZ (see SZ Table 3, Panel: *Additional parameters for structural implementation*). Columns (3) to (4) experiment with higher value of ε^{PD}. Calibration of the housing cost share and γ/δ follows SZ baseline choice. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.