



HAL
open science

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

Clément Malgouyres, Thierry Mayer, Clément Mazet-Sonilhac

► **To cite this version:**

Clément Malgouyres, Thierry Mayer, Clément Mazet-Sonilhac. Who Benefits from State Corporate Tax Cuts? A Local Labor Markets Approach with Heterogeneous Firms: Comment. 2020. halshs-03082268v1

HAL Id: halshs-03082268

<https://shs.hal.science/halshs-03082268v1>

Preprint submitted on 18 Dec 2020 (v1), last revised 16 Jul 2021 (v2)

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



WORKING PAPER N° 2020 – 83

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

**Clément Malgouyres
Thierry Mayer
Clément Mazet-Sonilhac**

JEL Codes: H22, H25, H32, H71, R23, R51

Keywords: Incidence, Corporate income tax, Discrete/continuous choice



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

Clément Malgouyres[†] Thierry Mayer[‡] Clément Mazet-Sonilhac[§]

December 2020

Abstract

Suárez Serrato and Zidar (2016) identify state corporate tax incidence in a spatial equilibrium model with imperfectly mobile firms. Their identification argument rests on comparative-statics omitting a channel implied by their model: the link between common determinants of a location's attractiveness and the average idiosyncratic productivity of firms choosing that location. This compositional margin causes the labor demand elasticity to be independent from the product demand elasticity, impeding the identification of incidence from reduced-form estimates. Assigning consensual values to the unidentified parameters, we find that the incidence share born by firm-owners is closer to 25% than the 40% initially reported. The null associated with the "conventional view" that the share on workers is 1 and that on firm owners is 0 is still rejected.

JEL: H22, H25, H32, H71, R23, R51

Key words: incidence, corporate income tax, discrete/continuous choice

*Malgouyres thanks ANR for financial support through grants ANR-17-EURE-0001 and ANR-19-CE26-0004. The views expressed herein are those of the authors and do not necessarily reflect those of the Banque de France or the Eurosystem.

[†]Paris School of Economics-IPP. Email: clement.malgouyres@ipp.eu.

[‡]Sciences Po, CEPII and CEPR. Email: thierry.mayer@sciencespo.fr.

[§]Sciences Po, Banque de France. Email: clement.mazet@sciencespo.fr.

1 Introduction

The incidence of the corporate income tax is arguably one of the most important questions in public finance and one that has defied clear cut empirical answers until recently. In 2016, [Suárez Serrato and Zidar \(2016\)](#), SZ henceforth, published a paper in the *American Economic Review* which broke ground both empirically and theoretically.

Empirically, they estimate the effects of changes in business taxes on four key outcomes, namely wages, establishment growth, rental costs and local population, using variation in state corporate tax rates. Theoretically, they develop a spatial equilibrium model in which firms vary idiosyncratically in terms of how productive they are across locations, with workers also displaying idiosyncratic preferences across alternative states of residence. Within this model, they study how the reduced-form impacts of changes in business taxes relate to changes in the welfare of workers, firm-owners and landowners. In particular, they show that, conditional on two parameters, their reduced-form results point-identify the incidence from changes in tax rates, i.e. the burden falling on each category of agents.

In this short comment, we show that comparative statics computed by SZ ignore the fact that changes in business tax rates in a given location—or other fundamentals affecting how attractive a location is for all business-owners—will affect the conditional expectation of the idiosyncratic productivity draw of firms actually choosing to locate in that particular location. Technically, there is a missing term in SZ's derivation of labor demand elasticities with respect to local fundamentals that are commonly valued by firm owners. We show that correcting this omission has important implications for SZ identification argument.

In SZ model, firm (log) productivity is equal to the sum of a local component common to all firms in the same location and of an idiosyncratic firm-location specific productivity draw. In that setting, intuitively, a high tax state will tend to attract (or retain), *ceteris paribus*, firms with higher realization of their state-specific idiosyncratic productivity draws than if the business taxes were lower. Analogously, consider an exogenous decline in local wage (due for instance to an unexpected increase in local labor supply in a given state). SZ show that in their model this shock will affect total local demand for labor in two ways. First, low labor costs will attract new entrants—what SZ refers to as the *extensive margin*. Second, for a given level of idiosyncratic productivity, it will make firms expand their scale of production and become more labor intensive—what SZ refer to as the *scale* and *substitution* effects respectively, the sum of which they call the *intensive margin*. We show that there is a third effect through which local labor demand will be impacted: the change in the average idiosyncratic

productivity of firms actually choosing to be based in that area following the decline in local wages. This effect, which we refer to as the “compositional margin” (using terminology from the trade literature surveyed in [Head and Mayer \(2014\)](#)), will work in the opposite way as the first two: as labor cost decreases, the state becomes more attractive and newly arriving firms tend to display *lower* idiosyncratic productivity draws than before. Taking the compositional margin into account turns out to have important implications for the identification of the incidence of corporate tax cuts. We show this in three main steps.

We first show that, under the distributional assumptions made by SZ, the compositional margin exactly offsets the substitution and scale effects described above, so that the local wage elasticity of labor demand is entirely driven by the location choice of plants. This result causes SZ’s exact identification argument to break down. In particular, we show that the term $\gamma(1 + \varepsilon^{PD})$, that is the labor elasticity of output (γ) times 1 plus the elasticity of product demand (ε^{PD}), is no longer identified through the combination of reduced form effects for which SZ obtain an empirical estimates. When accounting for the compositional margin, the two parameters (γ, ε^{PD}) need to be calibrated in order to identify the incidence of the corporate tax cuts on firm owners from SZ reduced-form estimates.

Second, we point out that ignoring the compositional margin creates inconsistencies between the theoretical framework and the empirical reduced-form results. The formula used by SZ to identify the incidence of business tax changes from reduced-form effects implies values for some structural parameters that are incompatible with a well-defined equilibrium—given the value of SZ’s reduced-form point estimates. More specifically, the reduced-form estimates obtained by SZ, when plugged into their formula for the term $\gamma(1 + \varepsilon^{PD})$, imply a product demand less than unit-elastic, i.e. $\varepsilon^{PD} > -1$, which is not compatible with a well defined equilibrium in the monopolistic competition setting that they consider. Accounting for the compositional margin allows to bypass the issue.

Third, we calibrate the corrected incidence formulas using a range of values for the parameters that cannot be identified and assess the associated incidence. Given consensual values, taken from SZ’s own baseline, we find that firm owners bear a smaller share of the burden (around 25%) than the magnitudes reported by SZ in the relevant part of their paper using reduced form estimates.¹

¹We do not revisit the structural estimation implemented by SZ (Section VI) in our comment. However, given that this approach relies on a mis-specified formula for the elasticity of labor demand as well as for the partial elasticity of location choice to the net-of-tax rate (see equation (4) and associated comments below) , it is likely that results presented in this note have consequences on this front as

This comment is structured as follows. We recall the broad structure of SZ model in section 2. We highlight the role played by the compositional margin in the macro local labor demand in section 3. Implications regarding the incidence on workers and business owners and the exact identification of the incidence terms from the reduced form moments are discussed in section 4. Section 5 presents new results using calibrated values for the two elasticities that are not identified when accounting for the compositional margin.

2 Overview of the model

We first present the key building blocks of the model used in [Suárez Serrato and Zidar \(2016\)](#) (using the published version in the AER and its online appendix). Unless otherwise specified, we follow their notation exactly.

The goal of SZ is to characterize the incidence on wages, rents, and profits of a change in the local business tax. Accordingly, their economy is populated by three types of agents: workers, business owners, and landowners. The effect of a change in the local business net-of-tax rate $1 - \tau_c^b$ on the welfare of each of these agents are characterized as functions of estimable elasticities (reduced-form effects) which themselves reflect structural parameters governing the supply and demand sides of the housing, labor, and product markets.

Workers choose their location to maximize utility, landowners supply housing units to maximize rental profits and establishments choose location and scale to maximize after-tax profits.

Household choice. SZ consider a standard environment in terms of worker's location choice (see e.g. [Kline and Moretti, 2014b](#)). Wages, rental costs, and amenities vary across locations and commonly valued by all households. Each household however displays idiosyncratic preferences for each location. The household picks the location yielding the highest utility, where the utility is equal to the sum to the common component and the idiosyncratic term. Given that idiosyncratic term follows an Extreme Value Type I distribution with dispersion parameter σ^W , this set-up yields a multinomial logit. Housing costs enter indirect utility with a constant weight α .

well. We detail some of these consequences at the end of Section 5.

Housing supply. Landowners supply housing units to maximize rental profits. The elasticity of housing supply—denoted η —will determine how much an increase in labor supply—due for an increase in local amenities for instance—translates into rising prices or rising population.

Elasticity of labor supply. The elasticity of housing supply and the dispersion term, together with the Cobb-Douglas weight on housing, define an “effective” elasticity of labor supply: by how much does local labor force increase following an increase in local wage w_c taking into account the fact that housing costs will go up following the arrival of new workers. This elasticity is denoted as ε^{LS} .

Establishment problem. When choosing the location of establishment j , firm owners seek to maximize the after tax profits π_{jc} . The log of establishment j 's productivity B_{jc} in location c is the sum of a location-specific level productivity common to all establishments, and of a location-establishment specific term ζ_{jc} distributed i.i.d. Extreme Value Type I with dispersion parameter σ^F . This set-up gives rise to a multinomial logit model of the location choice probability. Firms act as competitive monopolists and face a firm-level elasticity of demand denoted by $\varepsilon^{PD} < -1$.

In the SZ setup, the establishment problem involves i) the above described location choice and, ii) conditional on location choice, a decision regarding inputs, in particular labor, in order to maximize profit once a location has been chosen. The location choice is discrete while the input choice is continuous. In that sense, the problem facing the establishment is formally very similar to what Hanemann (1984) refers to as “discrete/continuous models” of consumer demand.² We will explore the implications of this formal similarity in the next section.

3 The compositional margin in the “macro elasticity of local labor demand”

In this section, we establish the existence of a compositional margin and how it impacts what SZ refer to as the macro elasticity of local labor demand. As a convention, when referring to equations that are directly taken from SZ we recall their original

²Carlton (1983) uses this setup to study the joint decision of location choices and employment of plants in the USA.

number on the left side of the equation with the number in brackets followed by the letters “SZ”.³

The establishment (discrete) location choice. The establishment problem involves a location choice giving rise to a probability for each location c to be chosen. This probability takes the familiar multinomial logit form given that ζ_{jc} , i.e. the idiosyncratic productivity of establishment j in location c follows a Type I extreme value distribution (with dispersion parameter σ^F), with draws across location being i.i.d. Denoting E_c the probability of a firm to locate in c , it can be expressed as:

$$(7SZ) \quad E_c = \mathbb{P} \left(V_{jc} = \max_{c'} \{ V_{jc'} \} \right) = \frac{\exp \frac{v_c}{\sigma^F}}{\sum_{c'} \exp \frac{v_{c'}}{\sigma^F}}, \quad (1)$$

where V_{jc} refers to the value function of establishment j when choosing location c which is itself the sum of the idiosyncratic productivity draw ζ_{jc} and a value common to all firms denoted v_c . Following SZ definition, the term v_c is equal to the non-stochastic component of establishment log profit in location c divided by $-(\varepsilon^{PD} + 1) > 0$ ⁴ and writes as follows:

$$v_c \equiv \frac{\ln(1 - \tau_c^b)}{-(\varepsilon^{PD} + 1)} + \bar{B}_c - \gamma \ln w_c - \delta \ln \rho_c + \frac{\ln \kappa_1}{-(\varepsilon^{PD} + 1)},$$

where ε^{PD} represents the product elasticity of demand, \bar{B}_c is a common location-specific level of productivity, γ and δ are the elasticities of output with respect to, respectively, labor and capital. The term w_c refer to local wage, the term $\rho_c = \rho / (1 - \tau_c^b)$ refers to the local cost of capital⁵ and finally κ_1 is collection of parameters, constant across establishments and across locations. We recall the definition of V_{jc} in first line

³For instance equation, (6SZ) will refer to the equation (6) of SZ.

⁴This does not affect the discrete choice as it is a strictly increasing transformation, see SZ footnote 16.

⁵The dependence of the cost of capital on the business net-of-tax rate derives from the tax treatment of the returns to equity holders, which is non-deductible against the business income tax, and the assumption that the marginal source of funds is equity. See SZ footnote 14.

of the equation below (see their SZ equation 6) and then group terms:

$$\begin{aligned}
(6SZ) \quad V_{jc}^F &= \underbrace{\frac{\ln(1 - \tau_c^b)}{-(\varepsilon^{PD} + 1)} + \bar{B}_c - \gamma \ln w_c - \delta \ln \rho_c + \frac{\ln \kappa_1}{-(\varepsilon^{PD} + 1)}}_{\equiv v_c} + \zeta_{jc} \\
&= \ln \left[(1 - \tau_c^b)^{-\frac{1}{\varepsilon^{PD} + 1}} \exp(\bar{B}_c) w_c^{-\gamma} \rho_c^{-\delta} \kappa_1^{-\frac{1}{\varepsilon^{PD} + 1}} \exp(\zeta_{jc}) \right] \quad (2) \\
&= \ln \left[(1 - \tau_c^b)^{\delta - \frac{1}{\varepsilon^{PD} + 1}} \exp(\bar{B}_c) w_c^{-\gamma} \rho_c^{-\delta} \kappa_1^{-\frac{1}{\varepsilon^{PD} + 1}} \exp(\zeta_{jc}) \right], \quad (3)
\end{aligned}$$

where we go from (2) to (3) by taking into account (importantly) the fact that the local cost of capital, depends directly on the local net-of-tax rate $\rho_c = \rho / (1 - \tau_c^b)$ (see equation (5) in SZ and associated discussion).

Based on the definition of E_c we can derive the partial derivative of location choice with respect to the net-of-tax rate:

$$\frac{\partial \ln E_c}{\partial \ln(1 - \tau_c^b)} = \frac{\delta}{\sigma^F} - \frac{1}{(\varepsilon^{PD} + 1)\sigma^F}. \quad (4)$$

Notice here a first difference with respect to the analogous equation in SZ (first equation of page 2592) which SZ refer to as one of their key objects of interest and writes as:

$$(9'SZ) \quad \frac{\partial \ln E_c}{\partial \ln(1 - \tau_c^b)} = -\frac{1}{(\varepsilon^{PD} + 1)\sigma^F}.$$

Equation (9'SZ) does not account for the fact that, because the business tax increases the relative cost of capital in location c , new firm entry following a tax cut will be more pronounced the more capital intensive the technology is—where capital intensity is captured by the capital output elasticity δ .

The role of z_c in equation (8) of SZ. The total labor demand in c is equal to the share of firms locating in c multiplied by the optimal labor demand conditional on choosing c . This is given in equation (8) of SZ which we reproduce below:

$$\begin{aligned}
(8SZ) \quad L_c^D &= E_c \times \mathbb{E}_\zeta \left[I_{jc}^* (\zeta_{jc}) \mid c = \arg \max_{c'} \{ V_{jc'} \} \right] \\
&= \underbrace{\left(\frac{1}{C\bar{\pi}} \exp\left(\frac{v_c}{\sigma^F}\right) \right)}_{\text{Extensive margin}} \times \underbrace{w_c^{(\gamma\varepsilon^{PD} + \gamma - 1)} \rho_c^{(1 + \varepsilon^{PD})\delta} \kappa_0 \left(e^{\bar{B}_c(-\varepsilon^{PD} - 1)} \right)}_{\text{Intensive margin}} z_{c'} \quad (5)
\end{aligned}$$

where κ_0 and $C\bar{\pi}$ are constant terms across establishments and across locations. The z_c is defined as follows (see subsection "B.3.1 Intensive Margin" (page 12) of SZ online appendix):⁶

$$z_c \equiv \mathbb{E}_\zeta \left[\exp \left(\left(-\varepsilon^{PD} - 1 \right) \zeta_{jc} \right) \mid c \right]. \quad (6)$$

Conditioning on c ($\cdot \mid c$) is an abbreviation for conditioning on the event that c is the best location for firm j : $A_c \equiv \left\{ c = \arg \max_{c'} \left\{ V_{jc'} \right\} \right\}$. Equation (8SZ) with substitution for z_c based on equation (6) writes as follows:

$$\begin{aligned} L_c^D &= \left(\frac{1}{C\bar{\pi}} \exp \left(\frac{v_c}{\sigma^F} \right) \right) \times w_c^{(\gamma\varepsilon^{PD} + \gamma - 1)} \rho_c^{(1 + \varepsilon^{PD})\delta} \kappa_0 \left(e^{\bar{B}_c(-\varepsilon^{PD} - 1)} \right) \\ &\times \mathbb{E}_\zeta \left[\exp \left(- \left(\varepsilon^{PD} + 1 \right) \zeta_{jc} \right) \mid c = \arg \max_{c'} \left\{ V_{jc'} \right\} \right]. \end{aligned} \quad (7)$$

SZ describe z_c as a "term increasing in the idiosyncratic productivity draw ζ_{jc} " (p.2591). More specifically, based on the definition of z_c given by SZ (see equation 6), z_c is a conditional expectation of a monotonic transformation of ζ_{jc} . The conditioning event here is the location c being chosen. This event, which we denote A_c , occurs with probability E_c . This probability depends on common fundamentals of city level attractiveness as captured in v_c (relative to that of other location, see equation (1)).

A key issue in SZ identification argument is that their derivations ignore the mathematical dependence of z_c with respect to v_c that is implied by their model, as will be clear below. Intuitively, it is straightforward to see why the two should be related. Consider c' to be a very attractive city ($v_{c'} \rightarrow \infty$). The probability that c' is chosen is close to 1. Accordingly, almost all firms, independently of their draw $\zeta_{jc'}$ will be located in c' . In that setting, $z_{c'}$ which is a conditional expectation will be very close to the unconditional expectation, as the conditioning event $A_{c'}$ has almost probability one. On the contrary, an unattractive city c'' with a low value of $v_{c''}$ will only attract firms with fairly high realization of the random term $\zeta_{jc''}$. In that setting, one would

⁶Here we reproduce SZ appendix, see "B.3.1 Intensive Margin" page 12 of SZ online appendix:

$$\begin{aligned} \mathbb{E}_\zeta \left[n^* \left(\zeta_c^j \right) \mid c \right] &= \tilde{w}_c^{(\gamma\varepsilon^{PD} + \gamma - 1)} \tilde{\rho}_c^{(1 + \varepsilon^{PD})\delta} \kappa_0 \mathbb{E}_\zeta \left[B_{ijc}^{-(\varepsilon^{PD} + 1)} \mid c \right] \\ \text{where } \mathbb{E}_\zeta \left[B_{ijc}^{-(\varepsilon^{PD} + 1)} \mid c \right] &= \exp \left(\left(-\varepsilon^{PD} - 1 \right) \bar{B}_c \right) \underbrace{\mathbb{E}_\zeta \left[\exp \left(\left(-\varepsilon^{PD} - 1 \right) \zeta_{ijc} \right) \mid c \right]}_{\equiv z_c}, \end{aligned}$$

where $\kappa_0 = I\mu^{\varepsilon^{PD}} \gamma^{-\gamma(\varepsilon^{PD} + 2) + 1} \delta^{-\delta(\varepsilon^{PD} + 2)} (1 - \gamma - \delta)^{-(1 - \gamma - \delta)(\varepsilon^{PD} + 2)}$. Note that in keeping with SZ analysis in the body of their paper, we ignore the subscript i which refers to firms and consider only the establishment dimension j .

expect $z_{c'}$ to be very high.

The relationship between the probability of the conditioning event E_c and the conditional expectation z_c in the case of a vector of iid Type I extreme value random variables was studied by [Hanemann \(1984\)](#), see in particular equation (3.15) in that paper. We reproduce his derivation in the Section [A](#) of the appendix.

Applying Hanneman's result to the computation of z_c as defined in equation (6), we obtain:

$$z_c = \mathbb{E}_\zeta \left[\exp \left(\left(-\varepsilon^{PD} - 1 \right) \zeta_{ijc} \right) \mid c \right] = \Gamma \left(1 + (\varepsilon^{PD} + 1)\sigma^F \right) E_c^{(1+\varepsilon^{PD})\sigma^F}, \quad (8)$$

where E_c is defined in equation (1).⁷ Because we have $1 + \varepsilon^{PD} < 0$, we do see that z_c is negatively related to E_c . As expected, as $E_c \rightarrow 1$, z_c becomes closer to the unconditional expected value of $\exp \left(\left(-\varepsilon^{PD} - 1 \right) \zeta_{ijc} \right)$. We now highlight the implication of that result for the value of the macro labor elasticity, an object defined in equation (10SZ). In the section [B](#) of our appendix, we perform a simple simulation to substantiate the analytical results presented here.

The “macro” local labor demand equation. We develop the expression of E_c which is the probability that location c is the profit maximizing choice (see equation 1):

$$E_c = \exp(v_c/\sigma^F) / \mathbf{E} = (1 - \tau_c^b)^{-\frac{1}{(\varepsilon^{PD}+1)\sigma^F}} \exp(\bar{B}_c/\sigma^F) w_c^{-\frac{\gamma}{\sigma^F}} \rho_c^{-\frac{\delta}{\sigma^F}} / \mathbf{E}, \quad (9)$$

where $\mathbf{E} = \sum_{c'} (1 - \tau_{c'}^b)^{-\frac{1}{(\varepsilon^{PD}+1)\sigma^F}} \exp(\bar{B}_{c'}/\sigma^F) w_{c'}^{-\frac{\gamma}{\sigma^F}} \rho_{c'}^{-\delta/\sigma^F}$.

We can therefore rewrite the “macro” local labor demand equation as:

$$\begin{aligned} L_c^D &= E_c^{1+(\varepsilon^{PD}+1)\sigma^F} \times w_c^{(\gamma(\varepsilon^{PD}+1)-1)} \rho_c^{(\varepsilon^{PD}+1)\delta} \exp \left(- \left(\varepsilon^{PD} + 1 \right) \bar{B}_c \right) \underbrace{\kappa_0 \times \Gamma \left(1 + (\varepsilon^{PD} + 1)\sigma^F \right)}_{\equiv \kappa_2} \\ &= w_c^{-\frac{\gamma}{\sigma^F}-1} \rho_c^{-\frac{\delta}{\sigma^F}} \left(1 - \tau_c^b \right)^{-\frac{1}{(\varepsilon^{PD}+1)\sigma^F}-1} \exp(\bar{B}_c/\sigma^F) \times \kappa_2 \mathbf{E}^{-1-(\varepsilon^{PD}+1)\sigma^F}, \end{aligned} \quad (10)$$

where the first line substitutes the value of z_c in equation (8) into the labor demand equation (5) and the second is obtained by plugging in the expression of E_c from equation (9).

⁷Or equivalently as : $E_c = \mathbb{P} \left(c = \arg \max_{c'} \{ V_{jc'} \} \right)$.

Implication for the macro elasticity of local labor demand. Taking the partial derivative of (10) with respect to w_c yields the macro elasticity of labor demand (denoted ε^{LD} in SZ):

$$\frac{\partial L_c^D}{\partial \ln w_c} = -\frac{\gamma}{\sigma^F} - 1. \quad (11)$$

Instead SZ's equation (9) writes as:

$$(9SZ) \quad \frac{\partial L_c^D}{\partial \ln w_c} = -\frac{\gamma}{\sigma^F} - 1 + \gamma(1 + \varepsilon^{PD}).$$

The difference between equations (11) and (9SZ) is taking into account the fact that the compositional margin changes with respect to w_c :

$$\frac{\partial \ln z_c}{\partial \ln w_c} = -\gamma(1 + \varepsilon^{PD}) > 0. \quad (12)$$

Under the maintained assumption that $\varepsilon^{PD} < -1$ (required by monopolistic competition), we have $\frac{\partial \ln z_c}{\partial \ln w_c} > 0$.

Therefore, under the distributional assumptions made by SZ (in common with most of the literature combining firm with worker/consumer mobility), changes in z_c due to a change in wages perfectly offset the intensive margin, leaving only the extensive margin parameters to affect the global response. The fact that [Suárez Serrato and Zidar \(2016\)](#) do not account for this effect is the reason why (9SZ) should be replaced by (11), which is the central point of our comment, with substantial quantitative implications that we detail in the next section.

This cancellation of the intensive margin parameters is closely related to recent results deriving gravity equations in the trade literature. It is the same mechanism that explains that the response of aggregate trade flows to changes in variable trade costs only does not depend on the product demand elasticity in [Eaton and Kortum \(2002\)](#) or [Chaney \(2008\)](#) for instance.⁸

Implication for the effect of business tax change on local labor demand. This result also affects what SZ refer to as the “effect of business tax change on local labor

⁸Recent examples where the demand parameter drops from the trade cost elasticity in firm-level sales equation derived in multinational production models appear in [Tintelnot \(2017\)](#) and [Head and Mayer \(2019\)](#).

demand": $\frac{\partial \ln L_c^D}{\partial \ln(1-\tau_c^b)}$, can now be written as:

$$\frac{\partial \ln L_c^D}{\partial \ln(1-\tau_c^b)} = \frac{\partial \ln E_c}{\partial \ln(1-\tau_c^b)} - 1 = \frac{\delta}{\sigma} - \frac{1}{(\varepsilon^{PD} + 1)\sigma^F} - 1, \quad (13)$$

where we used the definition of $\rho_c = \rho/(1-\tau_c^b)$, when differentiating equation (10). The analogous equation in SZ writes as:

$$(9''\text{SZ}) \quad \frac{\partial \ln L_c^D}{\partial \ln(1-\tau_c^b)} = \frac{\partial \ln E_c}{\partial \ln(1-\tau_c^b)} = -\frac{1}{(\varepsilon^{PD} + 1)\sigma^F}.$$

There are two main differences between (9''SZ) and (13). First, the direct effect of $1-\tau_c^b$ on the cost of capital ρ_c implies that the expression for the sensitivity of location choice depends on capital intensity ($\frac{\delta}{\sigma}$, a point we made above).⁹ Second, because z_c is itself a function of $1-\tau_c^b$, the impact of the net-of-tax-rate on labor demand is not the same as its impact on the extensive margin (thus the -1 term).

4 Incidence on workers and business-owners

4.1 The total wage effect of changes in business tax

In this section, we show what implications the properties of z_c (see equation 8) have for wage incidence. We start by recalling relationships between labor demand, the term z_c and the local wage rate w_c as well as the local business tax rate τ_c^b :

$$\begin{aligned} \frac{\partial \ln L_c^D}{\partial \ln z_c} &= 1 \quad \text{from equation (SZ8)} \\ \frac{\partial \ln z_c}{\partial \ln E_c} &= (1 + \varepsilon^{PD})\sigma^F \quad \text{from equation (8)} \\ \frac{\partial \ln z_c}{\partial \ln(1-\tau_c^b)} &= (1 + \varepsilon^{PD})\sigma^F \frac{\partial \ln E_c}{\partial \ln(1-\tau_c^b)} \\ &= (1 + \varepsilon^{PD})\sigma^F \times \frac{1}{\sigma^F} \left(\delta + \frac{1}{-(1 + \varepsilon^{PD})} \right) = (1 + \varepsilon^{PD})\delta - 1. \end{aligned}$$

Using the same notation as SZ, we denote the "total elasticity" of any local variable x_c with respect to changes in $(1-\tau_c^b)$ as $\dot{x}_c \equiv \frac{d \ln x_c}{d \ln(1-\tau_c^b)}$. Calculating those total elasticities

⁹The effect on the cost of capital is included here even though we consider a *partial* derivative. This is because the local cost of capital depends directly on the business tax rate and not through a change in an endogenous variable (which should be only included in a *total* derivative).

for the probability of choosing c as a production location E_c , the compositional margin z_c and the market clearing condition $N_c = L_c^D$, we have

$$\dot{E}_c = \frac{\partial \ln E_c}{\partial \ln(1 - \tau_c^b)} + \frac{\partial \ln E_c}{\partial \ln w_c} \dot{w}_c = \frac{1}{\sigma^F} \left(\delta + \frac{1}{-(1 + \varepsilon^{PD})} \right) - \frac{\gamma}{\sigma^F} \dot{w}_c, \quad (14)$$

$$\dot{z}_c = (1 + \varepsilon^{PD}) \sigma^F \dot{E}_c = \delta(1 + \varepsilon^{PD}) - 1 - \gamma(1 + \varepsilon^{PD}) \dot{w}_c \quad (15)$$

$$\dot{N}_c = \dot{L}_c^D \quad (16)$$

Let us define $l_{i,c}$ as the intensive margin of labor demand *not including* z_c such that $L_c^D = E_c l_{i,c} z_c$ (based on equation 5).¹⁰ We can express equation (16) as:

$$\varepsilon^{LS} \dot{w}_c = \dot{N}_c = \dot{E}_c + \dot{l}_{i,c} + \dot{z}_c, \quad \text{where} \quad (17)$$

$$\dot{E}_c = \frac{\delta}{\sigma^F} - \frac{1}{(\varepsilon^{PD} + 1)\sigma^F} - \frac{\gamma}{\sigma^F} \dot{w}_c, \quad (18)$$

$$\dot{l}_{i,c} = (\gamma(\varepsilon^{PD} + 1) - 1) \dot{w}_c - \delta(1 + \varepsilon^{PD}), \quad \text{and} \quad (19)$$

$$\dot{z}_c = \delta(1 + \varepsilon^{PD}) - 1 - (\varepsilon^{PD} + 1)\gamma \dot{w}_c, \quad (20)$$

where the computation of $\dot{l}_{i,c}$ comes from equation (5).

Equations (17) to (20) allow to solve for the equilibrium value of \dot{w}_c , which is a key equation in how SZ compute incidence:

$$\dot{w}_c = \frac{\frac{\delta}{\sigma^F} - 1 - \frac{1}{(\varepsilon^{PD} + 1)\sigma^F}}{\varepsilon^{LS} + \frac{\gamma}{\sigma^F} + 1} = \frac{\frac{\delta}{\sigma^F} - 1 + \frac{\mu - 1}{\sigma^F}}{\varepsilon^{LS} + \frac{\gamma}{\sigma^F} + 1}, \quad (21)$$

with μ used by SZ as a notation for the markup over marginal cost. The denominator in equation (21) is positive for any acceptable value of the parameters. For the numerator to be positive, so that the full effect on wage is positive consistent with reduced-form results, requires some additional condition regarding the link between elasticity of demand ε^{PD} , the dispersion of productivity σ^F and the output elasticity of capital δ :

$$\frac{\delta}{\sigma^F} - 1 - \frac{1}{(\varepsilon^{PD} + 1)\sigma^F} > 0 \Rightarrow \sigma^F < \mathbf{b} \equiv \delta - \frac{1}{\varepsilon^{PD} + 1}$$

The baseline choice of SZ of $\varepsilon^{PD} = 2.5, \gamma/\delta = 0.9$ and $\gamma = 0.15$ implies a upper a bound on σ^F of $\mathbf{b} \approx 0.82$.¹¹ A product elasticity of -4 to -5 still allows firms to be

¹⁰That is: $l_{i,c} = w_c^{\frac{(\gamma\varepsilon^{PD} + \gamma - 1)}{\rho_c^{(1 + \varepsilon^{PD})\delta}}} \kappa_0 \exp(-(\varepsilon^{PD} + 1)\bar{B}_c)$.

¹¹Reassuringly, this is way in excess of the estimates displayed in Table 6, although one must keep in mind that the interpretation of the results from the structural implementation might be impacted by the compositional margin as well as the role of capital intensity δ in the extensive margin.

fairly heterogeneous in their valuation of locations.

SZ do not find the same formula for \dot{w}_c . There are two reasons for the difference. First, as can be seen from equation (9'SZ) from page 2592 of SZ, the authors omitted the $\frac{\delta}{\sigma^F}$ term in \dot{E}_c . Second, and more important, they assumed that $\dot{z}_c = 0$ in the decomposition (17). They therefore have:

$$\begin{aligned}\varepsilon^{LS}\dot{w}_c &= \underbrace{-\frac{1}{(\varepsilon^{PD} + 1)\sigma^F} - \frac{\gamma}{\sigma^F}\dot{w}_c}_{\dot{E}_c} + \underbrace{(\gamma(\varepsilon^{PD} + 1) - 1)\dot{w}_c}_{\dot{i}_{i,c}} \\ &= -\frac{1}{(\varepsilon^{PD} + 1)\sigma^F} + \dot{w}_c \times \left(\gamma(\varepsilon^{PD} + 1) - 1 - \frac{\gamma}{\sigma^F} \right).\end{aligned}$$

Solving for \dot{w}_c gives the result displayed in (10SZ):

$$(10SZ) \quad \dot{w}_c = \frac{\left(\frac{\partial \ln L_c^D}{\partial \ln(1-\tau_c^b)} \right)}{\varepsilon^{LS} - \varepsilon^{LD}} = \frac{\frac{(\mu-1)}{\sigma^F}}{\varepsilon^{LS} - \gamma \left(\varepsilon^{PD} + 1 - \frac{1}{\sigma^F} \right) + 1}.$$

The main differences with (21) is the presence of the parameter governing the price elasticity of consumers in the denominator, which is due to the omission of the cancellation due to the compositional margin.¹²

4.2 Identification of the incidence on profit

The incidence of changes in state taxes on the three types of agents in the SZ model depends on the impact on housing rental rates, wages and profits. The presence of the compositional margin has direct implication for the identification of local incidence presented in Table 1 of SZ, as well as for some of the structural parameters. We now proceed to show what are the implied changes with respect to the original paper.

Vector of estimable reduced-form effects. In order to proceed, it is useful to introduce notation regarding the reduced-form effects on the four endogenous variables for which the authors obtain an empirical estimate: β^W (wage growth), β^N (population growth), β^R (rental cost growth), and β^E (establishment growth):¹³

¹²In order to recover exactly their equation, one should use the fact that $\varepsilon^{LS} = \left(\frac{1+\eta_c-\alpha}{\sigma^W(1+\eta_c)+\alpha} \right)$.

¹³Note that the reduced-form solution for β^E here has been amended to incorporate the impact of net-of-tax rate on location decision through the cost of capital. See equation (A4) in our appendix section

$$\beta^{\text{Business Tax}} = \begin{bmatrix} \beta^W \\ \beta^N \\ \beta^R \\ \beta^E \end{bmatrix} = \begin{bmatrix} \dot{w} \\ \dot{N} \\ \dot{r} \\ \dot{E} \end{bmatrix} = \begin{bmatrix} \dot{w} \\ \dot{w}\epsilon^{LS} \\ \frac{1+\epsilon^{LS}}{1+\eta}\dot{w} \\ \frac{\delta}{\sigma^F} + \frac{\mu-1}{\sigma^F} - \frac{\gamma}{\sigma^F}\dot{w} \end{bmatrix}. \quad (22)$$

Incidence on land owners and workers. Backing out changes in the welfare of landowners and workers from reduced-form effects of business taxes on wage and rental rate is fairly direct: The impact on landowners is equal to \dot{r}_c and can therefore be directly retrieved from the reduced-form effects of the local impact of corporate tax cuts on rents (denoted as β^R). The change in the welfare of workers will depend on wage and rental rate as well as the weight of housing in the utility function (α) and writes as $\dot{w}_c - \alpha\dot{r}_c$. Assigning a value to α , we can therefore deduct the change in workers welfare from $\beta^W - \alpha\beta^R$.

Incidence on firm owners. Firm owners' change in welfare—as measured by the change in the non-stochastic component of profits denoted $\dot{\pi}_c$ —involves several structural parameters on top the total local effect on wages \dot{w}_c . SZ show that it writes as $\dot{\pi}_c = 1 + \gamma(\epsilon^{PD} + 1)(\dot{w}_c - \delta/\gamma)$. Provided one assigns a value to the ratio δ/γ , information on $(1 + \epsilon^{PD})\gamma$ is still required in order to deduct $\dot{\pi}_c$ from \dot{w}_c .

SZ show (in their equation (18SZ) reported below) that they can retrieve the combination of parameters $(1 + \epsilon^{PD})\gamma$ without making any assumption on σ^F . This allows them in turn to back out the incidence on profits. This argument is based on the combination of equation (10SZ) with the theoretical mapping of reduced form estimates in (22):

$$(18SZ) \quad \beta^W = \frac{\beta^E + \frac{\gamma}{\sigma^F}\beta^W}{\underbrace{\frac{\beta^N}{\beta^W} - \gamma\left(\epsilon^{PD} + 1 - \frac{1}{\sigma^F}\right) + 1}_{\epsilon^{LD}}}.$$

However, accounting for the dependence of z_c upon local tax rate τ_c^b , implies a corrected version of (18SZ):

$$\beta^W = \frac{\beta^E + \frac{\gamma}{\sigma^F}\beta^W - 1}{\frac{\beta^N}{\beta^W} + \frac{\gamma}{\sigma^F} + 1}, \quad (23)$$

in which the parameter ϵ^{PD} does not appear anymore. Consequently, the term $\gamma(1 +$

C for a highlight of the differences between this expression and SZ analogous expression (equation 17 of SZ).

ε^{PD}) cannot be directly identified by inverting this equation.¹⁴ Because of the offsetting role of compositional margin, it becomes necessary to make an assumption (i.e. calibrate) the values of γ and ε^{PD} for what SZ call the “reduced-form implementation” in their Table 3. We present results from such an exercise in the next section. Before doing so, we highlight some additional issues regarding the compatibility between SZ conceptual framework and their reduced-form results.

Implications for ε^{PD} given $\hat{\beta}^{\text{Business Tax}}$. Another issue with the use of the original equation (18SZ) is that solving for $\gamma(1 + \varepsilon^{PD})$ yields the following equation (the second equation page 2599 of SZ):

$$\gamma(\varepsilon^{PD} + 1) = \left(\frac{\beta^N - \beta^E}{\beta^W} + 1 \right). \quad (24)$$

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 (24) in order to identify $\gamma(\varepsilon^{PD} + 1)$.

The implication that $\gamma(\varepsilon^{PD} + 1) > 0$ 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 of the appendix, 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

¹⁴One can note that equation (23) implies a linear constraint on reduced-form effects, namely: $\beta^N + \beta^W - \beta^E = -1$. Testing this restriction based on the $\hat{\beta}$ estimates presented in Table 4 of SZ leads to rejection in most instances—see Table A3 in the appendix.

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.

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

5 New estimates regarding incidence shares

Accounting for the compositional margin implies that backing out incidence estimates on business owners from the reduced-form effects requires the calibration of two additional parameters γ and ε^{PD} . This change will naturally impact the incidence share estimates for all three types of agents. As in SZ, we consider the change in the welfare of business owners as represented by the changes in the non-idiosyncratic component of profits which is given by

$$\hat{\pi}_c = 1 + \gamma \left(\varepsilon^{PD} + 1 \right) \left(\dot{w}_c - \frac{\delta}{\gamma} \right). \quad (25)$$

Table 1 presents the results. Column (1) reproduces the results presented in column 1 of Table 5 in SZ. Column (2) presents the incidence and incidence shares using calibrated values for γ and ε^{PD} in equation (25), instead of SZ estimate of $\gamma(\varepsilon^{PD} + 1) = 1.14$. The calibrated values are taken from SZ's structural analysis: $\gamma = 0.15$ and $\varepsilon^{PD} = -2.5$ (bottom panel of Table 3 in SZ). This has drastic implications for the welfare gains of firm owners, which are roughly halved in comparison with column (1). This implies that the share of incidence born by firm owners goes from 42 to 28%, a 14 percentage points or 33 percent decline. As acknowledged by SZ on page 2065, a value of -2.5 for the product elasticity of demand is somewhat lower than what is usually found by the macro/trade literature, where consensual estimates tend to be closer to -4 or -5 (Head and Mayer, 2014). The results associated with such values for ε^{PD} are displayed in columns (3) and (5). We see that it contributes to erode further the share of the tax cuts benefiting firm owners, although the differences remain more modest than the one between columns (1) and (2). Results are very similar when considering a specification which, as in SZ table 5 column (5), further accounts for potential confounders by controlling for Bartik shocks and changes in the net-of-personal tax rate—see the estimates Table A4 of the appendix.

Table 1: Revisiting Estimates of Economic Incidence Using Reduced-Form Effects

		(1)	(2)	(3)	(4)
		SZ Table 5 col.1	SZ BL param.	$\varepsilon^{PD} = -4$	$\varepsilon^{PD} = -5$
Panel A. Incidence	Landowners	1.1* (.59)	1.1* (.59)	1.1* (.59)	1.1* (.59)
	Workers	1.17 (1.43)	1.17 (1.43)	1.17 (1.43)	1.17 (1.43)
	Firm owners	1.63* (.9)	.88*** (.21)	.75* (.42)	.67 (.56)
Panel B. Incidence share	Landowners	.28*** (.09)	.35*** (.11)	.36*** (.12)	.37*** (.13)
	Workers	.3 (.19)	.37 (.26)	.39 (.29)	.4 (.31)
	Firm owners	.42*** (.12)	.28 (.21)	.25 (.26)	.23 (.29)
χ^2 : Joint test $S_W = 1$ and $S_F = 0$		132.67	39.71	28.89	23.99
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 cost share		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 estimated parameters in column 1 of Table 4 in SZ unless otherwise specified. Column (1) reproduces the results from Table 5 column (1) of SZ—which is based on SZ formula $1 + \left(\frac{\beta^N - \beta^E}{\beta^W} + 1\right) \left(\beta^W - \frac{\delta}{\gamma}\right)$ (see SZ Table 1). Column (2) takes the original formula for the incidence on firm owners $\tilde{\pi}_c = 1 + \gamma (\varepsilon^{PD} + 1) \left(\tilde{w}_c - \frac{\delta}{\gamma}\right)$ and calibrate parameters ε^{PD}, 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.

Implications regarding the structural implementation. SZ's structural implementation (Section VI of SZ) leads to estimates of the firm owners share of incidence of about 45% when considering business tax (column 4 of Table 7). Revisiting this result is beyond the scope of this comment. However, it is worth noting that this approach relies on the expression of wage incidence \tilde{w}_c as a function of structural parameters based on equation (10SZ) which ignores both the compositional margin and the effect of business tax on location choice through the local cost of capital—see our equation (21) for a formula incorporating both aspects. Moreover, the expression for \tilde{E}_c presented in the last row of (17SZ) also ignores the local cost of capital impact (see the last row of equation (22) for the corrected version). As such, both the structural estimation procedure and the expressions for incidence, conditional on having the right structural estimates, are necessarily affected by our result.

For instance, SZ structural approach is forced to consider a fairly low product de-

mand elasticity in their calibration in order to obtain macro local labor demand elasticities in line with estimates from the literature (around -1.5 , see Hamermesh, 1996; Kline and Moretti, 2014a). Once corrected to account for the compositional margin, ϵ^{LD} writes as (assuming $\gamma = 0.15$): $\epsilon^{LD} = -1 - 0.15/\sigma^2 \approx -1.5$ for $\sigma^F \approx 0.3$ which is close to estimates shown in SZ's Table 6 panel A. Ignoring that margin overstates the influence played by a larger product elasticity on the macro elasticity of labor demand, which occurs only through its impact on the estimated value of σ^F . Consequently, using the corrected formula for the macro labor demand elasticity might help to allow for larger response of product demand to price changes without running into counterfactual values regarding the local labor demand elasticity. Everything else equal, allowing for larger product elasticities (in absolute value) will tend to lower the share of the tax cuts accruing to firm owners.¹⁵

6 Conclusion

In this comment, we show that accounting for the compositional margin in Suárez Serrato and Zidar (2016) seminal paper on corporate tax incidence changes the expression for the macro elasticity of labor demand. This change impacts how SZ reduced-form results can be used to identify how much corporate tax cuts benefit business owners—requiring the calibration of more parameters. Using consensual values for such parameters—including values used by SZ themselves in part of their analysis—suggests that the share of the tax burden borne by firm owners hovers around 25% rather than 40%.

References

Carlton, Dennis W, "The location and employment choices of new firms: an econometric model with discrete and continuous endogenous variables," *The Review of Economics and Statistics*, 1983, pp. 440–449.

¹⁵For instance, in Panel C of their Table 6, SZ present structural estimates for ϵ^{PD} and find $\hat{\epsilon}^{PD} = -4.704$. Taking all estimates from this estimation, the demand elasticity is -2.93 when ignoring the compositional margin, but only -2.38 when using the corrected labor elasticity. Accounting for the compositional margin, using the estimates from Panel C Table 6, increases the workers' share of incidence, which goes from 0.25 to 0.296 and reduces that of firm owners which falls from 0.548 to 0.507 . Again, accounting for the compositional margin at the estimation stage might impact the value of $\hat{\sigma}^F$, resulting in ultimately larger or smaller elasticity of labor demand and incidence shares for firm owners than when the misspecified expressions is been used in the structural estimation—the misspecification occurs through what SZ refer to as $\mathbf{m}(\theta)$ in their classical minimum estimator.

Chaney, Thomas, “Distorted gravity: the intensive and extensive margins of international trade,” *American Economic Review*, 2008, 98 (4), 1707–21.

Eaton, Jonathan and Samuel Kortum, “Technology, geography, and trade,” *Econometrica*, 2002, 70 (5), 1741–1779.

Hamermesh, Daniel S, *Labor demand*, Princeton University press, 1996.

Hanemann, W Michael, “Discrete/continuous models of consumer demand,” *Econometrica: Journal of the Econometric Society*, 1984, pp. 541–561.

Head, Keith and Thierry Mayer, “Gravity equations: Workhorse, toolkit, and cookbook,” in Elhanan Helpman, Gita Gopinath, and Kenneth Rogoff, eds., *Handbook of International Economics*, Vol. 4, Elsevier, 2014, pp. 131–195.

— **and** — , “Brands in motion: How frictions shape multinational production,” *American Economic Review*, 2019, 109 (9), 3073–3124.

Kline, Patrick and Enrico Moretti, “Local economic development, agglomeration economies, and the big push: 100 years of evidence from the Tennessee Valley Authority,” *The Quarterly journal of economics*, 2014, 129 (1), 275–331.

— **and** — , “People, places, and public policy: Some simple welfare economics of local economic development programs,” *Annual Review of Economics*, 2014.

Serrato, Juan Carlos Suárez and Owen Zidar, “Who benefits from state corporate tax cuts? A local labor markets approach with heterogeneous firms,” *The American Economic Review*, 2016, 106 (9), 2582–2624.

Tintelnot, Felix, “Global production with export platforms,” *The Quarterly Journal of Economics*, 2017, 132 (1), 157–209.

Appendix

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 $c = 1, \dots, C$ 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).

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

Translation in SZ setting. Based on equation (A1), and on the definition of z_c provided in equation (6) 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 (8) 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 $c = 1, \dots, C$ 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 $n = 1, \dots, N^{\text{sim}}$, 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 $c^{\text{max}} = \arg \max_{c'} V_{c'n} \forall c' = 1, \dots, C$; and ii) the associated draw $e_{c^{\text{max}}n}$.

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

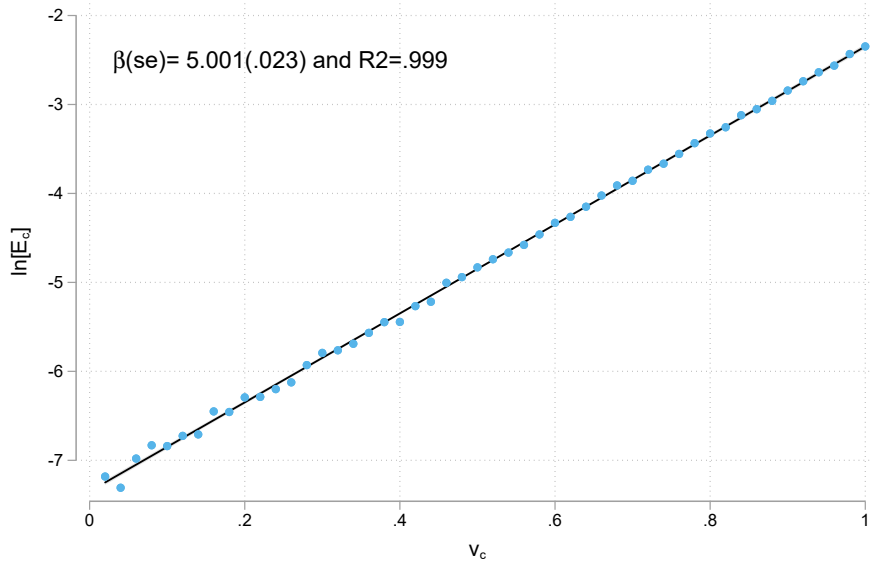
$$E_c^{\text{sim}} = \frac{1}{N^{\text{sim}}} \sum_{n=1}^{N^{\text{sim}}} \mathbb{1}\{c = \arg \max_{c'} V_{c'n}\} \quad (\text{A2})$$

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

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

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 A1: Scatter of $\ln E_c$ against v_c

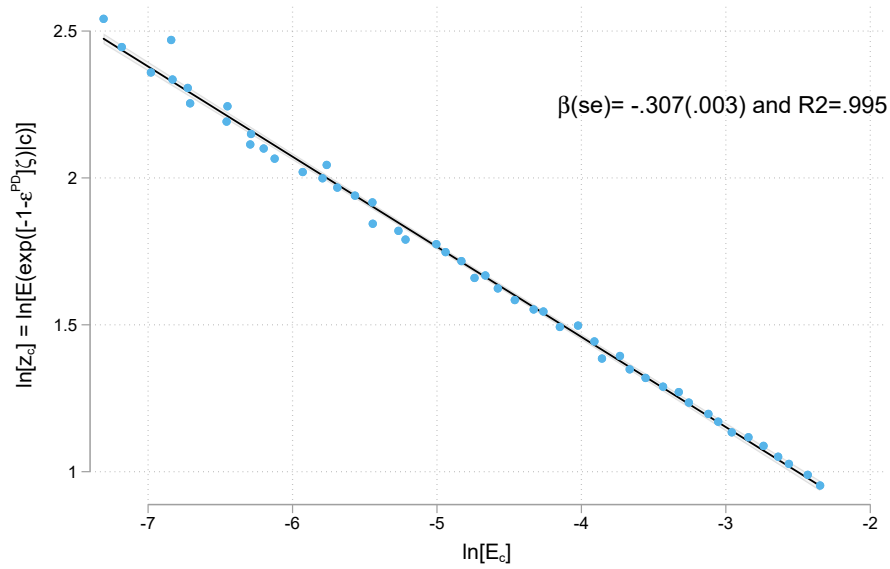


NOTES: This figure plot $\ln E_c^{\text{sim}}$ against v_c . Parameters of the simulation are as follows $C = 50$, $N^{\text{sim}} = 100,000$, $\sigma^F = 0.2$, $\varepsilon^{\text{PD}} = -2.5$.

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 $((1 + \varepsilon^{PD})\sigma^F = -0.30)$.

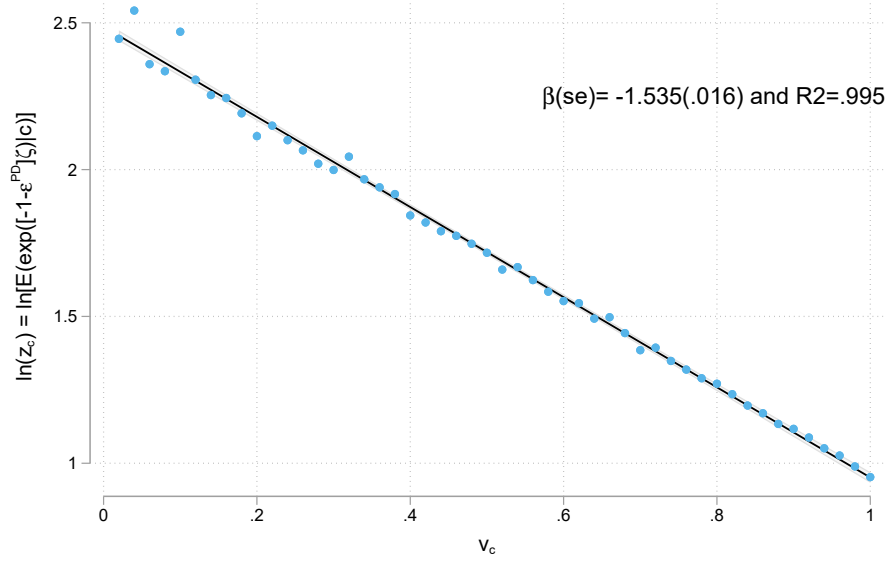
Figure A2: Scatter of $\ln z_c$ against $\ln E_c$



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

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 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 $C = 50$, $N^{\text{sim}} = 100,000$, $\sigma^F = 0.2$, $\varepsilon^{\text{PD}} = -2.5$.

C Tables and Formulas

$$\mathbf{Y}_{c,t} = \begin{bmatrix} \Delta \ln w_{c,t} \\ \Delta \ln N_{c,t} \\ \Delta \ln r_{c,t} \\ \Delta \ln E_{c,t} \end{bmatrix}, \mathbf{A} = \begin{bmatrix} -\frac{1}{\sigma^W} & 1 & \frac{\alpha}{\sigma^W} & 0 \\ 1 & -\frac{1}{\varepsilon^{\text{LD}}} & 0 & 0 \\ -\frac{1}{1+\eta} & -\frac{1}{1+\eta} & 1 & 0 \\ \frac{\gamma}{\sigma^F} & 0 & 0 & 1 \end{bmatrix}, \mathbf{B} = \begin{bmatrix} 0 \\ \frac{1}{\varepsilon^{\text{LD}} \sigma^F (\varepsilon^{\text{PD}} + 1)} \\ 0 \\ \frac{\delta}{\sigma^F} + \frac{1}{-\sigma^F (\varepsilon^{\text{PD}} + 1)} \end{bmatrix} \quad (\text{A4})$$

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
$\chi^2: R = 0$	4.98	3.63	9.89
p-value: $R = 0$	0.02	0.06	0.00

NOTES: This table shows nonlinear test implied by equation (23).

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 (.17)	.64 (.98)	1.12 (1.71)
Productivity Dispersion (σ_F)	-.09* (.05)	-.23 (.21)	-.44 (.44)
Housing Supply (η)	3.88 (5.24)	.64 (1.1)	1.09 (1.15)
Product Demand (ε^{PD}) ^a	7.59 (6.25)	5.66 (4.76)	4.8 (3.15)
Productivity Dispersion (σ_F) ^b , accounting for comp. margin	.14* (.08)	.33 (.35)	.93 (.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 18) 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.

Table A3: 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
$\chi^2: R = 0$	4.98	3.63	9.89
p-value: $R = 0$	0.02	0.06	0.00

NOTES: This table shows nonlinear test implied by equation (23).

Table A4: 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	Landowners	.98 (.84)	.98 (.84)	.98 (.84)	.98 (.84)
	Workers	1.86 (1.56)	1.86 (1.56)	1.86 (1.56)	1.86 (1.56)
	Firm owners	1.54* (.92)	.86*** (.25)	.71 (.5)	.62 (.67)
Panel B. Incidence share	Landowners	.22* (.12)	.26 (.17)	.28 (.18)	.28 (.2)
	Workers	.42** (.17)	.5** (.2)	.52** (.22)	.54** (.24)
	Firm owners	.35*** (.09)	.23 (.18)	.2 (.23)	.18 (.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 cost share	0.3	0.3	0.3	0.3

NOTES: This table shows estimates of economic incidence for the three categories of agents in the economy. Results are based on the empirical specifications used in column (5) of Table 5 in SZ which controls for Bartik shocks as well as growth in the net-of-personal tax rate. Column (1) reproduces the results from Table 5 Column (5) of SZ—which are based on SZ formula $1 + \left(\frac{\beta^N - \beta^E}{\beta^W} + 1\right) \left(\beta^W - \frac{\delta}{\gamma}\right)$ (see SZ Table 1). Column (2) takes the original formula for the incidence on firm owners $\tilde{\pi}_c = 1 + \gamma (\varepsilon^{PD} + 1) \left(\tilde{w}_c - \frac{\delta}{\gamma}\right)$ and calibrate parameters ε^{PD}, 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.