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IZA DP No. 14569

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ISSN: 2365-9793

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ABSTRACT

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

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 the four estimated reduced-form effects. Assigning consensual values to the unidentified parameters, we find that the incidence share born by firm-owners is closer to 25% than 40%.

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

Keywords: incidence, corporate income tax, discrete/continuous choice

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* 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.

1 Introduction

The incidence of the corporate income tax is arguably one 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 comment, we show that comparative statics computed by SZ ignore two channels implied by their own model. We derive the corrected expressions and discuss the implications of our corrections when mapping the reduced-form of the model with respect to a change tax rates—which can be transparently estimated through panel regressions—into incidence shares for workers, capitalists and landowners.

We first show that, since capital costs are not deductible in SZ setting, the corporate income tax increases the relative cost of capital. This relative cost effect implies that the sensitivity of business location choices to corporate tax will depend on the capital intensity of the technologies that are considered. This dependence is ignored in a key equation of SZ. Next, and more importantly, 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's identification argument.

In SZ's 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 two main steps. We first establish 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 empirical estimates. When accounting for the compositional margin, the two parameters $(\gamma, \varepsilon^{PD})$ need to be calibrated in order to identify the incidence of the corporate tax cuts on firm owners from SZ reduced-form estimates.[1]

Second, 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

[1]In addition, 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 (see appendix C.1).

relevant part of their paper using reduced form estimates.[2]

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 start by presenting the key building blocks of the model used in Suárez Serrato and Zidar (2016) (using the version published 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, profits, and land rents of a change in the local business tax. Accordingly, their economy is populated by three types of agents: workers, business owners, and landowners. The effects of a change in the local business net-of-tax rate, denoted $1 - \tau_c^b$, 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 business owners choose the location of their production site and the price of their output so as to maximize after-tax profits. There are no trade costs when shipping the goods between regions.

Household location choice. SZ consider a standard environment in terms of workers' location choices (see e.g. Kline and Moretti, 2014b). Wages, rental costs, and amenities vary across locations and are commonly valued by all households. Each household however displays idiosyncratic preferences for each location. The household picks the location yielding the highest total utility, which is equal to the sum

[2] We 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 (10) and associated comments below), it is likely that results presented in this note have consequences on this front as well. We detail some of these consequences at the end of Section 5.

of the common component and the idiosyncratic term. Given that the idiosyncratic term follows an Extreme Value Type I distribution with dispersion parameter σ^W, this set-up yields the classical multinomial logit functional form for the location choice probability. Housing costs enter indirect utility with a constant weight α.

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

Labor supply. The elasticity of housing supply η, together with the Cobb-Douglas weight on housing α, and the dispersion parameter σ^W, determine an "effective" elasticity of labor supply: by how much does local labor force (N_c) 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}.

Business owners' problem. When choosing the location of establishment j, business owners seek to maximize after tax profits π_{jc}. The log of establishment j's productivity in location c (B_{jc}) is the sum of a location-specific productivity term common to all establishments ($\bar{B}_c$), 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 also gives rise to a multinomial logit model of the establishment's location choice probability. Firms act as competitive monopolists and face a firm-level elasticity of demand denoted by $\varepsilon^{PD} < -1$. They operate a constant returns to scale Cobb-Douglas production function aggregating labor, capital and intermediates, with output elasticity respectively equal to γ, δ and $1 - \delta - \gamma$.

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.[3] We will explore the implications of this formal similarity in the next section.

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

3 The "macro elasticity of local labor demand"

In this section, we derive a amended version of SZ's expression of local labor demand, which drives incidence in their model. There are two differences with the original expression derived in SZ: 1) we account for how corporate taxation affects the effective cost of capital, 2) we include the "compositional margin", arising from endogenous location choices by firms in this setup. As a convention, when referring to equations that are directly taken from SZ we recall their original number on the left side of the equation with the number in brackets followed by the letters "SZ".[4]

The "macro" local labor demand L_c^D is defined as total labor demand by firms choosing to locate in a given location c. Without loss of generality, it can be written as the measure of firms locating in c—denoted E_c—multiplied by the average of individual labor demands by firms located in c (denoted with l_{jc}^*):

$$L_c^D \equiv E_c \times \mathbb{E}_\zeta(l_{jc}^*|c). \tag{1}$$

Following SZ, the conditioning on c $(.|c)$ in the expected labor demand term of (1) is a notation shortcut denoting the event that c is the best location for firm j. The expectation is taken over the random draws of establishment-location productivity ζ, hence the $\mathbb{E}_\zeta$ notation.

We start by deriving expressions for each of the two components of the macro local labor demand in subsection 3.1. We then highlight the differences between the resulting expressions and the corresponding ones in SZ in subsection 3.2.

3.1 Deriving the macro local labor demand.

Prices, quantities and profits. Under monopolistic competition, optimal pricing of firm j in c involves a constant markup over marginal cost (also unit cost u_{jc} because of the constant returns to scale assumption):

$$p_{jc} = \frac{-\varepsilon^{PD}}{-\varepsilon^{PD} - 1} u_{jc}, \quad \text{with} \quad u_{jc} = \frac{w_c^\gamma \rho_c^\delta P^{1-\gamma-\delta}}{\exp(\bar{B}_c + \zeta_{jc})}, \tag{2}$$

[4]For instance equation, (6SZ) will refer to the equation (6) of SZ.

where P is the price index of intermediates, and the term $\rho_c = \rho/(1-\tau_c^b)$ refers to the local cost of capital.[5] CES demand implies that the quantity produced by j is $y_{jc} = p_{jc}^{\varepsilon^{PD}} \times IP^{-\varepsilon^{PD}}$, where I is national real income and P is the CES price index over all available varieties. Combining CES demand with monopolistic competition, profits are equal to revenue divided by the CES parameter. After-tax profits are therefore equal to: $\pi_{jc} = (1-\tau_c^b)p_{jc}y_{jc}/(-\varepsilon^{PD})$. Using the expression for unit cost (2), and CES demand y_{jc}, we can write the non-stochastic component of after-tax profits (π_c) as:

$$\pi_c = \kappa_1 \times (1-\tau_c^b) \times \frac{w_c^{\gamma(1+\varepsilon^{PD})}\rho_c^{\delta(1+\varepsilon^{PD})}}{(\exp(\bar{B}_c))^{(1+\varepsilon^{PD})}}, \tag{3}$$

where a constant κ_1 accounts for all profit determinants that do not depend on c.

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:

$$\text{(7SZ)} \quad E_c = \mathbb{P}\left(V_{jc} = \max_{c'}\left\{V_{jc'}\right\}\right) = \frac{\exp(v_c/\sigma^F)}{\sum_{c'}\exp(v_{c'}/\sigma^F)}, \tag{4}$$

where $V_{jc} = v_c + \zeta_{jc}$ 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—as given in levels in equation (3)—divided by $-\left(\varepsilon^{PD}+1\right) > 0$ and writes as follows[6]:

$$v_c \equiv \frac{\ln \pi_c}{-\left(\varepsilon^{PD}+1\right)} = \frac{\ln\left(1-\tau_c^b\right)}{-\left(\varepsilon^{PD}+1\right)} + \bar{B}_c - \gamma \ln w_c - \delta \ln \rho_c + \frac{\ln \kappa_1}{-\left(\varepsilon^{PD}+1\right)}, \tag{5}$$

The intensive margin of labor demand. The labor demand for a given establishment j, located in c, is obtained using the Cobb-Douglas production technology as-

[5]The 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.

[6]Taking logs of profits π_{jc} and dividing by $-\left(\varepsilon^{PD}+1\right)$ does not affect the discrete choice as it is a strictly monotonic transformation, see SZ footnote 16.

sumption, which ensures that the share of labor in total costs (unit cost u_{jc}, times output y_{jc}) is constant and equal to γ. Hence, we have $l^*_{jc} = \gamma \frac{u_{jc} y^*_{jc}}{w_c}$. Using equilibrium output of the firm y^*_{jc}, we obtain

$$l^*_{jc}(\zeta_{jc}) = \underbrace{w_c^{\left(\gamma\varepsilon^{PD}+\gamma-1\right)} \rho_c^{\left(1+\varepsilon^{PD}\right)\delta} \kappa_0 \left(e^{\bar{B}_c\left(-\varepsilon^{PD}-1\right)}\right)}_{\equiv l_{\mathbf{i},c}} \exp\left(\left(-\varepsilon^{PD}-1\right)\zeta_{jc}\right), \tag{6}$$

where κ_0 combines determinants that are constant across establishments and locations. In equation (6), we see that that firm-level labor demand is a function of both $l_{\mathbf{i},c}$, a term that captures determinants common to all firms located in c, and the idiosyncratic draw ζ_{jc}. An important point to note here is that firms in this model choose an optimal location before deciding how much labor to hire in that location. Accordingly, labor demand by firm j in city c as expressed in equation (6) is latent in the sense that it will only be realized if c happens to be j's profit maximizing location choice.

Average labor demand in location c (which SZ refer to as the intensive margin) writes as:

$$\begin{aligned} \mathbb{E}_\zeta\left[l^*_{jc}\left(\zeta_{jc}\right) \mid c\right] =& w_c^{\left(\gamma\varepsilon^{PD}+\gamma-1\right)} \rho_c^{\left(1+\varepsilon^{PD}\right)\delta} \kappa_0 \left(e^{\bar{B}_c\left(-\varepsilon^{PD}-1\right)}\right) \\ & \times \mathbb{E}_\zeta\left[\exp\left(\left(-\varepsilon^{PD}-1\right)\zeta_{jc}\right) \mid c\right]. \end{aligned} \tag{7}$$

Macro labor demand. Total labor demand in c is equal to the share of firms locating in c multiplied by optimal labor demand conditional on choosing c. Combining (4) and (7):

$$\begin{aligned} L_c^D &= E_c \times \mathbb{E}_\zeta\left[l^*_{jc}\left(\zeta_{jc}\right) \mid c\right] = E_c \times l_{\mathbf{i},c} \times z_c \\ &= \frac{\exp(v_c/\sigma^F)}{\sum_{c'} \exp(v_{c'}/\sigma^F)} \times w_c^{\left(\gamma\varepsilon^{PD}+\gamma-1\right)} \rho_c^{\left(1+\varepsilon^{PD}\right)\delta} \kappa_0 \left(e^{\bar{B}_c\left(-\varepsilon^{PD}-1\right)}\right) \\ &\times \underbrace{\mathbb{E}_\zeta\left[\exp\left(\left(-\varepsilon^{PD}-1\right)\zeta_{jc}\right) \mid c\right]}_{\equiv z_c}. \end{aligned} \tag{8}$$

The compositional margin in labor demand. Key to our understanding of labor demand is the z_c term in (8). SZ describe it as a "*term increasing in the idiosyncratic productivity draw* ζ_{jc}" (p.2591). More specifically, it is the conditional expectation of a monotonic transformation of ζ_{jc}, with the conditioning event occurring with probability E_c. This probability depends on common fundamentals of city-level attractiveness as captured in v_c. The conditioning therefore implies a dependence of z_c with respect to v_c.

It is quite intuitive to see why z_c and v_c are related. Consider a very attractive city c' ($v_{c'} \to \infty$). 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 has a probability close to 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 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).[7] Applying Hanneman's result to the computation of z_c, we obtain:

$$z_c \equiv \mathbb{E}_\zeta \left[\exp\left(\left(-\varepsilon^{PD} - 1 \right) \zeta_{jc} \right) \mid c \right] = \Gamma\left(1 + (\varepsilon^{PD} + 1)\sigma^F \right) E_c^{(1+\varepsilon^{PD})\sigma^F}, \tag{9}$$

where the probability that c is the best location, E_c, is given in equation (4), and $\Gamma()$ is the gamma function. We will refer to changes in z_c following changes in fundamentals in area c as a the "compositional margin" as it captures changes in the composition (in terms of productivity) of the pool of firms choosing to locate in c.

3.2 Differences with SZ

We now turn to detailing the two main differences with the original SZ paper. Those are expressed in terms of missing terms in two critical elasticities of the model. The first one relates to how the cost of capital impacts the response of location choice to the tax rate. The second (and most important) one is the omission of the compositional margin in the elasticity of aggregate labor demand in c with respect to local wages.

Cost of capital and location choice. Based on the definition of E_c in equation (4) and the expression for the value for firm j to locate in c (v_c) in equation (5), we can derive the elasticity of the location choice probability with respect to the net-of-tax rate:

$$\frac{\partial \ln E_c}{\partial \ln(1 - \tau_c^b)} = \frac{\delta}{\sigma^F} - \frac{1}{(\varepsilon^{PD} + 1)\sigma^F}. \tag{10}$$

[7]See in particular equation (3.15) in Hanemann (1984). We adapt his derivation to our notations and overall setup in Section A of the appendix.

The analogous equation in SZ (first equation of page 2592), which the authors refer to as one of their key objects of interest writes as:

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

Equation (9′SZ) does not account for the fact that, because the business tax increases the relative cost of capital in location c, the entry of new firms 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.

Compositional margin and the macro elasticity of local labor demand. Taking the partial derivative of (8) with respect to w_c yields the macro elasticity of labor demand with respect to local wage (denoted ε^{LD} in SZ):

$$\begin{aligned}
\frac{\partial \ln L_c^D}{\partial \ln w_c} &= \underbrace{\frac{\partial \ln E_c}{\partial \ln w_c}}_{\text{extensive margin}} + \underbrace{\frac{\partial \ln l_{i,c}}{\partial \ln w_c}}_{\text{initial intensive margin}} + \underbrace{\frac{\partial \ln z_c}{\partial \ln w_c}}_{\text{compositional margin}} \\
&= \underbrace{-\frac{\gamma}{\sigma^F}}_{\text{extensive margin}} \underbrace{+\underbrace{\gamma(1+\varepsilon^{PD})}_{\text{scale effect}} \underbrace{-1}_{\text{substitution effect}}}_{\text{initial intensive margin}} + \underbrace{\left[-\frac{\gamma}{\sigma^F}(1+\varepsilon^{PD})\sigma^F\right]}_{\text{compositional margin}} \\
&= -\left(\frac{\gamma}{\sigma^F}+1\right). \qquad (11)
\end{aligned}$$

As the first line of equation (11) makes clear, the wage elasticity of total local labor demand is equal to the sum of three terms: the elasticity of the extensive margin (location choice), the intensive margin and the compositional margin. We express these three terms as a function of parameters in the second line. We further decompose the intensive margin into two components. The first subcomponent of the intensive margin is a scale effect, which captures the fact that firms cut down labor demand because of the reduced sales induced by the rise in labor cost. This depends on the price elasticity of demand on the product market as well as on the labor intensity of the technology. The second subcomponent is a substitution effect which is equal to -1 due to the Cobb-Douglas production function. In the third line, we simplify the expression using the fact that the scale effect and the composition effect cancel each other out. This cancellation of the intensive margin parameters is closely related to theoretical derivations of the gravity equation in trade models featuring country-level or firm-level heterogeneity in productive efficiency. It is the same mechanism that explains that the response of aggregate trade flows to changes in variable trade costs does *not* depend on the product demand elasticity in Eaton and Kortum (2002) or

Chaney (2008) for instance.[8]

Instead SZ's equivalent equation for the macro elasticity of labor demand writes as:

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

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

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

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 location choice with worker/consumer mobility), changes in z_c due to a change in wages perfectly offset the scale effect part of the intensive margin, leaving only the extensive margin parameters and the substitution effect to enter 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 most important point of our comment, with substantial quantitative implications that we detail in the next section.

Implications for the effect of business tax change on local labor demand. Both of our points (cost of capital and composition margin) also affect what SZ refer to as the "effect of business tax change on local labor demand": $\frac{\partial \ln L_c^D}{\partial \ln(1-\tau_c^b)}$ which can be written as:

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

where we used the definition of $\rho_c = \rho/(1-\tau_c^b)$, when differentiating equation (8). The analogous equation in SZ writes as:

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

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

[8] Recent 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).

choice depends on capital intensity ($\frac{\delta}{\sigma^F}$, 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

The approach developed by SZ to calculate the incidence of corporate taxation on firm owners, workers, and landowners respectively consists of three steps:

1. Establish, using their spatial equilibrium model, that the incidence on each of these three groups can be expressed as a function of the reduced-form effects of local corporate tax on four observables.

2. Estimate the empirical counterparts of the reduced-form effects using changes in state-level corporate taxation.

3. Plug in these estimates, along with calibrated values for two structural parameters and proceed to compute incidence.

We show in this section that the differences highlighted in the previous sections have implications for step (1), with consequences for the conclusions derived in step (3), even if the empirical estimates obtained in step (2) remain unchanged.

In this section, we use the same notation as SZ, and denote the total elasticity of any local variable x_c with respect to changes in $(1-\tau_c^b)$ as $\dot{x}_c \equiv \frac{d\ln x_c}{d\ln(1-\tau_c^b)}$. SZ refer to $\dot{x}_c$ as the "reduced-form effect" of $1-\tau_c^b$ on x_c: it represents the total impact of an exogenous shift in the tax rate through both its direct effect and implied changes in other endogenous variables of the model.

4.1 The total wage effect of changes in business tax

We start by deriving the expression for the incidence falling on wages, which is central in the computation of incidence more generally, and also for highlighting the implications of the two omissions in SZ.

[9] The 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).

The equilibrium change in wages that follows a change in local taxes comes from the labor market clearing condition $N_c = L_c^D$. Denoting the labor supply elasticity as $\varepsilon^{LS} \equiv \frac{\partial \ln N_c}{\partial \ln w_c}$, market clearing implies that $\dot{N}_c = \varepsilon^{LS} \dot{w}_c = \dot{L}_c^D$. Combining with the expression for labor demand in c, $L_c^D = E_c l_{\mathbf{i},c} z_c$, we obtain :

$$
\begin{aligned}
\varepsilon^{LS} \dot{w}_c &= \dot{E}_c + \dot{l}_{\mathbf{i},c} + \dot{z}_c, \quad \text{with} && (14)\\
\dot{E}_c &= \frac{\partial \ln E_c}{\partial \ln(1-\tau_c^b)} + \frac{\partial \ln E_c}{\partial \ln w_c} \dot{w}_c = \frac{1}{\sigma^F}\left(\delta + \frac{1}{-(1+\varepsilon^{PD})}\right) - \frac{\gamma}{\sigma^F}\dot{w}_c, && (15)\\
\dot{l}_{\mathbf{i},c} &= (\gamma(1+\varepsilon^{PD}) - 1)\dot{w}_c - \delta(1+\varepsilon^{PD}), \quad \text{and} && (16)\\
\dot{z}_c &= (1+\varepsilon^{PD})\sigma^F \dot{E}_c = \delta(1+\varepsilon^{PD}) - 1 - \gamma(1+\varepsilon^{PD})\dot{w}_c, && (17)
\end{aligned}
$$

where the computation of $\dot{l}_{\mathbf{i},c}$ comes from equation (6).

Equations (14) to (17) allow to solve for the equilibrium value of $\dot{w}_c$:[10]

$$
\dot{w}_c = \frac{\frac{\delta}{\sigma^F} - 1 - \frac{1}{(\varepsilon^{PD}+1)\sigma^F}}{\varepsilon^{LS} + \frac{\gamma}{\sigma^F} + 1} = \frac{\frac{\delta}{\sigma^F} - 1 + \frac{\mu-1}{\sigma^F}}{\varepsilon^{LS} + \frac{\gamma}{\sigma^F} + 1}, \tag{19}
$$

with μ used by SZ as a notation for the markup over marginal cost, that is $\mu = \frac{-\varepsilon^{PD}}{-\varepsilon^{PD}-1}$.

SZ do not find the same formula for $\dot{w}_c$. There are two reasons for the discrepancy, that are related to the differences (regarding *partial* effects of taxes) highlighted in section 3.2. First, the numerator is different due to the role of the cost of capital. As can be seen from equation (9'SZ, page 2592 of their paper) reproduced above, the authors omitted the $\frac{\delta}{\sigma^F}$ term in $\frac{\partial \ln E_c}{\partial \ln(1-\tau_c^b)}$. Moreover, as revealed by the comparison of equations (9"SZ) and (13), the term -1 (reflecting substitution from labor to capital due to lower capital cost) is missing from the numerator. Second, and more important, SZ's derivations of labor demand (implicitly) imply that $\dot{z}_c = 0$ in the decomposition

[10] Another (related) way to derive the same result is to write the total elasticity of labor demand (which depends on both the tax rate and the local wages) as $\dot{L}_c^D = \frac{\partial \ln L_c^D}{\partial \ln(1-\tau_c^b)} + \frac{\partial \ln L_c^D}{\partial \ln w_c}\dot{w}_c$. Combining with $\dot{N}_c = \varepsilon^{LS}\dot{w}_c = \dot{L}_c^D$, one can then solve for $\dot{w}_c$ as

$$
\dot{w}_c = \frac{\frac{\partial \ln L_c^D}{\partial \ln(1-\tau_c^b)}}{\left(\varepsilon^{LS} - \frac{\partial \ln L_c^D}{\partial \ln w_c}\right)}, \tag{18}
$$

which is the traditional incidence formula. Replacing $\frac{\partial \ln L_c^D}{\partial \ln(1-\tau_c^b)}$ with (13), and $\frac{\partial \ln L_c^D}{\partial \ln w_c}$ with (11), we obtain (19).

(14), which alters the term in the denominator. Their equilibrium[11] value for $\dot{w}_c$ is displayed in (10SZ), that we reproduce here:[12]

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

As a final remark regarding how taxes affect wages in this model, we can investigate the parameter values' restrictions for the effect to be positive (consistent with empirical reduced-form results of SZ). Note first that the denominator in equation (19) is positive for any acceptable value of the parameters. For the numerator to be positive, we need 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 $\mathbf{b} \approx 0.82$.[13] A product elasticity of -4 to -5 still allows firms to be fairly heterogeneous in their valuation of locations.

4.2 Identification of the incidence on profit

The incidence of changes in business taxes on the three types of agents in the SZ model depends on the impact on real wages, housing rental rates, and profits. The

[11] SZ therefore have the following (incomplete) formulation for the labor market clearing:

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

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

[13] Reassuringly, this is way in excess of the estimates displayed in SZ's 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.

change in welfare for each agent, written as a vector $\mathbf{I}$, is:

$$\begin{array}{l} \text{Workers:} \\ \text{Landlords:} \\ \text{Business owners:} \end{array} = \mathbf{I} \equiv \begin{bmatrix} \dot{w} - \alpha \dot{r} \\ \dot{r} \\ \dot{\pi} \end{bmatrix}. \tag{20}$$

The authors obtain empirical estimates regarding the reduced-form effects on four endogenous variables: β^W (wage growth), β^N (population growth), β^R (rental cost growth), and β^E (establishment growth):[14]

$$\boldsymbol{\beta}^{\text{Business Tax}} = \begin{bmatrix} \beta^W \\ \beta^N \\ \beta^R \\ \beta^E \end{bmatrix} = \begin{bmatrix} \dot{w} \\ \dot{N} \\ \dot{r} \\ \dot{E} \end{bmatrix}. \tag{21}$$

The authors then proceed to express changes in welfare contained in equation (20) as functions of the elements of $\boldsymbol{\beta}^{\text{Business Tax}}$ combined with calibrated parameters $(\alpha, \delta/\gamma)$. The presence of the compositional margin has direct implications for this last step, that is 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.

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, one 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 effect on local wages $\dot{w}_c$. Using the expression for

[14] We provide the corrected version of equation (17) of SZ (the vector representation of the solution for the changes in these 4 variables) in equation (A5) in our appendix section C.

equilibrium profits (3), $\dot{\pi}_c$ can be written as:

$$\dot{\pi}_c = 1 + \gamma \left(\varepsilon^{PD} + 1\right) (\dot{w}_c - \delta/\gamma) \tag{22}$$

$$= \underbrace{1}_{\text{mechanical}} + \underbrace{\gamma(1 + \varepsilon^{PD})\dot{w}}_{\text{higher labor cost}} - \underbrace{\delta(1 + \varepsilon^{PD})}_{\text{lower cost of capital}} . \tag{23}$$

Equation (23) provides intuition regarding the determinants of incidence on firm owners by decomposing the impact of corporate taxes on profits into 3 components. The first component is mechanical: a lower corporate tax rate, in the absence of any changes in equilibrium variables, increases after tax profits with an elasticity of 1 (with respect to the net-of-tax rate). The second component relates to the equilibrium impact of taxes on wages and how in turn this impacts profits. Quite intuitively one can see that higher wage will erode profits more when demand is price elastic (very negative ε^{PD}) or when technology is labor intensive (high γ). Finally, cuts in corporate taxes lower the effective cost of capital $\rho_c = \rho/(1 - \tau_c^b)$ which benefits business owners all the more that technology is capital intensive (high δ) and demand is elastic.

Identifying the incidence on firm-owners from reduced-form effects. As can be seen from equation (22), even if one assigns a value to the ratio δ/γ, information on $(1 + \varepsilon^{PD})\gamma$ is still required in order to deduct $\dot{\pi}_c$ from $\dot{w}_c$. SZ show that they can retrieve $(1 + \varepsilon^{PD})\gamma$ without making any further assumption (notably on σ^F).

Their argument starts from the theoretical expression for $\dot{w}$ in equation (10SZ) and expresses it as a function of the reduced-form effects in $\boldsymbol{\beta}^{\text{Business Tax}}$. To do so, it uses the expression of $\dot{E}_c$ in their own version of equation (15)—which omits $\frac{\delta}{\sigma^F}$—and the fact that $\dot{N} = \varepsilon^{LS}\dot{w} \Rightarrow \varepsilon^{LS} = \beta^N/\beta^W$. This results in equation (18SZ) which writes as:[15]

$$\text{(18SZ)} \qquad \beta^W = \frac{\beta^E + \frac{\gamma}{\sigma^F}\beta^W}{\frac{\beta^N}{\beta^W} + \underbrace{\frac{\gamma}{\sigma^F} + 1 - \gamma\left(\varepsilon^{PD} + 1\right)}_{-\varepsilon^{LD}\text{from (9SZ)}}},$$

and enables to recover $\gamma(\varepsilon^{PD} + 1)$, which is needed to compute the incidence of busi-

[15]The SZ-equivalent version of equation (15) writes as $\dot{E}_c = \frac{1}{-\sigma^F\left(\varepsilon^{PD}+1\right)} - \dot{w}_c\frac{\gamma}{\sigma^F}$ and implies for the numerator of (10SZ) that $\frac{1}{-\sigma^F\left(\varepsilon^{PD}+1\right)} = \frac{\mu-1}{\sigma^F} = \beta^E + \frac{\gamma}{\sigma^F}\beta^W$. Combining this with the fact that $\varepsilon^{LS} = \beta^N/\beta^W$ in the denominator of (10SZ) yields (18SZ).

ness tax on business owners.[16]

However, when starting from the corrected version of $\dot{w}$ in (19), and using the corrected version of $\dot{E}_c$ obtained from equation (15), one ends up with a different version of (18SZ):

$$\beta^W = \frac{\beta^E + \frac{\gamma}{\sigma^F}\beta^W - 1}{\frac{\beta^N}{\beta^W} + \underbrace{\frac{\gamma}{\sigma^F} + 1}_{-\varepsilon^{LD}\text{from (11)}}}, \tag{24}$$

in which the parameter ε^{PD} does not appear anymore. Consequently, the term $\gamma(1 + \varepsilon^{PD})$ cannot be directly identified by inverting this equation. The compositional margin implies that ε^{LD} is not informative about ε^{PD}, and hence that the incidence shares falling on each category of agents cannot be uniquely identified from the vector of $\boldsymbol{\beta}^{\text{Business Tax}}$.[17]

We see two potential solutions to this issue:

The first one is to expand the vector of reduced-form effects $\boldsymbol{\beta}^{\text{Business Tax}}$ in order to obtain an estimate of the intensive margin of labor demand *on the set of incumbent firms*—in the spirit of Head and Mayer (2014)'s suggestion regarding firm-level empirical analysis of exports. If one is willing to assume that idiosyncratic productivity shocks are constant over time, looking at the evolution of labor demand among a set of incumbent firms—i.e. holding ζ_{jc} fixed in equation (6)—reveals the equivalent of $\dot{l}_{\mathbf{i},c}$. Equation (16) may be rewritten as $\dot{l}_{\mathbf{i},c} = \gamma(1 + \varepsilon^{PD})(\dot{w}_c - \delta/\gamma) - \dot{w}_c$, which makes it clear that an estimate of this intensive margin combined with β_W enable to back-out $\gamma(1 + \varepsilon^{PD})$ under the same assumption as in SZ—i.e. calibrating the ratio δ/γ. This analysis would require to overcome two challenges: 1) the availability of firm-level data over multiple year, 2) circumventing the potential bias stemming from focusing on firms that decide to stay in the same locality in the face of changing taxes.

A second, more readily implementable solution is to make an assumption (i.e. calibrate) the values of γ and ε^{PD} and proceed to what SZ call the "reduced-form implementation"—see their Table 3. This method is all the more attractive that most of the structural approach of SZ relies on the same set of assumptions. We present results applying this second option in the next section.

[16]Manipulating (18SZ) yields $\gamma(\varepsilon^{PD} + 1) = 1 + \frac{\beta^N - \beta^E}{\beta^W}$, which once introduced in the profit incidence equation (22) yields $\dot{\pi}_c = 1 + \left(1 + \frac{\beta^N - \beta^E}{\beta^W}\right)(\beta^W - \delta/\gamma)$.

[17]One can furthermore note that equation (24) implies a linear constraint on reduced-form effects, namely: $\beta^N + \beta^W - \beta^E = -1$. Testing this restriction based on the $\widehat{\beta}$ estimates presented in Table 4 of SZ leads to rejection in most instances—see Table A1 in the appendix.

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 naturally impacts the incidence share estimates for all three types of agents. 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 (22), instead of SZ estimate of $\gamma\left(\varepsilon^{PD}+1\right) = 1.14$. 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 large implications for the welfare gains of firm owners, which are roughly halved in comparison with column (1). This implies that the share of incidence borne 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 column (5) of SZ's Table 5, further accounts for potential confounders by controlling for Bartik shocks and changes in the net-of-personal tax rate—see the estimates Table A3 of the appendix.

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 their 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 $\dot{w}_c$ 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 (19) for a formula incorporating both aspects. Moreover, the expression for $\dot{E}_c$ presented in the last row of (17SZ) also ignores the local cost of capital impact (see the last row of equation (21) 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

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

		(1) SZ Table 5 col.1	(2) SZ BL param.	(3) $\varepsilon^{PD} = -4$	(4) $\varepsilon^{PD} = -5$
Panel A. Incidence	Workers	1.1*	1.1*	1.1*	1.1*
		(.59)	(.59)	(.59)	(.59)
	Landowners	1.17	1.17	1.17	1.17
		(1.43)	(1.43)	(1.43)	(1.43)
	Firm owners	1.63*	.88***	.75*	.67
		(.9)	(.21)	(.42)	(.56)
Panel B. Incidence share	Workers	.28***	.35***	.36***	.37***
		(.09)	(.11)	(.12)	(.13)
	Landowners	.3	.37	.39	.4
		(.19)	(.26)	(.29)	(.31)
	Firm owners	.42***	.28	.25	.23
		(.12)	(.21)	(.26)	(.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 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 (1) 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. Column (1) reproduces the results from Table 5 column (1) of SZ—which is based on SZ formula for business owners: $\dot{\pi}_c = 1 + \left(\frac{\beta^N - \beta^E}{\beta^W} + 1\right)\left(\beta^W - \frac{\delta}{\gamma}\right)$ (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 $|\varepsilon^{PD}|$. Calibration of the housing cost share and γ/δ follows SZ baseline choice. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

demand elasticity in their calibration in order to obtain macro local labor demand elasticites 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, and assuming $\gamma = 0.15$, we have $\varepsilon^{LD} = -1 - 0.15/\sigma^F \approx -1.5$ 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.[18]

6 Conclusion

In this comment, we revisit Suárez Serrato and Zidar (2016)'s seminal contribution on the local incidence of corporate taxation. We show that comparative statics regarding the impact of changes in the local corporate tax rate computed by SZ ignore two channels implied by their theoretical model: i) the impact of corporate taxes on location choice through the effective cost of capital and, ii) a "compositional margin", i.e. the fact that the average idiosyncratic productivity of firms is affected by changes in taxes, wages and all other local fundamentals. Accounting for the compositional margin is especially important as it changes the expression for the macro elasticity of labor demand (ε^{LD}) and causes it to be independent from the elasticity of demand on the product market (ε^{PD}). This change impacts how SZ reduced-form results can be used to identify how much corporate tax cuts benefit business owners—requiring either the estimation of additional reduced-form effects or the calibration of more parameters. Calibrating the parameters based on consensual values—including values used by SZ in part of their analysis—suggests that the share of the tax burden borne by firm owners hovers around 25% rather than 40%.

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[18]For instance, in Panel C of their Table 6, SZ present structural estimates for ε^{PD} and find $\widehat{\varepsilon}^{PD} = -4.704$. 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 $\widehat{\sigma}^F$, 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 mispecification occurs through what SZ refer to as $\mathbf{m}(\boldsymbol{\theta})$ in their classical minimum estimator.

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Online Appendix

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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. $A_c \equiv \left\{\zeta \mid V_c^F > V_{c'}^F, \forall c'\right\}$.

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:

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

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

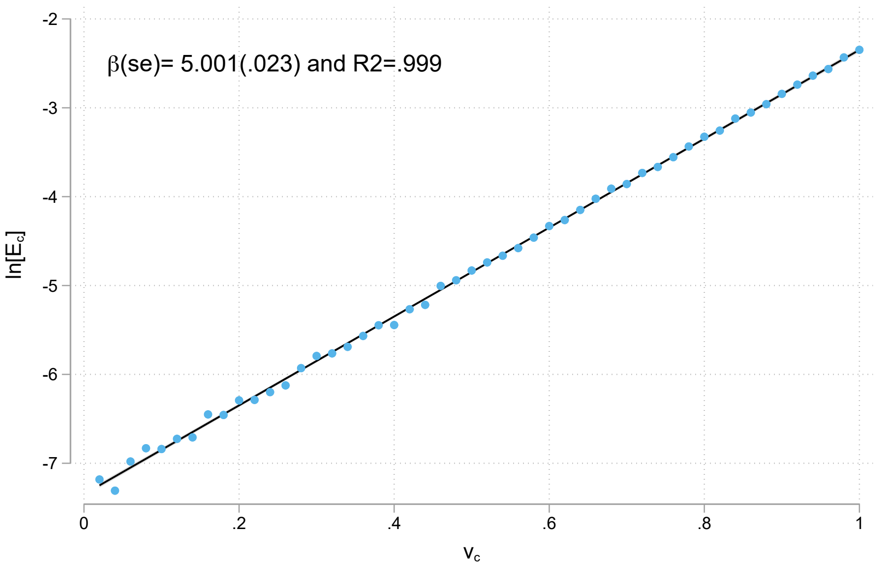
We set the parameters of the simulation are as follows: $C = 50$, $N^{\text{sim}} = 100,000$, $\sigma^F = 0.2$, $\varepsilon^{PD} = -2.5$.

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

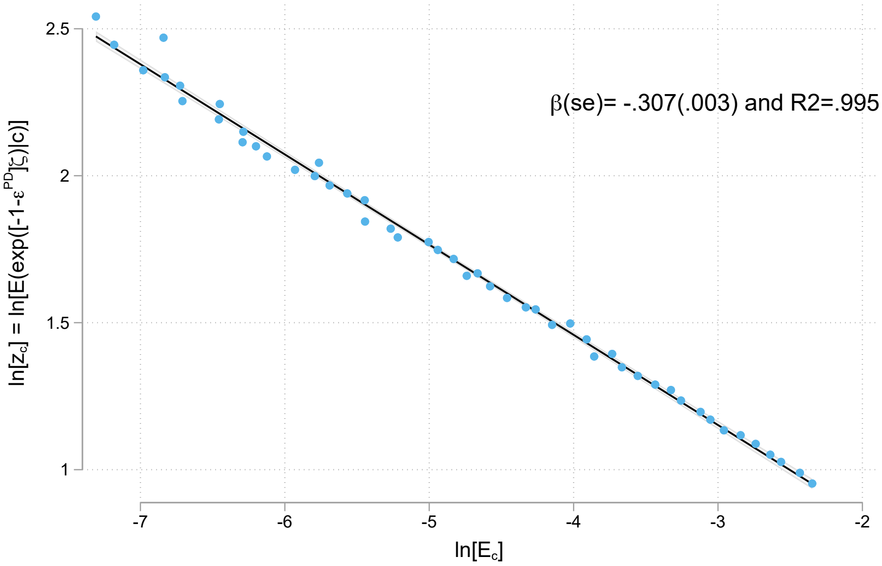
Finally, A3 confirms the negative relationship between $\ln z_c$ and v_c with a slope virtually identical to its theoretical value given the value of the parameters considered $((1 + \varepsilon^{PD}) = -1.5)$.

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



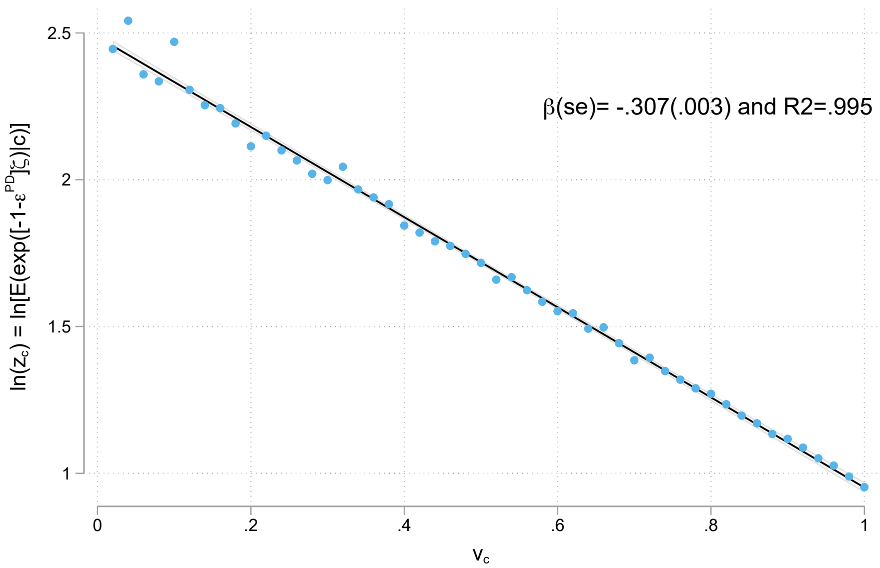
NOTES: This figure plot $\ln E_c^{\text{sim}}$ against v_c. Parameters of the simulation are as follows $C = 50$, $N^{\text{sim}} = 100,000$, $\sigma^F = 0.2$, $\varepsilon^{PD} = -2.5$.

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], accounting for comp. margin	0.14*	0.33	0.93
	(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. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.