Micro vs. Macro Corporate Tax Incidence

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Abstract

This paper studies the unequal incidence of corporate taxes across firms and its consequences for macroeconomic outcomes. I develop a dynamic general equilibrium Harberger model with heterogeneous workers and firms. I show that corporate tax cuts generate stronger wage increases at capital intensive firms, and that this heterogeneous effect creates a discrepancy between micro and macro estimates of their impact on workers' welfare. I confirm the core firm-level mechanisms using French employer-employee data and multiple reforms over the period 2009-2019. I calibrate the model using moments from these same data, and evaluate the short vs. long run, and micro vs. macro consequences of corporate tax reforms. When firm heterogeneity, general equilibrium dynamics and fiscal externalities are taken into account, workers do not bear the burden of the corporate income tax. Using estimates from micro-empirical designs that abstract from these three dimensions overestimates their share of this burden by more than 30 percentage points.

JEL codes: H22, H25, E22, E25

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1 Introduction

The past four decades have witnessed major cuts in corporate income tax rates across OECD countries, as illustrated in Figure 1. This massive decline has brought the incidence of corporate taxes back to the forefront, with this simple question: Who benefits from corporate tax cuts? This paper develops a general equilibrium model that proves the importance of firm heterogeneity and dynamics for answering this question, and explicitly derives and quantifies the potential biases emerging from the traditional methods used to estimate the distribution of the corporate tax burden.

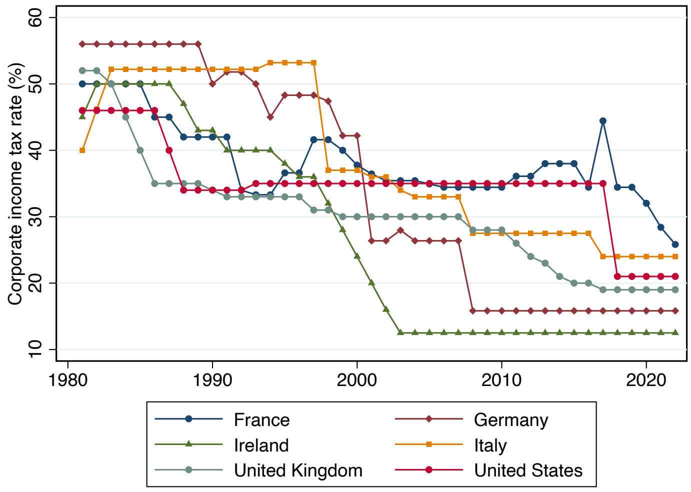

Figure 1: Top statutory corporate income tax rates

The first-order welfare impact of corporate tax reforms on workers is summarized by the elasticity of wages with respect to the net-of-tax rate. Armed with this elasticity, one can determine the tax burden associated with a corporate tax reform and its distribution across factors (Fuest et al., 2018). Several papers use credible microeconomic designs, with plausibly exogenous variations in exposure to corporate tax reforms, to estimate this elasticity (Arulampalam et al., 2012; Devereux et al., 2014; Fuest et al., 2018; Carbonnier et al., 2022; Kennedy et al., 2022).

This paper demonstrates that the micro elasticity estimated from such approaches can be quite far from the true aggregate elasticity governing the incidence of corporate taxes. As a result, high-quality micro estimates do not, on their own, summarize the incidence of corporate tax cuts. However, I derive the moments needed to quantify the gap between these micro elasticities and their macroeconomic counterpart, and thus measure the macro incidence of corporate taxes from micro data.

I develop a new framework that allows me to express these key moments in terms of simple sufficient statistics and to estimate the distribution of the corporate tax burden across workers, capital owners and shareholders at the aggregate level. This framework is a dynamic general equilibrium model à la Harberger (1962) with heterogeneous firms and workers. Firms differ in their productivity and capital intensity. These technological differences generate heterogeneous firm-level responses to corporate tax reforms, and the cross-sectional distribution of these responses governs the discrepancy between micro and macro elasticities. Workers differ in their preferences over existing employers, generating less than infinite labor supply elasticities, and monopsony power, at the firm level. Investment in the aggregate capital stock faces capital adjustment costs, which determine the dynamics that follow a tax reform, and thus the gap between its short and long-run consequences.

A careful definition of the incidence of corporate taxes clarifies the three main elements that determine the consequences of corporate tax reforms for workers' welfare. First, the distribution of technologies across firms is a key determinant of workers' wage gains. Secondly, the use of public funds is of major importance for the distribution of the tax burden. For example, a government that uses corporate income tax revenues as a transfer to workers would largely offset the negative impact of the distortionary tax on their wages. Finally, price dynamics are crucial to understanding the welfare consequences of corporate tax changes. If wages adjust slowly after a reform is introduced, an important part of workers' labor market gains (or losses) would be discounted, and they would likely bear a smaller share of the corporate tax burden.

Unlike the traditional Harberger model, all firms in this economy are subject to the corporate income tax. Yet, its distortion bites deeper into more capital intensive firms. Because of this unequal distortion, corporate tax cuts generate larger wage and employment responses at capital intensive firms. The mobility of factors across heterogeneous firms endogenizes the aggregate capital intensity and productivity of the economy, even though micro technologies remain unchanged.

I derive closed-form solutions for the key elasticities that determine the incidence of corporate taxes, at both the firm and aggregate levels. These results show that most of the cross-sectional heterogeneity can be summarized by firms' labor share. Moving to the aggregate level, the explicit expressions for the macro elasticities governing the incidence of corporate taxes show that they can be estimated with simple sufficient statistics. These expressions highlight the role of general equilibrium effects and firm heterogeneity in determining the share of the burden borne by workers.

I confirm the core mechanisms of the model with reduced-form evidence based on French tax returns covering all firms and employees between 2009 and 2019. These administrative data provide me with an ideal environment to estimate the main elasticities and their variation at the firm level. To do so, I exploit all movements in corporate income taxes occurring in France during the sample period. I use the instrumental variable method developed by Gruber and Saez (2002) to estimate the elasticity of wages and wage bills with respect to corporate tax changes across the labor share distribution. The resulting estimates show quite strikingly the stronger responses of capital intensive firms.

I calibrate the model using moments from the same data. I construct a model inversion technique inspired by the spatial economics literature (Redding and Rossi-Hansberg, 2017) to recover the non-parametric distribution of firm-level TFP and capital intensity. It hinges on the mapping between vectors of observable firm size and labor share and vectors of unobservable TFP and capital intensity generated by firm optimization. Then, I simulate a one percentage point cut in the corporate income tax rate and quantify its impact on workers', shareholders' and capital owners' welfare.

While plugging micro elasticities into the standard incidence formula would imply that workers bear 31% of the tax burden, accounting for firm heterogeneity, general equilibrium dynamics, and the use of public funds, yields a negative share of −2%, roughly equivalent to zero pass-through of corporate taxes to workers. The large gap between micro and macro incidence estimates is due to the fact that firms differ greatly in their capital shares and to strong general equilibrium effects, both of which are missed by standard micro empirical techniques.

Moreover, workers end up with a net loss from this corporate tax cut because it reduces the transfers the government can make with its revenue. Removing this fiscal externality brings workers' share back into positive territory, at 10%. It is important to emphasize that the fiscal externality is specific to a given level of initial taxation. Workers' share of the tax burden can be negative only because the economy considered here is on the upward sloping part of the corporate income tax Laffer curve. Once the economy moves to the downward sloping part of this curve (at higher tax rates), the fiscal externality has the opposite sign and increases workers' share of the tax burden.

This paper is related to the theoretical literature that studies the incidence of corporate taxes. Following the seminal work of Harberger (1962), several papers (see Gravelle (2013) and Auerbach (2018) for comprehensive surveys) have developed general equilibrium models with a representative firm subject to the corporate income tax, and outside firms which represent either the non-corporate sector (Batra, 1975; Shoven, 1976; Ratti and Shome, 1977a,b; Baron and Forsythe, 1981; Atkinson and Stiglitz, 2015; Bhatia, 1981), or the rest of the world (Mutti and Grubert, 1985; Kotlikoff and Summers, 1987; Randolph, 2006). It is closely related to the literature that studies the role of capital accumulation and dynamics for the welfare consequences of corporate income and capital taxation (Feldstein, 1974; Boadway, 1979; Turnovsky, 1982; Judd, 1985). Compared to these papers, the present analysis examines the importance of firm and worker heterogeneity for corporate tax incidence and its estimation. More recently, Suárez-Serrato and Zidar (2016) have built a static general equilibrium model which combines heterogeneous firm and location-specific productivity with corporate taxation. I explore the role of another source of firm heterogeneity, namely their capital intensity, in a dynamic general equilibrium framework, and I explicitly derive the macro elasticities that determine the distribution of the corporate tax burden from micro elasticities. I provide closed-form expressions for the gap between these two, and show that it is a function of sufficient statistics that can be recovered from micro data.

This paper also pertains to the empirical literature that has used reduced-form evidence to measure the incidence of corporate taxes on various agents. An early literature has used time-series data to look at the response in factors' income and prices to corporate tax reforms (Krzyzaniak and Musgrave, 1963; Gordon, 1967; Cragg et al., 1967). Cragg et al. (1967) concluded that time-series data were not well suited for measuring such elasticities: "*We remain impressed by the difficulties of making inferences concerning tax incidence from time-series data*". More recent analyses have exploited cross-sectional tax rate variations across jurisdictions (Fuest et al., 2018; Giroud and Rauh, 2019), and microeconomic variations in exposure to corporate taxation (Arulampalam et al., 2012; Devereux et al., 2014; Carbonnier et al., 2022; Kennedy et al., 2022) to estimate the key elasticities that determine the share of the corporate tax burden borne by workers. I show in this paper that using the resulting micro elasticities in the standard incidence formula, without the suggested adjustments, may lead to a substantial overestimation of workers' share. An alternative is to structurally estimate a general equilibrium model to measure the distribution of the tax burden (Suárez-Serrato and Zidar, 2016). Section 7 compares these different methods.

Finally, this paper is related to the literature that explores the effect of firm heterogeneity on the aggregate consequences of fiscal reforms. Zwick and Mahon (2017) and Winberry (2020) show the role of firm heterogeneity for the aggregate consequences of bonus depreciation policies. Gourio and Miao (2010) and Gourio and Miao (2011) demonstrate that firm heterogeneity matters for the aggregate response to dividend tax changes. Kaymak et al. (Forthcoming) study the importance of the capital intensity distribution for the impact of corporate tax cuts on the labor share. I contribute to this literature by examining the role of firm heterogeneity for the incidence of corporate taxation.

The paper is organized as follows. Section 2 describes the model. Section 3 starts from a standard incidence formula and derives the sufficient statistics needed to estimate workers' share of the corporate tax burden. Section 4 characterizes the equilibrium response to a tax reform and shows analytically how heterogeneous firm responses aggregate into the sufficient statistics derived in 3. Section 5 confirms the main mechanism with reduced-form evidence. Section 6 calibrates the model. Section 7 presents the response of this calibrated model to a corporate tax cut.

2 Model

The economy is composed of a mass of workers of measure one, a representative capital owner, and a representative firm owner. Workers and the firm owner are hand-to-mouth and consume their current income. The capital owner invests in the aggregate capital stock and lends it to firms. Time is discrete, and there is no uncertainty. All agents discount future utility at rate $\beta \in (0, 1)$.

The labor market is imperfectly competitive. Workers have idiosyncratic preferences over all firms and these firms set their wages without observing their workers' taste, as in Berger et al. (2022). There is a continuum of firms with different technologies, which operate on a competitive market for homogeneous final consumption goods. The final good is used as numeraire.

This model is a dynamic heterogeneous agent Harberger model, which introduces heterogeneous workers and firms, as well as imperfect competition in the labor market, to the traditional dynamic models of corporate tax incidence.

2.1 Workers

There is a continuum of workers of size one, who supply inelastically one unit of labor every period. Workers are hand-to-mouth and consume their income every period. They are equally productive, but heterogeneous in their taste for each firm. They move freely across firms each period to solve

$$\max_{j} \quad \ln\Big((1-\tau_t^w)w_{j,t}\Big) + \varepsilon_{i,j} \tag{1}$$

where i and $j \in \{1, ..., N\}$ index workers and firms, $w_{j,t}$ is firm j's wage in period t, τ_t^w is the labor income tax rate, and $\varepsilon_{i,j}$ is worker i's idiosyncratic taste for firm j, drawn from a T1EV distribution, and constant across time. These heterogeneous preferences emerge for example from different location choices or different valuations of firms' amenities. These idiosyncratic tastes $\{\varepsilon_{i,j}\}_{j=1}^N$ are drawn from a distribution with a cumulative distribution function

$$F(\{\varepsilon_{i,j}\}_{j=1}^N) = \exp\left[-\left(\sum_j e^{-\gamma\varepsilon_{i,j}}\right)^{\frac{1}{\gamma}}\right]$$

where γ governs the dispersion of idiosyncratic tastes.

An important assumption is that firms do not observe their workers' preferences, and therefore cannot condition wages on these preferences. This is why wages are not indexed by i. As in Card et al. (2018) and Berger et al. (2022), the solution to this discrete choice problem results in a mass of workers who choose to work for firm j equal to

$$l_{j,t} = \frac{w_{j,t}^{\gamma}}{\boldsymbol{w_t}} \tag{2}$$

where $\boldsymbol{w_t} = \sum_j w_{j,t}^{\gamma}$ is the labor market wage index. Equation (2) shows that, when firms take the labor market wage index as given, γ can be interpreted as the firm-level labor supply elasticity. As γ increases, workers' idiosyncratic tastes over different firms become less dispersed, which means that they are more responsive to wage variations, and that firms face more elastic supply curves. With $\gamma \in [0, +\infty)$, firms face upward sloping labor supply curves and benefit from some degree of monopsony power over their workers.

Importantly, the labor income tax rate, τ_t^w, was cancelled out from equation (2), which shows that this tax is non-distortionary in this framework. Two main features of the model generate this result: (i) the labor income tax rate is flat, so that it does not affect the relative after-tax wage that a worker derives from different employers; (ii) workers do not make extensive margin decisions, so that the labor income tax does not distort the amount of labor they supply.

2.2 Firms

Every period t, a firm $j \in \Omega_f$, with technology (z_j, α_j), rents k units of capital at price r_t and posts a wage $w_{j,t}$, which attracts $l_t(w_{j,t})$ workers. The function $l_t(w)$ is defined by equation (2) below, and firms take the labor market wage index $\boldsymbol{w_t}$ as given. They make these input choices to maximize after-tax profits

$$\begin{aligned} \max_{k,w} \quad & (1-\tau)\left[f(k, l_t(w), \alpha_j, z_j) - w l_t(w)\right] - (1-\lambda\tau) r_t k \\ \text{s.t.} \quad & f(k, l_t(w), \alpha_j, z_j) = z_j \left(\alpha_j k^{\frac{\sigma-1}{\sigma}} + (1-\alpha_j) l_t(w)^{\frac{\sigma-1}{\sigma}}\right)^{\frac{\sigma\xi}{\sigma-1}} \\ & l_t(w) = \frac{w^\gamma}{\boldsymbol{w_t}} \end{aligned} \tag{3}$$

where z_j is its TFP and $\alpha_j \in (0,1)$ its capital intensity. Returns to scale, ξ, the firm-level elasticity of substitution between capital and labor, σ, and the firm-level labor supply elasticity, γ, are constant across firms.

The tax system is summarized by two elements: a corporate income tax rate, τ, and λ, which governs the share of capital costs that firms can deduct from their tax base. This last parameter is generally interpreted as the present discounted value of depreciation allowances, which may vary across firms based on their capital structure and maturity (Zwick and Mahon, 2017). Since this model assumes that firms are capital renters facing a static problem, it is safer to consider λ as a parameter that represents the share of capital costs that firms can deduct from their tax base. I assume that τ and λ are constant across firms.

Let $u = \frac{1-\lambda\tau}{1-\tau} r$ denote the user cost of capital. One can divide the objective function by $(1-\tau)$ to reformulate the maximization problem in a more traditional way, with the following objective function: $f(k, l, \alpha_j, z_j) - w l_t(w) - u_t k$.

2.3 Capital owner

A representative capital owner chooses, in each period t, her consumption of goods $\{c_{jt}^K\}_{j=1}^N$, which are perfect substitutes, and next period capital K_{t+1} to maximize

$$V_k = \max_{\{c_{jt}, K_{t+1}\}_{t=0}^{\infty}} \sum_{t=0}^{\infty} \beta^t \ln(C_t^K) \quad , \quad C_t^K = \int_0^N c_{jt}^K dj \tag{4}$$

$$\text{s.t. } C_t^K + [K_{t+1} - (1-\delta)K_t] + \phi\left(K_t, K_{t+1}\right) = r_t K_t$$

where $\phi(.)$ is a capital adjustment cost function. Consumption goods produced by firms $j \in \{1, ..., N\}$ are perfect substitutes, and their price is normalized to 1.

2.4 Shareholder

A representative shareholder collects after-tax profits from all firms and consumes its income every period. This agent is not important for the equilibrium allocation, as it does not make any choice. However, it is convenient to consider this representative shareholder to study the distributional consequences of corporate tax changes, and more particularly the shares of the tax burden that workers, the representative capital owner, and the representative shareholder bear.

I assume that the representative shareholder has a log-utility in order to be consistent with the other agents in this economy, and to be consistent with the recent literature on corporate tax incidence (Suárez-Serrato and Zidar, 2016). Hence, its present value of utility is

$$V_f = \sum_{t=0}^{\infty} \beta^t \ln(\Pi_t^{AT}) \tag{5}$$

where Π_t^{AT} denotes the sum of firms' after-tax profits.

2.5 Government

The government finances a constant level of expenditures G with two fiscal revenues: the receipts from the corporate income tax, T_t, and the receipts from the labor income tax $\tau_t^w W_t$, where $W_t = \sum_j w_{j,t} l_{j,t}$ denotes aggregate labor income. It chooses τ_t^w every period to balance its budget, such that

$$T_t + \tau_t^w W_t = G \quad \forall t \tag{6}$$

All agents in this economy, including the government, take the corporate income tax rate τ as given and expect it to remain constant in the future. The quantitative exercises in section 7 simulate the response of this economy to unexpected and permanent shock to τ.

2.6 Equilibrium

A general equilibrium is a path of prices $\{\{w_{j,t}\}_{j\in[0,N]}\}_{t=0}^{\infty}$, $\{r_t\}_{t=0}^{\infty}$, quantities $\{K_t\}_{t=0}^{\infty}$, $\{\{k_{jt}\}_{j\in\Omega_f}\}_{t=0}^{\infty}$, $\{\{l_{jt}\}_{j\in\Omega_f}\}_{t=0}^{\infty}$, $\{C_t^K\}_{t=0}^{\infty}$, $\{\Pi_t^{AT}\}_{t=0}^{\infty}$, $\{T_t\}_{t=0}^{\infty}$, and labor income tax rates $\{\tau_t^w\}_{t=0}^{\infty}$ such that, given technologies $\{(z_j,\alpha_j)\}_{j\in\Omega_f}$, σ, ξ and policies $\{\tau_t\}_{t=0}^{\infty}$ and G,

1. Taking prices as given, the representative capital owner chooses $\{C_t^K, K_{t+1}\}_{t=0}^{\infty}$ to solve (4)

2. Taking prices $\{r_t\}_{t=0}^{\infty}$ and $\{\boldsymbol{w}_t\}_{t=0}^{\infty}$ as given, firms rent capital and set wages to solve (3)

3. Capital, labor and goods markets clear

2.7 Discussion of the assumptions

Closed economy. Following the literature interested in the incidence of corporate income and capital taxation in a dynamic setting (Feldstein, 1974; Boadway, 1979; Turnovsky, 1982; Judd, 1985), I assume that the baseline economy is closed, and that investment in the capital stock has to be financed by private savings. This assumption is necessary to study the impact of capital accumulation on the incidence of corporate taxes, and to estimate the share of the tax burden that capital owners bear. In section 7, I compare the estimated distribution of the corporate income tax burden with and without this assumption, by solving a small-open-economy version of the model with an infinitely elastic supply of capital.

Imperfect competition in the labor market. This assumption is essential to generate heterogeneous wage responses at the firm level, which is one of the empirical findings of section 5. Imperfect competition is introduced in the form of what Berger et al. (2024) name "*heterogeneous worker-firm-specific preferences*", which generate upward-sloping labor supply curves at the firm level. These non-wage amenities are an important feature of labor markets (Berger et al., 2022, 2024), and they allow me to connect the aggregate elasticities that govern the macro incidence of corporate taxes to the the typical elasticities that one would estimate with micro data. This link between micro and macro wage elasticities is examined in section 4.

Government budget constraint. The assumptions that public expenditures G are fixed and that there are only two sources of revenue, namely corporate and labor income taxation, imply that lower corporate income tax revenues must be offset by higher labor income tax revenues. If $G = 0$, the revenues from the corporate income tax are simply transferred to workers, in which case a lower corporate income tax revenue results in a lower transfer. These assumptions are meant to capture the redistributive motive which justifies the introduction of a corporate income tax even though it creates distortions. The only reason for the mass of workers to vote for a corporate income tax is that they benefit from an associated transfer (or lower taxation of labor income).[1]

3 Corporate Tax Incidence: a Sufficient Statistics Approach

The first objective of this section is to formally clarify the definition of corporate tax incidence used in this paper. Then, it expresses the share of the corporate tax burden borne by workers in terms of key sufficient statistics and decomposes these macro elasticities as an aggregation of firm-level responses.

3.1 Corporate Tax Incidence

Following Suárez-Serrato and Zidar (2016) and Fuest et al. (2018), I focus on the incidence of the corporate income tax in terms of welfare. This tax creates a welfare cost, or burden, for the private part of the economy, which is distributed between its various components. The incidence on a given private agent is its share of the tax burden.

Moreover, the incidence is necessarily associated with a tax reform (which can be hypothetical). It is defined as the ratio of the change in this agent's welfare

[1] As explained by Judd (1985) in the case of capital taxation, "*this is the only interesting case since there is no point in this model to taxing capital income and returning it to capitalists*".

generated by the reform over the change in the overall tax burden, i.e. the change in aggregate welfare associated with this reform.

The incidence of a small tax reform $d\ln(1-\tau)$ on workers is defined as

$$I_W = \frac{\frac{dV_w}{d\ln(1-\tau)}}{\frac{dV_w}{d\ln(1-\tau)} + \frac{dV_k}{d\ln(1-\tau)} + \frac{dV_f}{d\ln(1-\tau)}} \tag{7}$$

where V_w denotes the discounted sum of workers' utility, and V_k and V_f denote the discounted sum of the representative capital owner's and shareholder's utility.

As in Feldstein (1974), these welfare changes are dynamic objects which account for utility changes along the transition path from one steady state to the other. All agents discount future utility at rate β, and value consumption through the same log-utility function. Workers' welfare is defined as

$$V_w = \sum_{t=0}^{\infty} \beta^t \sum_i \max_j [\ln((1-\tau_t^w) w_{j,t}) + \varepsilon_{i,j}]$$

This definition relies on a utilitarian aggregation of workers' welfare, which values them equally. Using the envelope theorem, we obtain

$$\frac{dV_w}{d\ln(1-\tau)} = \sum_{t=0}^{\infty} \beta^t \Bigg[\underbrace{\sum_j l_j \epsilon^j_{w_t,1-\tau}}_{\text{Wage effect}} + \underbrace{\epsilon_{1-\tau_t^w,1-\tau}}_{\text{Fiscal externality}} \Bigg] \tag{8}$$

where $\epsilon_{X,1-\tau} = d\log(X)/d\log(1-\tau)$ denotes the elasticity of X with respect to the net-of-tax rate $1-\tau$. The change in workers' welfare for each horizon t associated with a corporate tax reform can be decomposed into a wage effect resulting from an aggregate of firms' wage adjustments, and a fiscal externality stemming from the government's budget constraint.

The wage effect is a standard feature of incidence definitions. It is an employment-weighted average of microeconomic wage elasticities $\epsilon^j_{w_t,1-\tau} = d\ln w_{j,t}/d\ln(1-\tau)$. By the envelope theorem, changes in firms' employment dl_j disappear from this first-order effect. This is intuitive, as workers who change of employer following a tax reform are almost indifferent between these employers.

We can further simplify this aggregate wage effect by noticing that it is equal to the elasticity of the labor market wage index $\boldsymbol{w}_t$ with respect to the net-of-corporate income tax rate divided by γ:

$$\sum_j l_j \epsilon^j_{w_t,1-\tau} = \frac{\sum_j w_{j,t}^{\gamma-1} \frac{dw_{j,t}}{d\ln(1-\tau)}}{\boldsymbol{w}_t} = \frac{\epsilon_{\boldsymbol{w}_t,1-\tau}}{\gamma}$$

The fiscal externality is less standard, and relies on the assumptions made about government's use of its fiscal revenues. Such assumptions are necessary for the model to be closed, but microeconomic incidence formulas often abstract from the effect of corporate tax changes on government's budget. In line with Judd (1985) and Suárez-Serrato and Zidar (2016), I assume that lower corporate tax revenues have to be compensated for by higher labor income tax revenues (or a lower transfer to workers if τ_t^w is negative). In section 7, I assess the quantitative importance of this fiscal externality in workers' share of the corporate tax burden.

The representative capital owner's welfare, V_k, is defined by (4). The envelope theorem yields

$$\frac{dV_k}{d\ln(1-\tau)} = \sum_{t=0}^{\infty} \beta^t \frac{K_t r_t}{C_t^K} \epsilon_{r_t,1-\tau}$$

where $\epsilon_{r_t,1-\tau}$ is the elasticity of the rental cost of capital with respect to the net-of-tax rate, and $C_t^K = r_t K_t - [K_{t+1} - (1-\delta)K_t] - \phi(K_t, K_{t+1})$ denotes the net aggregate capital income. Finally, the change in the representative shareholder's welfare is

$$\frac{dV_f}{d\ln(1-\tau)} = \sum_{t=0}^{\infty} \beta^t \epsilon_{\Pi_t^{AT},1-\tau}$$

where $\epsilon_{\Pi_t^{AT},1-\tau}$ is the elasticity of aggregate after-tax profits with respect to the net-of-corporate income tax rate.

Combining these results allows us to express workers' share of the corporate tax burden as

$$I_W = \frac{\sum_{t=0}^{\infty} \beta^t \left[\epsilon_{\boldsymbol{w}_t,1-\tau}/\gamma + \epsilon_{1-\tau_t^w,1-\tau} \right]}{\sum_{t=0}^{\infty} \beta^t \left[\epsilon_{\boldsymbol{w}_t,1-\tau}/\gamma + \epsilon_{1-\tau_t^w,1-\tau} + \frac{r_t K_t}{C_t^K} \epsilon_{r_t,1-\tau} + \epsilon_{\Pi_t^{AT},1-\tau} \right]} \quad (9)$$

where $\epsilon_{\boldsymbol{w}_t,1-\tau}$ is the elasticity of the labor market wage index with respect to the net-of-corporate income tax rate. Equation (9) shows that, provided we have measures of aggregate net capital income C_t^K, the capital stock K_t and the rental rate of capital r_t, we can estimate the share of the corporate tax burden borne by workers with four sufficient statistics, namely $\epsilon_{\boldsymbol{w}_t,1-\tau}$, $\epsilon_{1-\tau_t^w,1-\tau}$, $\epsilon_{r_t,1-\tau}$ and $\epsilon_{\Pi_t^{AT},1-\tau}$.

3.2 Micro-to-Macro Decomposition

A long literature has attempted to estimate these elasticities to assess the extent to which workers bear the burden of the corporate income tax. Recent papers have exploited firm-level and local variations in tax rates or bases, together with detailed firm-level data, to obtain micro estimates for these sufficient statistics, and more particularly the aggregate wage elasticity $\epsilon_{\boldsymbol{w}_t,1-\tau}$ (Suárez-Serrato and Zidar, 2016; Fuest et al., 2018; Carbonnier et al., 2022; Kennedy et al., 2022).

However, the elasticities described in equation (9) are aggregate elasticities. When firms j are characterized by heterogeneous treatment effects, notably heterogeneous wage elasticities $\epsilon^j_{w,1-\tau}$, the mapping between the distribution of firm-level responses and the aggregate sufficient statistics is not trivial.

Suppose we are interested in estimating the elasticity of the labor market wage index with respect to the net-of-corporate income tax rate, $\epsilon_{\boldsymbol{w}_t,1-\tau}$. This elasticity is a sufficient statistics for the numerator of our incidence equation (9) when we abstract from the fiscal externality, which is why it has been the focus of an important empirical literature[2]. An ideal experiment that would randomize tax rates across firms would aim to estimate the average firm-level treatment effect, $\mathbb{E}[\epsilon^j_{w,1-\tau}]$. Firm-level or local variations are generally necessary to rely on plausibly exogenous treatments and to interpret estimates as causal. Yet, such empirical designs cannot capture all the components of the macro elasticity we need, $\epsilon_{\boldsymbol{w}_t,1-\tau}$. To see this, one can decompose the latter as[3]

$$\frac{\epsilon_{\boldsymbol{w}_t,1-\tau}}{\gamma} = \underbrace{\mathbb{E}\left[\epsilon^j_{w_t,1-\tau}\right]}_{\text{Average micro response}} + N \underbrace{\mathbb{Cov}\left(l_j, \epsilon^j_{w_t,1-\tau}\right)}_{\text{Wage bill reallocation}} \tag{10}$$

where N denotes the number of firms in the economy, and l_j is firm j's initial employment share.

Equation (10) shows that the aggregate wage response is the sum of the aver-

[2]For example Suárez-Serrato and Zidar (2016); Fuest et al. (2018); Carbonnier et al. (2022); Kennedy et al. (2022).

[3]See appendix C for a proof.

age firm response and a covariance term which represents heterogeneity in wage responses across the firm size distribution. This second term may amplify (attenuate) the micro effect of corporate tax changes if larger firms are also the most (least) responsive.

One can further decompose our sufficient statistic by noticing that firm-level elasticities $\epsilon^{j}_{w_t,1-\tau}$ consist of both partial equilibrium (or direct) effects and general equilibrium (or indirect) effects arising from price adjustments. Since most corporate tax reforms are macroeconomic shocks, the latter are likely to be an important determinant of aggregate incidence.

Let $\mathbf{p}_t$ denote the vector of prices that firm j faces in period t. In the economy described in section 2, $\mathbf{p}_t = (r_t, \boldsymbol{w}_t)^\top$, where r_t is the rental cost of capital, and $\boldsymbol{w}_t$ is the labor market wage index. Its particular value $\mathbf{p_0}$ denotes the price vector just before the tax shock we consider occurs. We can rewrite the firm-level general equilibrium elasticity of wages with respect to the net-of-tax rate as

$$\epsilon^{j}_{w_t,1-\tau} = \underbrace{\epsilon^{j}_{w,1-\tau}\Big|_{\mathbf{p}=\mathbf{p_0}}}_{\text{Direct effect}} + \underbrace{(\epsilon^{j}_{w_t,\boldsymbol{p_t}})^\top \cdot \frac{d\ln(\mathbf{p_t})}{d\ln(1-\tau)}}_{\text{Indirect GE effects}} \tag{11}$$

where $\epsilon^{j}_{w_t,\boldsymbol{p_t}} = (\epsilon^{j}_{w_t,r_t}, \epsilon^{j}_{w_t,\boldsymbol{w}_t})^\top$ is the vector of elasticities of wages with respect to the price of capital and the labor market wage index, $\ln(\mathbf{p}_t) = (\ln(r_t), \ln(\boldsymbol{w}_t))^\top$, and $\epsilon^{j}_{w,1-\tau}\Big|_{\mathbf{p}=\mathbf{p_0}}$ is the partial equilibrium elasticity of firm j's wage with respect to the net-of-tax rate, i.e. holding other prices constant.

In this economy, dynamic responses to tax shocks are generated by the progressive buildup of the aggregate capital stock, which translates into price adjustments along the transition path. Therefore, partial equilibrium responses, which abstract from these price dynamics, are time-invariant objects. This is why the partial equilibrium firm-level wage elasticity is not indexed by t.

To ease the notation, I rewrite equation (11) as

$$\epsilon^{j}_{w_t,1-\tau} = \underbrace{\epsilon^{j,PE}_{w,1-\tau}}_{\text{Direct effect}} + \underbrace{\epsilon^{j,GE}_{w_t,1-\tau}}_{\text{Indirect GE effects}}$$

where $\epsilon^{j,PE}_{w,1-\tau}$ denotes the partial equilibrium elasticity $\epsilon^{j}_{w,1-\tau}\Big|_{\mathbf{p}=\mathbf{p_0}}$ and $\epsilon^{j,GE}_{w_t,1-\tau}$ denotes the general equilibrium feedback from price adjustments $(\boldsymbol{\epsilon}^{\boldsymbol{j}}_{\boldsymbol{w_t,p}})^\top \cdot \frac{d\mathbf{p}_t}{d(1-\tau)}$.

Then, we can extend the decomposition in (10) to include the distinction between partial and general equilibrium effects, which gives

$$\frac{\epsilon_{\boldsymbol{w}_t,1-\tau}}{\gamma} = \underbrace{\mathbb{E}\left[\epsilon^{j,PE}_{w,1-\tau}\right]}_{\text{Average direct effect}} + N \underbrace{\mathbb{Cov}\left(l_j, \epsilon^{j,PE}_{w,1-\tau}\right)}_{\text{Distribution of direct effects}} + \underbrace{\mathbb{E}\left[\epsilon^{j,GE}_{w_t,1-\tau}\right]}_{\text{Average indirect effect}} + N \underbrace{\mathbb{Cov}\left(l_j, \epsilon^{j,GE}_{w_t,1-\tau}\right)}_{\text{Distribution of indirect effects}} \tag{12}$$

Equation (12) shows that taking firm heterogeneity and general equilibrium effects into account generates a discrepancy between the the average partial equilibrium firm response to a tax change, and its aggregate wage effect on workers' utility.

The first term on the right-hand side of this equation is the moment that an average treatment effect abstracting from general equilibrium would estimate. Indeed, micro empirical analyses often exploit local exogenous variations between firms, such as tax code thresholds, to define a treatment and a control group, and thus leave out general equilibrium adjustments that would affect both groups. This is why the first moment that one can estimate with local variations is an average firm-level partial equilibrium elasticity of wages.

A first discrepancy appears from heterogeneous responses across firms. As we will see more explicitly in the next section, various factors, starting with technological differences, can make the elasticity of wages with respect to the corporate income tax rate vary across firms. This heterogeneity gives rise to the second term of the right-hand side of equation (12), which is the covariance between firms' employment shares and partial equilibrium responses to a tax change. A second discrepancy springs from general equilibrium price adjustments, which can also be decomposed in an average effect across firms and a covariance term reflecting heterogeneous responses to these price movements.

Importantly, both covariance terms may be positive or negative, leading to an amplification or an attenuation of the average partial equilibrium response to a corporate income tax reform. Additionally, price adjustments are dynamic as the economy progressively reacts to a tax shock and transitions to a new steady state. This is why the macro elasticity on the left-hand side of equation (12) and the last last two terms on its right-hand side are indexed by t, which denotes the number of periods after a change in the tax rate. The elasticity of the aggregate wage effect with respect to the net-of-tax rate, and therefore its incidence on workers, are dynamic.

Finally, we have focused on the elasticity of labor income, but one can decompose the elasticity of aggregate profits with respect to the net-of-tax rate, in the denominator of equation (9), in exactly the same way. Heterogeneity across firms creates a gap between the micro and macro elasticities. The remaining two sufficient statistics, namely the elasticities of the rental cost of capital and the labor income tax rate with respect to the net-of-corporate income tax rate, can either be estimated with macroeconomic data, or through the general equilibrium closure of the model estimated in section 6.

The next section uses the general equilibrium model described in 2 to explore the different components of the macro elasticity described in (12).

4 Micro and Macro Responses to a Corporate Tax Cut

4.1 Wage elasticity

We can use the model described in section 2 to derive the elasticities that determine the incidence of corporate taxes. Given the focus of this paper on the incidence of corporate taxes on workers, this section will be particularly interested in analyzing the elasticity of wages with respect to the net-of-tax rate at the firm level[4]:

$$\epsilon^j_{w_t,1-\tau} = \underbrace{-[1-\sigma(1-\xi)]\Lambda_r(s^j_{l,0})\epsilon_{u_t,1-\tau}}_{\text{Capital cost channel}} + \underbrace{\Lambda_w(s^j_{l,0})\epsilon_{\boldsymbol{w}_t,1-\tau}}_{\text{Labor cost channel}} \tag{13}$$

where $s^j_{l,t}$ denotes firm j's labor share in t,

$$s^j_{l,t} = \frac{w_{j,t} l_{j,t}}{y_{j,t}} = \xi \frac{(1-\alpha_j)^\sigma w_{j,t}^{1-\sigma}}{\alpha_j^\sigma u_t^{1-\sigma} + (1-\alpha_j)^\sigma w_{j,t}^{1-\sigma}} \tag{14}$$

[4]See appendix D.7

as derived in appendix D.5, and where $\Lambda_r(s^j_{l,t})$ and $\Lambda_w(s^j_{l,t})$ are defined as

$$\Lambda_r(s^j_{l,t}) = \frac{\left(1 - \frac{1+\gamma}{\gamma}\frac{s^j_{l,t}}{\xi}\right)}{(1-\xi)(\gamma+\sigma) + [1-\sigma(1-\xi)]\frac{1+\gamma}{\gamma}\frac{s^j_{l,t}}{\xi}}$$

$$\Lambda_w(s^j_{l,t}) = \frac{(1-\xi)}{(1-\xi)(\gamma+\sigma) + [1-\sigma(1-\xi)]\frac{1+\gamma}{\gamma}\frac{s^j_{l,t}}{\xi}}$$

Equation (13) shows that firms' wage response to a corporate tax change is determined by two channels stemming from capital and labor costs. I will now derive the results that will allow us to sign these channels.

First we can derive the following lemma, which states that any firm j's labor share is bounded above by $\xi\frac{\gamma}{1+\gamma}$.

Lemma 1. *For all j and t, $s^j_{l,t} \leq \xi\frac{\gamma}{1+\gamma}$.*

Proof. Remember that $\xi \leq 1$ is the degree of returns-to-scale in the production function, and that $\frac{\gamma}{1+\gamma} \leq 1$ is the markdown on workers' wages. Both imply that the share of before-tax profits in a firm's revenues is necessarily greater than $1 - \xi\frac{\gamma}{1+\gamma}$. The residual shares, among which is the labor share, are thus lower or equal to $\xi\frac{\gamma}{1+\gamma}$. □

We can derive the following corollary from Lemma 1,

Corollary 1. *If $\sigma(1-\xi) < 1$, then for any j and t, $\Lambda_r(s^j_{l,t}) \geq 0$ and $\Lambda_w(s^j_{l,t}) \geq 0$, and both $\Lambda_r(s^j_{l,t})$ and $\Lambda_w(s^j_{l,t})$ are decreasing in firms' labor share $s^j_{l,t}$.*

where σ is the firm-level elasticity of substitution between capital and labor, which is common to all firms.

These results produce the following relationship between the elasticities of the user cost of capital and the labor market wage index with respect to the net-of-corporate income tax rate,

Lemma 2. *If $\sigma(1-\xi) < 1$, then, for all t, the elasticity of the labor market wage index with respect to the net-of-corporate income tax rate is positive, i.e. $\epsilon_{\boldsymbol{w}_t,1-\tau} \geq 0$, and the elasticity of the user-cost of capital with respect to this net-of-tax rate is negative, i.e. $\epsilon_{u_t,1-\tau} \leq 0$.*

Proof. See Appendix C.

Lemma 2 shows that, when the elasticity of substitution between capital and labor is small enough, the equilibrium wage index increases after a corporate tax cut. This result springs from the fact that the elasticity of substitution, σ, determines the relative strengths of substitution and scale effects at the firm level. When capital and labor are complements, the latter dominates the former, which yields an increase in labor demand when the user cost of capital falls.

Oberfield and Raval (2021) estimate a firm-level elasticity of substitution σ lower than one, and $\xi \leq 1$ by definition of decreasing returns to scale. The premise of Lemma 2 is satisfied, so that a corporate income tax cut reduces the user cost of capital and boosts the wage index.

Corollary 1 and Lemma 2 pin down the signs of the capital cost and labor costs channels in equation 13. The first term on the right-hand-side of this equation represents the impact of a shock to the net-of-tax rate on a firm's wage policy which goes through a change in the user cost of capital u_t. As corporate tax cuts reduce the user-cost of capital, they create an incentive for firms to substitute away from labor, and drive them to scale up production by renting more capital and hiring more workers. The substitution effect draws wages down, while the scale effect pushes wages up. An elasticity of substitution between capital and labor, σ, lower than one makes the latter dominate the former. Hence, the capital cost channel is positive.

The second term on the right-hand side of equation 13 represents the effect of a shock to the net-of-tax rate on a firm's wage policy which goes through a change in the labor market wage index $\boldsymbol{w}_t$. Following a corporate income tax cut, the demand for labor increases, notably through the capital cost channel just described, which pushes wages up. This general wage increase feeds back to firms' wages as they compete for workers through their relative wage rates. Thus, the labor cost channel is positive.

These results imply that all wages rise after a corporate income tax cut. It is important to note, however, that it does not mean that all firms grow in size. Relative wage changes across firms determine the movement of workers across employers. Some firms raise wages more than others following a corporate tax cut, causing a reallocation of workers towards those firms.

We are interested in the heterogeneity of firm-level responses to tax changes. It is the source of the gap between the micro and macro elasticities presented in section 3.2. Corollary 1 and Lemma 2 imply that the wage elasticity defined in equation (13) is decreasing in a firm's labor share, s_l^j. Capital intensive firms benefit more from corporate tax cuts and workers are reallocated away from labor intensive firms. This heterogeneous response pattern arises from the fact that corporate income taxes distort input choices in favor of labor, which is fully deductible from firms' tax bases. Firms using capital intensive technologies are more hindered by this distortion. As the distortion goes away, capital intensive firms grow, while labor intensive firms are hit by the rising wage.

Following the method used in section 3.2, one can decompose the general equilibrium elasticity from equation (13) into a partial equilibrium and a price component. We can isolate the partial equilibrium component by setting $dr_t = d\boldsymbol{w}_t = 0$:

$$\epsilon^{j,PE}_{w_t,1-\tau} = \Lambda_r(s^j_{l,t})\frac{1-\lambda}{1-\lambda\tau} > 0 \tag{15}$$

The direct effect of a corporate tax cut on wages is positive for all firms and decreasing in their initial labor share $s^j_{l,0}$.

The indirect effect is summarized by the following elasticity:

$$\begin{aligned}\epsilon^{j,GE}_{w_t,1-\tau} &= \epsilon^{j}_{w_t,1-\tau} - \epsilon^{j,PE}_{w_t,1-\tau} \\ &= -[1-\sigma(1-\xi)]\Lambda_r(s^j_{l,0})\frac{1-\lambda\tau}{1-\tau}\epsilon_{r_t,1-\tau} + \Lambda_r(s^j_{l,0})\epsilon_{\boldsymbol{w}_t,1-\tau}\end{aligned} \tag{16}$$

This general equilibrium effect results from capital and labor price adjustments. Following a corporate tax cut, the price of capital rises as demand shifts up while supply slowly adjusts. Therefore, we can expect $\epsilon_{r_t,1-\tau}$ to be positive after a corporate income tax cut, which will be confirmed in the quantitative exercise of section 7. The sign of this indirect effect is ambiguous.

4.2 Aggregate Wage Effect

We can now decompose the aggregate labor income elasticity with respect to the net-of-tax rate using the formula derived in equation (12), that is

$$\frac{\epsilon_{\boldsymbol{w}_t,1-\tau}}{\gamma} = \mathbb{E}\left[\epsilon^{j,PE}_{w,1-\tau}\right] + \underbrace{N\mathbb{C}\mathrm{ov}\left(l_j, \epsilon^{j,PE}_{w,1-\tau}\right) + \mathbb{E}\left[\epsilon^{j,GE}_{w_t,1-\tau}\right] + N\mathbb{C}\mathrm{ov}\left(l_j, \epsilon^{j,GE}_{w_t,1-\tau}\right)}_{\text{Gap between micro and macro elasticities}} \tag{17}$$

where t is the horizon we consider to evaluate this elasticity after a tax change.

We can use the expressions derived in the previous section to uncover the sign and magnitude of the last three terms of the right-hand-side, which represent the discrepancy between micro and macro wage elasticities.

The first covariance term springs from heterogeneous firm-level technologies, which determine the distribution of partial equilibrium elasticities[5]:

$$\mathbb{Cov}\left(l_j, \epsilon^{j,PE}_{w,1-\tau}\right) = [1-\sigma(1-\xi)]\frac{1-\lambda}{1-\lambda\tau}\mathbb{Cov}\left(l_j, \Lambda_r(s_l)\right) \tag{18}$$

where $\mathbb{Cov}\left(l_j, \Lambda_r(s^j_l)\right)$ is the covariance between initial employment shares l_j and a decreasing function of their initial labor shares s^j_l. If capital intensive firms tend also to be the largest firms, the covariance is negative and the first component of the micro-macro gap amplifies the average firm-level effect.

The second element of the discrepancy between micro and macro wage responses is the average indirect effect across firms.

$$\mathbb{E}\left[\epsilon^{j,GE}_{w_t,1-\tau}\right] = -[1-\sigma(1-\xi)]\frac{1-\lambda\tau}{1-\tau}\mathbb{E}\left[\Lambda_r(s^j_l)\right]\epsilon_{r_t,1-\tau} + \mathbb{E}\left[\Lambda_w(s^j_l)\right]\epsilon_{\boldsymbol{w}_t,1-\tau} \tag{19}$$

Importantly, the price elasticities $\epsilon_{r_t,1-\tau}$ and $\epsilon_{\boldsymbol{w}_t,1-\tau}$ are horizon-specific, which is why the average indirect effect is dynamic.

The last term on the right-hand-side of equation (12) can be rewritten as

$$\begin{aligned}\mathbb{Cov}\left(l_j, \epsilon^{j,GE}_{w_t,1-\tau}\right) = -[1-\sigma(1-\xi)]\frac{1-\lambda\tau}{1-\tau}\mathbb{Cov}\left(l_j, \Lambda_r(s^j_l)\right)\epsilon_{r_t,1-\tau} \\ + \mathbb{Cov}\left(l_j, \Lambda_w(s^j_l)\right)\epsilon_{\boldsymbol{w}_t,1-\tau}\end{aligned} \tag{20}$$

As the first (partial equilibrium) covariance term, its sign depends on the sign of the covariance of employment and decreasing functions of labor shares across firms, $\mathbb{Cov}\left(l_j, \Lambda_r(s^j_l)\right)$ and $\mathbb{Cov}\left(l_j, \Lambda_w(s^j_l)\right)$.

Equations (18), (19) and (20) characterize the discrepancy between micro and macro, as well as between short and long run elasticities of wages with respect to the net-of tax rate. They highlight the fact that, given a set of parameters $\{\xi, \sigma, \lambda, \gamma\}$, one can estimate these differences using simple sufficient statistics.

Finally, we can collect these results to express the key elasticity for workers' welfare

[5] By definition, it abstracts from price movements, which are the source of dynamics in this framework. This is why this first covariance term does not require any horizon index t.

as

$$\frac{\epsilon_{\boldsymbol{w}_t,1-\tau}}{\gamma} = [1-\sigma(1-\xi)]\frac{N\mathbb{E}\left[l_j\Lambda_r(s_l^j)\right]}{1-\gamma N\mathbb{E}\left[l_j\Lambda_w(s_l^j)\right]}\left(\frac{1-\lambda}{1-\lambda\tau}+\frac{1-\lambda\tau}{1-\tau}\epsilon_{r_t,1-\tau}\right) \tag{21}$$

One can estimate $\mathbb{E}\left[l_j\Lambda_r(s_l^j)\right]$ and $\mathbb{E}\left[l_j\Lambda_w(s_l^j)\right]$ directly from micro data. However, we generally need more structure to estimate the elasticity of the rental price of capital, $\epsilon_{r_t,1-\tau}$. One common assumption in the literature on local corporate tax incidence is the small open economy, with which $\epsilon_{r_t,1-\tau}$ is set to zero. In the case of national tax reforms, which is the focus of this paper, an endogenous capital price that clears the capital market is often required. Section 7 solves the model and compares the results with each of these assumptions.

5 Reduced-form evidence

This section estimates firm-level elasticities of average wages and labor income with respect to the net-of-corporate income tax rate. It aims to confirm the main predictions of the model described in sections 2 and 4. More specifically, it shows the heterogeneous wage response and the reallocation of labor income across firms with different labor shares. To do so, I exploit multiple reforms implemented in France between 2009 and 2019 which modified the tax schedule that firms face on their corporate income.

I use French administrative data provided by the Public Finance Administration (DGFiP) and the National Institute of Statistics and Economic Studies (Insee). The three main datasets are DADS, FARE and BIC-RN, which collect detailed information on all firms and employees in France from tax returns. I match these datasets using the unique administrative firm identifier that is common across data sources. These datasets, and the definition of the sample and the variables used, are described in appendix B.

5.1 Empirical design

Each reform introduced throughout the sample period (2009-2019) modified the corporate income tax schedule for targeted groups of firms[6]. For example, a re-

[6] In practice, I build a tax function that I apply to firms' reported income, and which includes multiple rules and reforms on top of the standard rate ("taux normal"): the reduced rate

form named "exceptional contributions" increased the marginal tax rate of firms with sales above 2.5 million euros, which applied to very large firms compared to French standards. A second reform, introduced in 2017, reduced all marginal tax rates above 38,120 euros of corporate income. The large differences in scale and target between reforms introduced throughout the sample period is a great advantage as it allows me to exploit both tax cuts and hikes, on firms with various characteristics, to estimate the elasticities of interest.

Let us focus first on estimating the firm-level elasticities of average wages with respect to corporate tax changes described in equations (13) and (15). To do so, I consider the following specification:

$$\ln(w_{j,t}/w_{j,t-1}) = \delta_j + \delta_t + e \cdot \ln([1-\tau_{j,t}]/[1-\tau_{j,t-1}]) + \varepsilon_{j,t} \quad (22)$$

where $w_{j,t}$ denotes firm j's average wage in year t. δ_j and δ_t denote firm and year fixed effects, $\tau_{j,t}$ denotes the marginal corporate income tax rate that firm j faces in year t, and $\varepsilon_{j,t}$ is an error term.

Tax variations are measured using firms' marginal tax rate, rather than their average tax rate, because it is the relevant determinant of firms' choices in the model presented in section 2. Moreover, the corporate income tax schedule features very few kinks (only one at 38,120 euros in most years), in contrast with individual income tax schedules, which means that marginal and average tax rates are very close for a large fraction of firms.

The coefficient of interest, $\widehat{e}$, is an estimate of the corporate tax elasticity of average wages at the firm level. A well-known source of endogeneity in this type of settings comes from firms' behavioural response to changes in the tax schedule. Firm j's marginal tax rate, $\tau_{j,t}(\pi^b_{j,t})$, is a function of its tax base (or before-tax corporate income), $\pi^b_{j,t}$, which is determined by its production choices and thus correlated with its wages.

In order to correct for this source of endogeneity, I follow the framework developed by Gruber and Saez (2002) for individual income and instrument the change in corporate income tax rate by the predicted change if firms' tax bases had remained constant. More formally, $\ln([1-\tau_{j,t}(\pi^b_{j,t})]/[1-\tau_{j,t-1}(\pi^b_{j,t-1})])$ in equation (22) is instrumented by $\ln([1-\tau_{j,t}(\pi^b_{j,t-1})]/[1-\tau_{j,t-1}(\pi^b_{j,t-1})])$. This method isolates the

for small firms ("taux réduit"), the "contribution sociale sur les bénéfices", the "contributions exceptionnelles", the sequential 2017 reform. See Bach et al. (2019) for more details.

mechanical response to tax rate changes, which is uncorrelated with simultaneous wage changes.

In the preferred specification, I use two-year differences rather than one in order to abstract from very short-run adjustment frictions like the time needed to change production plans. As a robustness check, I estimate the same specification with one-year differences and show that the estimates are very close.

5.2 Average micro elastcities

I first estimate the specification described in (22) on the whole sample of firms. Column (1) of Table 1 shows the estimated firm-level elasticity of wages with respect to the net-of-corporate income tax rate using two-year differences and controlling for time and firm fixed effects. As expected from section 4, this elasticity is positive and significant. The average firm-level elasticity is 0.012, which means that a one percent increase in the net-of-tax rate increases average wages by .012%. This relatively small average effect hides heterogeneous wage responses across different firms, as explored in the next section.

Table 1: Estimated micro elasticities

	Δ log(Average wage)			Δ log(Wage bill)		
	2-year diff		1-year diff	2-year diff		1-year diff
	(1)	(2)	(3)	(4)	(5)	(6)
Δ Net-of-tax rate	.012	.030	.017	.074	.152	.095
	(.004)	(.004)	(.004)	(.008)	(.009)	(.008)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	No	Yes	Yes	No	Yes
Obs (millions)	1.3	1.4	1.6	1.4	1.4	1.6

Columns (2) and (3) estimate this wage elasticity using different versions of the specification described in (22), namely by removing firm fixed effects in (2) and using one-year differences in (3). The estimated elasticities are positive, significant, and close to the preferred estimate in (1). In the quantitative exercise of section 7, I use these microeconomic estimates to evaluate the distribution of the corporate tax burden, and compare the results to macroeconomic estimates computed through the general equilibrium model described in section 2.

Columns (4)-(6) estimate the elasticity of firms' wage bill with respect to the net-of-tax rate. As expected, these estimates are positive, significant, and larger than their wage counterparts (in columns (1)-(3)). Indeed, since firms benefit from monopsony power in the labor market, an increase in their wage not only increases the labor cost associated with each of their incumbent employees, at the intensive margin, but also expands their labor force and thus their labor costs at the extensive margin.

5.3 Heterogeneous firm-level elasticities

Since heterogeneous responses to corporate tax changes across the labor share distribution are essential to the main mechanisms of the model, I validate this pattern by estimating equation (22) for different quintiles of labor share[7].

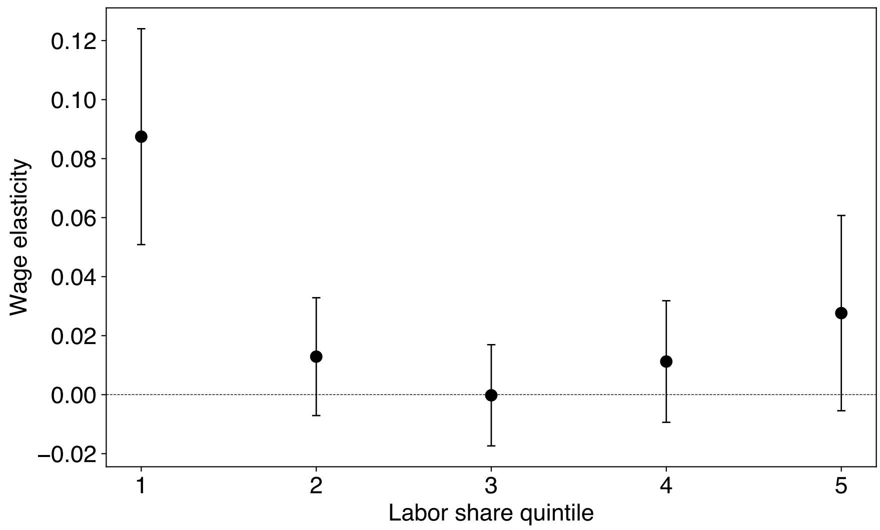

Figure 2: Firm-level elasticity of average wages w.r.t. the net-of-tax rate for different quintiles of labor share

Figure 2 shows that the elasticity of wages with respect to the net-of-corporate income tax rate is weakly positive for all labor share quintiles, and with a much larger effect for firms which belong to the first quintile, i.e. firms with low labor shares. The point estimates are decreasing over the first three quintiles, and then slightly increase for the last two quintiles, although these last coefficients are not significantly different from zero.

[7]These quintiles are defined in the year before the tax rate changes, that is in $t-2$ when considering two-year differences.

These results confirm the prediction from section 4 that wages increase after a corporate income tax cut, and more so for firms with low labor shares.

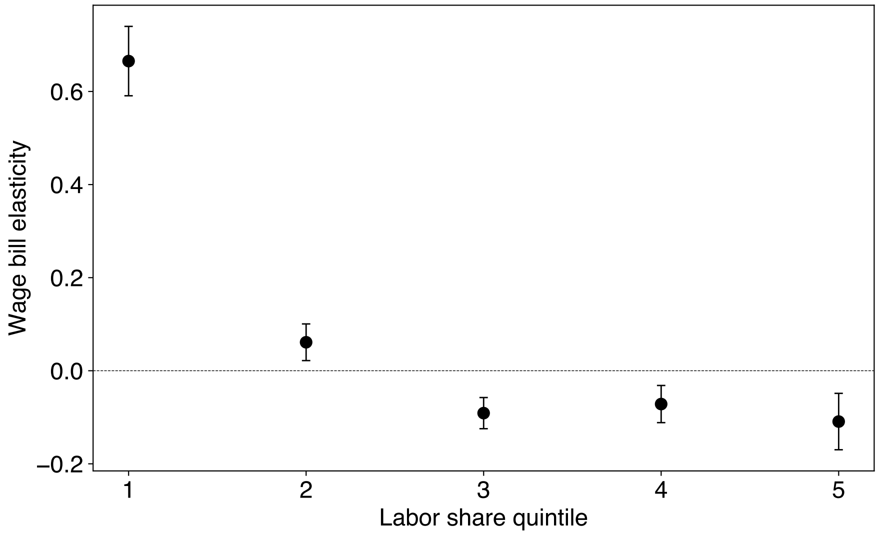

Figure 3: Firm-level elasticity of labor income w.r.t. the net-of-tax rate for different quintiles of labor share

Figure 3 presents results from a version of (22) with the log-change in wage bill as the outcome variable. It shows that the effect of corporate tax cuts on wage bills decreases with firms' labor share. Labor income elasticities are positive and significant for the first two quintiles of labor share, and negative, significant and relatively close for the last three quintiles. Firms that experience substantial labor income growth following a corporate tax cut are concentrated at the very top of the capital intensity distribution. On average, a 1% increase in the net-of-tax rate generates a .67% increase in labor income at firms in the first quintile of labor share. Workers reallocate from labor intensive to capital intensive employers as corporate tax rates fall, confirming the findings of section 4.

6 Calibration

The calibration strategy proceeds in two steps. First, I calibrate several parameters using estimates from the recent literature either as direct values or as targets. Secondly, I estimate the distribution of technologies across firms by inverting the model. A given set of economy-wide parameters generates a one-to-one mapping between observed pairs of (labor share, size) and unobserved pairs of technologies (α, z) that we can use to identify the non-parametric distribution of technologies.

6.1 External calibration

I use estimates from the literature as well as my own estimates (based on the micro data described in the previous section) to calibrate parameters { σ, δ, β, ν, λ, ψ, γ, ξ, τ_0, r_0 }. The last two parameters, τ_0 and r_0, denote the initial corporate income tax rate and return on capital. The exercise presented in the next section simulates the response of this economy to an exogenous tax cut. This unanticipated reform is introduced while the economy is in an initial steady state. This is why we need to specify initial values for τ and r, which participate in the definition of this first steady state.

Following Oberfield and Raval (2021), I set the firm-level elasticity of substitution between capital and labor σ, common across all firms, to 0.5. The capital depreciation rate δ is set to 0.095, as in Gourio and Miao (2011). I set the firm-level labor supply elasticity γ to 4.8, based on estimates from Azar et al. (2022). This elasticity implies that workers receive 83% of their marginal product in wages. I set the returns-to-scale parameter ξ to 0.99 to match the aggregate operating surplus (which is a measure of pre-tax corporate income) share of value added in France in 2010. Note that even when this parameter is close to one, which corresponds to a constant-returns-to-scale technology, firms' revenue functions still exhibit decreasing returns to scale, which result from the convexity of labor costs induced by their monopsony power.

All agents' preferences are characterized by the annual discount factor β, set to 0.9615 ($\beta = 1/(1 + 0.04)$), and log utility derived from consumption. I set the initial rate of return on capital r_0 to 0.07, which corresponds to the average rate of return on equity for all establishments in France from 1996 to 2022 computed with data provided by the Bank of France. Given $\{\beta, \delta, r_0\}$, the capital adjustment cost parameter ψ is pinned down by steady state necessary conditions, as derived in appendix D.1.

The corporate income tax schedule is summarized by two parameters: the corporate income tax rate τ_0 and the present value of depreciation allowances λ. I set the former to 0.3333, which was the main statutory corporate income tax rate in France at the beginning of the sample used for the empirical analysis. I compute λ using tax returns data. As in the United States, each type of capital defined in the French tax code features a legal rate at which firms are required to formally depreciate their assets. Tax deductions are then inferred from these legal depreciation rates. Hence,

$$\lambda = \sum_{a \in A} \gamma_a \sum_{t=1}^{T_a} \frac{D_{a,t}}{(1+r)^t} \tag{23}$$

where $a \in A$ are asset categories defined in the tax code, γ_a is their share of total assets measured in the data, T_a is the number of years on which a firm is allowed to depreciate its asset of class a, and $D_{a,t}$ is the share of its value that can be depreciated and deducted from a firm's tax base t years after being purchased. Firms discount these future depreciation allowances with the initial rate of return on capital, i.e. $r = r_0$ in (23). Doing so yields a value of λ equal to 0.68.

I assume that the government uses the revenues from the corporate income tax as a transfer to workers, such that $G = 0$ in equation (6).

6.2 Model inversion

I fix the number of firms for this economy to 300. Each firm is characterized by a pair of technologies (α, z), as described in section 2. To obtain a distribution of technologies across firms, I use the fact that, for a given initial wage index $\boldsymbol{w}_0$, and a set of values for $\{\sigma, \delta, \beta, \nu, \lambda, \psi, \gamma, \xi, \tau_0, r_0\}$, pairs of technologies (α, z) are exactly identified by pairs of labor share and employment share (s_l, l). The good news is that firms' labor and employment shares are directly observable using the data described in section B.

Hence, I use the actual distribution of (s_l, l) across firms in the data to jointly identify the full set of technologies $\{\alpha_j, z_j\}_{j \in \Omega_f}$. I set the initial wage index $\boldsymbol{w}_0$ to be equal to $N u_0^{\gamma}$, such that a homogeneous firm version of the calibrated model would set the intial wage equal to the initial user cost of capital u_0. The distribution of labor and employment shares is generated from the 2010 data as follows. Since the number of firms in the model is set to 300, I group firms in the data into 300 quantiles of labor share. Each of these quantiles represents a firm, for which I compute its labor share as well as its share of total employment.

This method of exact identification of firms' unobservable technologies, given a set of structural parameters, is inspired by the spatial economics literature, which uses model assumptions to recover the distribution of unobservable amenities across space (Redding and Rossi-Hansberg, 2017). It generates a non-parametric distribution of technologies that fits exactly the observed characteristics of firms, once considered through the lens of the model.

Figure A.6 plots the distributions of labor share and employment share across firms in the data (Panels (a) and (b)), and the resulting marginal distributions of technological parameters (α, z). Table 4 summarizes the calibrated parameters.

Table 2: Calibrated parameters

Description	**Parameter**	**Value**	**Target/Source**
External calibration			
Capital depreciation	δ	0.095	Gourio & Miao (2011)
Initial return on capital	r_0	0.07	Return on equity
Capital adjustment cost	ψ	0.162	Initial return on capital r_0
Elasticity of substitution K-L	σ	0.5	Oberfield & Raval (2021)
Firm-level labor supply elasticity	γ	4.8	Azar et al. (2022)
PDV of deprec. allowances	λ	0.68	Data
Retruns to scale	ξ	0.99	Operating surplus
Internal calibration			
Average capital intensity	$\mathbb{E}[\alpha]$	0.194	Data
Std. capital intensity	std(α)	0.220	Data
Average TFP	$\mathbb{E}[z]$	0.119	Data
Std. TFP	std(z)	0.022	Data
Corr(cap. int., TFP)	Corr(α, z)	0.620	Data

7 Results

This section describes the response of the calibrated economy to a one percentage point corporate income tax cut along several dimensions.

7.1 Dynamic corporate tax incidence

Figure 4 shows the paths of welfare gains for workers, the representative shareholder and the representative capital owner, expressed as shares of the total welfare gains, following a one percentage point corporate income tax cut.

The representative capital owner (red line in Figure 4) realizes large welfare gains in the short run, which slowly vanish along the transition path. As shown in section 3.1, these first-order gains are generated by movements in the rental price

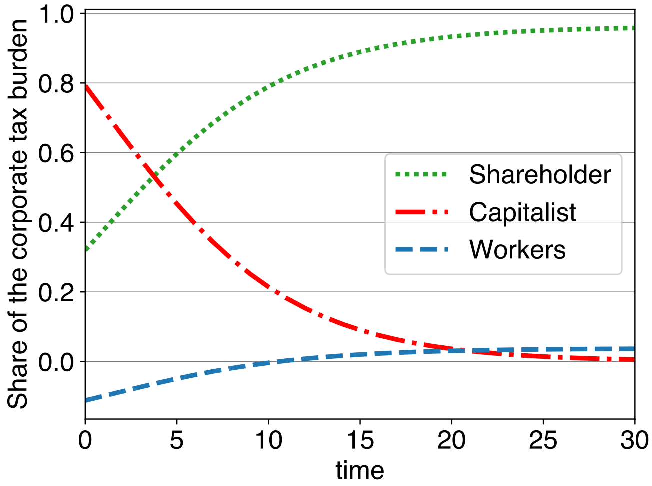

Figure 4: Corporate tax incidence

of capital r_t. Figure 5 shows that this price jumps immediately when the tax cut is introduced, and then slowly returns to its steady-state level. The reform increases firms' demand for capital, but the supply of capital is relatively inelastic in the short run. The price of capital r_t rises and offsets the exogenous reduction in the user cost resulting from the tax cut. As capital supply builds up, r_t falls down and the user cost u_t with it. Capital is perfectly elastic in the long run, which is why its share of the burden tends to zero.

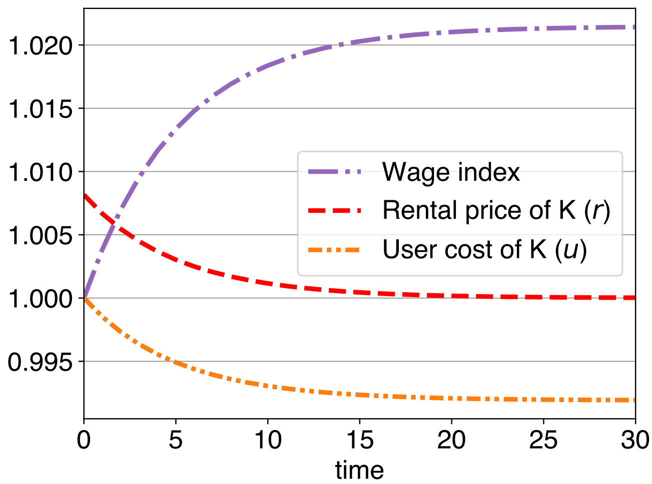

Figure 5: Aggregate price responses

Capital and labor are complements at the firm level, which implies a partial equilibrium increase in labor demand from all firms as the user cost of capital decreases, which pushes up the aggregate wage index (purple line in Figure 5). The capital stock builds up progressively over time, which generates a slow movement in prices and firm behavior.

In section 3.1, we decomposed the consequences of a corporate income tax reform on workers' lifetime utility into a wage effect and a fiscal externality. The evolution of the aggregate wage index following a tax cut generates a positive wage effect, which increases over time, as shown by the blue dotted line of Figure 4. However, the fiscal externality drives down workers' welfare because the government must reduce some of its transfers to workers as the lower corporate income tax rate generates less revenue.

In the short run, workers' gains from the labor market are relatively small because firms have not yet scaled up production. On the contrary, the fiscal externality is large in the short run as it consists of a mechanical negative effect on government's budget, which is immediate, and a positive behavioral effect, arising from firms' increase in production, which occurs gradually along the transition path. This is why Figure 4 shows that workers suffer net losses in the short run, and start to benefit from the reform only a few years after its introduction.

Finally, the representative shareholder (green line in Figure 4) derives utility from aggregate after-tax profits. These profits mechanically increase when the corporate tax cut is implemented, and then grow along the transition path as the user cost of capital goes down. This is why the shareholder's share of the burden grows over time.

Following the definition of dynamic incidence shares presented in equation 7, I compute the net present value of welfare gains for workers, the representative shareholder and the representative capital owner, and express them as shares of the total welfare gains generated by the corporate tax cut. These results are reported in column (2) of Table 3.

Workers experience virtually no change in lifetime utility, even though they benefit from the corporate tax cut in the long run. The present value of their welfare gains and losses is equal to -2% of the total welfare gains generated by the reform, roughly equivalent to zero pass-through of corporate taxes to workers. The representative capital owner obtains 23% of the discounted welfare gains, although her share was almost 80% in the short run. On the contrary, the representative shareholder experiences 79% of the total welfare gains, although her share was less than 40% in the short run.

Overall, these findings show that workers bear a very small share of the corporate income tax burden, which is even negative when we take into account the fiscal externality generated by corporate tax changes. Shareholders bear the lion's share of this burden. Finally, the large difference between the short-run and the long-run distribution of the corporate income tax burden shows that it is crucial to take dynamics into account when assessing the incidence of this tax. These results are quite surprising in light of the recent literature on corporate tax incidence, which finds that workers bear between 30 and 50% of the corporate tax burden (Fuest et al., 2018; Carbonnier et al., 2022; Kennedy et al., 2022). The next section shows that it stems from the macroeconomic perspective of this paper, as well as the micro heterogeneity on which it is based.

7.2 Micro vs. Macro estimates

In order to compare these results with estimates based on average micro responses, I introduce three common assumptions made in the micro empirical literature on corporate tax incidence. These assumptions are relevant at the micro level, but they can introduce biases in the estimation of incidence shares when we aggregate micro-level responses.

The first one is that average firm-level elasticities can summarize workers' welfare changes. As demonstrated in section 3.2, and more specifically equation 12, the underlying assumption is that firms change their wages homogeneously in response to a corporate income tax reform.

The second assumption is that there is no fiscal externality. The link between corporate tax revenues and public expenditures is often unclear at local or regional levels, for example if revenues are collected at the national level and can therefore be redistributed among local entities. Hence, most studies that rely on local or firm-level variations in corporate tax rates make this assumption.

These first two assumptions (homogeneous firms and the absence of fiscal externalities) reduce the measure of welfare changes for workers to the average firm-level elasticity of wages with respect to the net-of-tax rate. To see this, notice that the first assumption removes the covariance term in (10), and the second one removes the fiscal externality term in equation (8). Thus, I use the estimate from column (1) of Table 1 as the microeconomic measure of the change in workers' welfare (dV_w in equation 7).

The third assumption is the small open economy. Most studies relying on microeconomic estimates make this assumption because firm-level or local variations in corporate tax rates do not affect the price of capital. The small open economy assumption abstracts from any welfare effect on capital owners, as capital prices are fixed. The corporate tax burden is only distributed between workers and shareholders.

Table 3: Micro vs. Macro estimates

	Share of the CIT burden				
	Micro estimates	Macro estimates			
		Baseline	w/o Firm het.	w/o Transfers	SOE
	(1)	(2)	(3)	(4)	(5)
Workers	0.31	−0.02	−0.13	0.10	0.04
Shareholder	0.69	0.79	1.04	0.70	0.96
Capital owner	-	0.23	0.09	0.20	-

Note: This table reports the estimated shares of the corporate income tax (CIT) burden borne by workers and the representative shareholder and capital owner. Column (1) uses the empirical estimates from Table 1. Column (2) reports the results from the baseline model. Column (3) removes firm heterogeneity. Column (4) removes the fiscal externality. Column (5) assumes that it is a small open economy (SMO).

Column (1) of Table 3 shows the distribution of the corporate tax burden once we make these three micro-relevant assumptions. Workers bear 31% of the corporate tax burden, while the representative shareholder bears the remaining 69%. This result is very much in line with the recent literature using estimates of average microeconomic effects with these same assumptions. This literature finds that workers' share of the corporate tax burden lies between 32.5% (Suárez-Serrato and Zidar, 2016) and 50% (Carbonnier et al., 2022)[8]. Figure A.7 makes a more extensive comparison between this paper's estimates and the recent literature.

Hence, the three micro-relevant assumptions of a small open economy without fiscal externalities, and with homogeneous firms, generate an estimate of workers' share of the corporate tax burden which is much higher than the negative share estimated through the general equilibrium model.

In order to understand the role of each of these assumptions, I impose them one by one in the baseline general equilibrium model and estimate the corresponding distribution of the corporate tax burden.

Column (3) in Table 3 shows the result from an economy similar to baseline one except that all firms are the average firm, i.e. they all have the same technology

[8]Using the wage elasticity from column (2) of Table 1, rather than the baseline estimates from column (1), yields an estimate of workers' share of the tax burden equal to 53%, which is still in line with the range of estimates from the recent literature.

$(\mathbb{E}[\alpha], \mathbb{E}[z])$. In this economy without firm heterogeneity, workers suffer even bigger losses following a corporate tax cut, which implies that they bear a negative share of the corporate tax burden. The reason for this outcome is that, when firms are heterogeneous, corporate income tax changes generate different wage effects across firms. We saw in section 4 that capital intensive firms respond more intensely to such changes. Given that they also pay higher wages on average, the wage effect of a corporate tax cut is amplified by these heterogeneous responses. In other words, the covariance terms in equation (12) are positive. Without firm heterogeneity, and without the amplification coming from these covariance terms, corporate tax cuts generate lower wage gains for workers.

Column (4) removes the fiscal externality from the baseline model by assuming that the change in the corporate income tax rate does not affect the government's transfers to workers. In this scenario, workers' bear 10% of the burden. The fiscal externality is the reason why a corporate tax cut can generate losses. Abstracting from it makes workers bear a greater share of the burden. It is important to notice that the sign and magnitude of this fiscal externality depend on the initial location of the economy on the corporate income tax Laffer curve. The fiscal externality has a negative effect on workers' share of the tax burden only because this economy is on the increasing portion of the Laffer curve. At much higher tax rates, on the decreasing portion of the Laffer curve, this fiscal externality would have the opposite sign and would increase workers' share of the burden. More generally, these results show that the use of public funds is an important determinant of these incidence shares at the aggregate level.

Finally, column (5) shows the distribution of the corporate income tax burden in a small-open-economy (SOE) version of the baseline model. This scenario assumes that any amount of capital is supplied at a constant rental price r_0. Capital owners' utility is no longer taken into account as they are moved outside of the model. Therefore, in both column (1) and (5), the burden is shared only between workers and shareholders. Moreover, since capital is now supplied without any adjustment costs, the economy moves immediately to its new steady state. As a result, workers bear a larger share of the burden than in the baseline economy. Although they still suffer a negative effect from the fiscal externality, they benefit immediately from the entire wage effect. Indeed, firms no longer need several years to scale up production and thus raise wages as soon as the tax reform is introduced. However, workers still bear a very small share (4%) of the corporate tax burden in this small open economy.

Overall, the three micro-relevant assumptions, namely a small open economy, without any fiscal externality, and with homogeneous firms, are necessary to obtain a relatively large share of the tax burden falling on workers.

8 Conclusion

In this paper, I introduce firm and worker heterogeneity and capital adjustment costs into a Harberger model to estimate the share of the corporate tax burden borne by workers. These new ingredients generate stronger wage responses at capital intensive firms than at labor intensive firms following a corporate tax cut. I confirm this prediction using French administrative data that collect information from all firms' tax returns.

I calibrate the model using these data and show that heterogeneous agents, general equilibrium dynamics and fiscal externalities generate a net loss for workers after a corporate income tax cut. I estimate this loss to be 2% of the total welfare gains from this tax cut. I show that using average micro estimates rather than aggregate general equilibrium elasticities to measure the change in workers' welfare leads to an overestimation of their share of the tax burden. I derive a closed-form expression for the discrepancy between micro and macro elasticities, and demonstrate that it is a function of another set of sufficient statistics that can be recovered from empirical analyses.

The present analysis could be extended in many interesting directions. One avenue would be to add other margins that make capital and labor income more or less elastic to corporate tax rates, like international mobility (Gordon and Hines Jr, 2002), income shifting, or the salience of this incidence (Aghion et al., 2023). Another extension could be to introduce different types of workers, characterized by heterogeneous levels of complementarity with capital, as in Krusell et al. (2000), and thus heterogeneous shares of the corporate tax burden.

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APPENDIX

A Additional figures

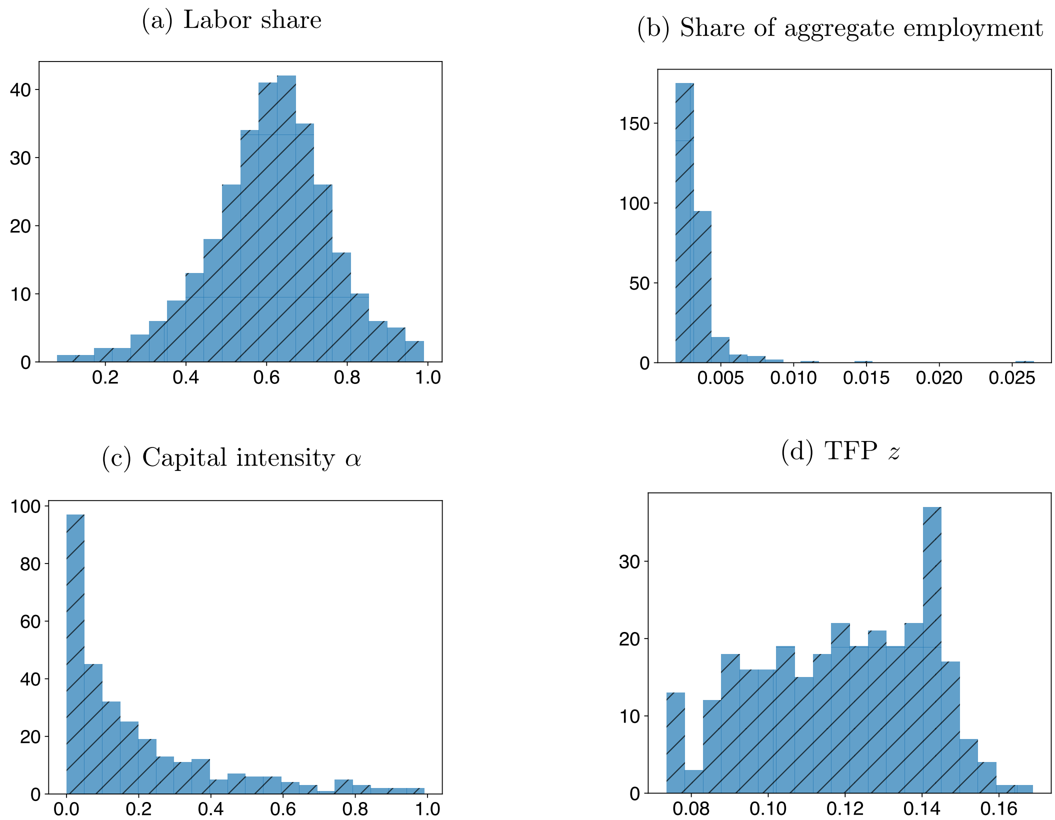

Figure A.6: Firm distribution

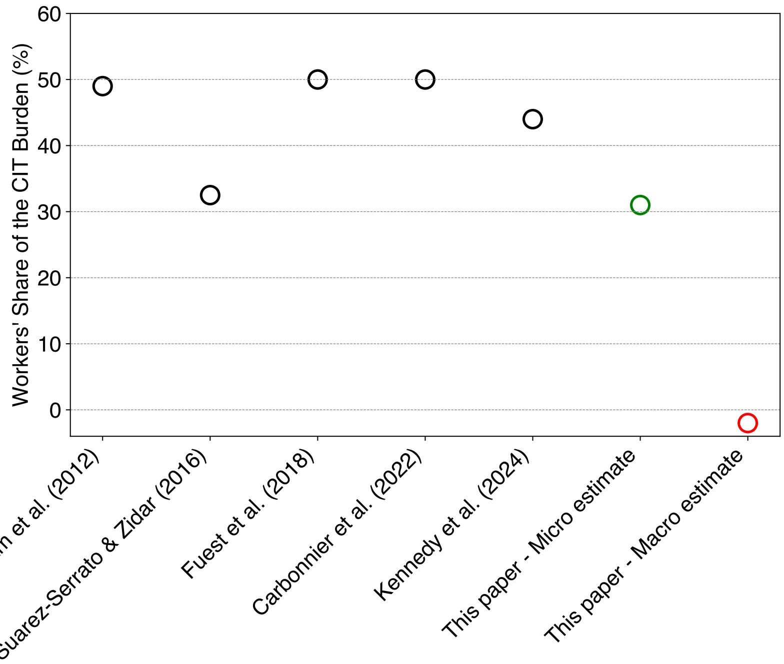

Figure A.7: Comparison to the recent literature

B Data

I use French administrative data provided by the Public Finance Administration (DGFiP) and the National Institute of Statistics and Economic Studies (Insee). The three main datasets are employee and firm data called DADS, FARE and BIC-RN.

The DADS (*Déclarations Annuelles des Données Sociales*) dataset gathers social security reports provided to the French administration by every firm operating in France. It provides information at the contract level on gross and net wage earnings, hours worked, type of contract, age, gender. Each contract is assigned an employee identifier as well as a firm identifier. The latter remains constant across years, which gives a panel dimension at the firm level. This firm identifier is the same across datasets, which gives the possibility to match the DADS dataset with FARE data. I use DADS data for all worker-related variables, typically employment, wages, and skills.

FARE gathers firm-level balance sheet data based on their tax and social security reports. It covers all firms in France except financial and agricultural industries. It is an unbalanced panel on the 2009-2019 sample period. I use FARE data for the majority of firm-related variables that have no direct link with employment and wages, for example value added and sales.

Finally, I use BIC-RN (*Bénéfices industriels et commerciaux - Régime normal*) data for tax related variables. BIC-RN provides all information present on firms' tax returns. It notably provides firms' tax bases, or taxable corporate income, which is very useful to determine firms' marginal and average tax rates, as well as predicted changes in these two outcomes.

B.1 Sample selection

As is common in the literature, I drop firms that have less than five employees. I also drop the few firms that end up with a negative labor share because they have a negative value added or a negative wage bill in the data. As described above, using firms that are present in these datasets implies to restrict the sample to the corporate sector. All firms in the final dataset are taxed under the "normal regime", which means that their are subject to the corporate income tax. This is an equivalent of C-corporations in the US. Moreover, the final dataset excludes financial and agricultural industries.

B.2 Marginal tax rates

I build a tax function that I apply to firms' reported income, and which includes multiple rules and reforms on top of the standard rate ("taux normal"): the reduced rate for small firms ("taux réduit"), the "contribution sociale sur les bénéfices", the "contributions exceptionnelles", the sequential 2017 reform. See Bach et al. (2019) for more details. These features yield a tax schedule and a thus a marginal tax rate for any reported income.

This tax function allows me to create the instrument used in the empirical design, which relies on a predicted marginal tax rate corresponding to the mechanical effect of a tax reform. This predicted tax rate is computed by plugging the previous years' reported income in the current tax function.

B.3 Employment and wage variables

Employment and wage data are taken from the DADS dataset. This data report before-tax income, hours worked, contract type, and many other information for each contract a firm has with an employee. An observation in this data is a contract in a given year. Workers can have multiple contracts in the same year, typically if they have multiple jobs. I drop observations that report negative hours worked, negative days worked, or negative wages.

I compute firms' wage bill as the sum of gross income reported in each of their contracts. Firms' employment is the sum of days worked in each of their contracts, divided by 360, which is the maximum number of days worked for a contract. Firms' average wage in a given year is then simply their wage bill divided by their employment.

B.4 Summary statistics

Table 4: Summary statistics

Variable	Mean	Std. Dev.	Median
Value added	2,649.4	47,334.5	597.6
CIT bill	106.3	3,681.9	3.6
Total assets	14,975.4	631,976.2	1,280.3
EBE	713.1	21,687.0	78.2
Wage bill	1,371.0	21,653.8	358.2
Sales	10,035.4	184,147.3	1,587.8
Employment	38.9	670.2	11.0
Investment (intangible)	118.8	18,655.7	0.0
Investment (tangible)	414.6	20,130.0	14.1
Reported income	589.9	25.9	73.8

Note: All values, except for Employment, are expressed in thousands of 2015 euros.

C Omitted proofs

Derivation of (10)

$$\begin{aligned}\frac{\epsilon_{\boldsymbol{w_t},1-\tau}}{\gamma} &= \sum_j l_j \epsilon^j_{w,1-\tau} \\ &= N\mathbb{E}\left[l_j \epsilon^j_{w,1-\tau}\right] \\ &= \mathbb{E}\left[\epsilon^j_{w,1-\tau}\right] + N\mathbb{C}\mathrm{ov}\left(l_j, \epsilon^j_{w,1-\tau}\right)\end{aligned}$$

Sufficient conditions for Lemma 2

Multiply both sides of equation 13 by l_j, and sum over firms j to obtain

$$\epsilon_{\boldsymbol{w}_t,1-\tau} = -\frac{[1-\sigma(1-\xi)]\sum_j l_j \Lambda_r(s^j_{l,0})}{1-\sum_j l_j \Lambda_w(s^j_{l,0})}\epsilon_{u_t,1-\tau}$$

The numerator is positive, which means that we need to prove that

$$1 - \sum_j l_j \Lambda_w(s^j_{l,0}) > 0$$

i.e.

$$\gamma + \sigma + \frac{1-\sigma(1-\xi)}{1-\xi}\frac{1+\gamma}{\gamma}\frac{s^j_{l,t}}{\xi} > 1$$

Straightforward sufficient conditions this inequality to hold are that $\gamma \geq 1$ and $\sigma > 0$, given that third term of the left-hand side is weakly positive. This is the case in all the cases considered in this paper, notably the main calibration which sets $\gamma = 4.8$ (based on Azar et al. (2022)) and $\sigma = 0.5$ (based on Oberfield and Raval (2021)).

□

D Model - Details

D.1 Capital owner

The representative capital owner chooses, in each period t, her consumption of each good c_{jt} and next period capital K_{t+1} to maximize

$$V_k = \max_{\{c_{jt}, K_{t+1}\}_{t=0}^{\infty}} \sum_{t=0}^{\infty} \beta^t \ln(C_t^K) \quad , \quad C_t^K = \int_0^N c_{jt}^K dj \tag{24}$$
$$\text{s.t. } C_t^K + [K_{t+1} - (1-\delta)K_t] + \phi\left(K_t, K_{t+1}\right) = r_t K_t$$

The first order conditions of the problem are

$$\frac{\beta^t}{C_t^K} = \xi_t$$
$$\xi_t \left[1 + \phi_2\left(K_t, K_{t+1}\right)\right] = \left[r_{t+1} + (1-\delta) - \phi_1\left(K_{t+1}, K_{t+2}\right)\right] \xi_{t+1}$$

Combining these two equations yields the Euler equation:

$$\frac{C_{t+1}^K}{\beta C_t^K} = \frac{r_{t+1} + (1-\delta) - \phi_1\left(K_{t+1}, K_{t+2}\right)}{1 + \phi_2\left(K_t, K_{t+1}\right)} \tag{25}$$

Assuming $\phi(K, K') = \psi \frac{(K' - (1-\delta)K)^2}{2K}$, the Euler equation becomes

$$\frac{C_{t+1}^K}{C_t^K} = \beta \frac{r_{t+1} + (1-\delta) + \frac{\psi}{2}\left(\frac{K_{t+2}}{K_{t+1}}\right)^2}{1 + \psi\left(\frac{K_{t+1}}{K_t} - (1-\delta)\right)}$$

In steady state:

$$1 = \beta \frac{r^* + (1-\delta) + \frac{\psi}{2}}{1 + \psi\left(1 - (1-\delta)\right)} \implies r^* = \frac{1 + \psi\delta}{\beta} - (1-\delta) - \frac{\psi}{2}$$

D.2 Firm problem

Firms choose a vector of inputs (k, l) and a wage w to maximize

$$\begin{aligned} \max_{k,l,w} \quad & zf(k,l,\alpha) - lw - uk \\ \text{s.t.} \quad & f(k,l,\alpha) = \left(\alpha k^{\frac{\sigma-1}{\sigma}} + (1-\alpha) l^{\frac{\sigma-1}{\sigma}}\right)^{\frac{\sigma\xi}{\sigma-1}} \\ & l(w) = \frac{w^\gamma}{\boldsymbol{w}} \end{aligned}$$

or

$$\max_{k,w} \quad z\left(\alpha k^{\frac{\sigma-1}{\sigma}} + (1-\alpha)(w^\gamma \boldsymbol{w}^{-1})^{\frac{\sigma-1}{\sigma}}\right)^{\frac{\sigma\xi}{\sigma-1}} - w^{1+\gamma}\boldsymbol{w}^{-1} - uk$$

The FOC's are

$$\begin{aligned} (k) \quad & z\xi\left(\alpha k^{\frac{\sigma-1}{\sigma}} + (1-\alpha) l^{\frac{\sigma-1}{\sigma}}\right)^{\frac{\sigma\xi}{\sigma-1}-1} \alpha k^{-\frac{1}{\sigma}} = u \\ (w) \quad & z\xi\left(\alpha k^{\frac{\sigma-1}{\sigma}} + (1-\alpha)(w^\gamma \boldsymbol{w}^{-1})^{\frac{\sigma-1}{\sigma}}\right)^{\frac{\sigma\xi}{\sigma-1}-1} (1-\alpha)\boldsymbol{w}^{-\frac{\sigma-1}{\sigma}} \gamma w^{\gamma\frac{\sigma-1}{\sigma}-1} = (1+\gamma) w^\gamma \boldsymbol{w}^{-1} \end{aligned}$$

Rearranging the second equation yields

$$(w) \quad z\xi\left(\alpha k^{\frac{\sigma-1}{\sigma}} + (1-\alpha)(\boldsymbol{w}^{-1} w^\gamma)^{\frac{\sigma-1}{\sigma}}\right)^{\frac{\sigma\xi}{\sigma-1}-1} (1-\alpha)\boldsymbol{w}^{\frac{1}{\sigma}} \frac{\gamma}{1+\gamma} w^{-\frac{\gamma+\sigma}{\sigma}} = 1$$

Dividing (k) by (w) gives

$$\frac{\alpha}{1-\alpha}\frac{k^{-\frac{1}{\sigma}}}{\boldsymbol{w}^{\frac{1}{\sigma}} w^{-\frac{\gamma+\sigma}{\sigma}}} = \frac{\gamma}{1+\gamma} u$$

i.e.

$$k^{\frac{\sigma-1}{\sigma}} = \left(\frac{\gamma}{1+\gamma} u \frac{1-\alpha}{\alpha}\right)^{1-\sigma} \boldsymbol{w}^{-\frac{\sigma-1}{\sigma}} w^{\frac{(\gamma+\sigma)(\sigma-1)}{\sigma}}$$

D.3 Wage bill

We can take our FOC (w)

$$z\xi\left(\alpha k^{\frac{\sigma-1}{\sigma}} + (1-\alpha)(\boldsymbol{w}^{-1} w^\gamma)^{\frac{\sigma-1}{\sigma}}\right)^{\frac{\sigma\xi}{\sigma-1}-1} (1-\alpha)\boldsymbol{w}^{\frac{1}{\sigma}} \frac{\gamma}{1+\gamma} w^{-\frac{\gamma+\sigma}{\sigma}} = 1$$

and use our previous result to substitute for k

$$
\begin{aligned}
& z\xi\left(\alpha\left(\frac{\gamma}{1+\gamma}u\frac{1-\alpha}{\alpha}\right)^{1-\sigma}\boldsymbol{w}^{-\frac{\sigma-1}{\sigma}}w^{\frac{(\gamma+\sigma)(\sigma-1)}{\sigma}}+(1-\alpha)(\boldsymbol{w}^{-1}w^{\gamma})^{\frac{\sigma-1}{\sigma}}\right)^{\frac{\sigma\xi}{\sigma-1}-1} \\
& (1-\alpha)\boldsymbol{w}^{\frac{1}{\sigma}}\frac{\gamma}{1+\gamma}w^{-\frac{\gamma+\sigma}{\sigma}}=1 \\
\implies\quad & z\xi\left(\alpha^{\sigma}\left(\frac{\gamma}{1+\gamma}\frac{u}{w}(1-\alpha)\right)^{1-\sigma}+(1-\alpha)\right)^{\frac{\sigma\xi}{\sigma-1}-1}(1-\alpha)\boldsymbol{w}^{1-\xi}\frac{\gamma}{1+\gamma}w^{-[1+\gamma(1-\xi)]}=1 \\
\implies\quad & z\xi\left(\alpha^{\sigma}u^{1-\sigma}+(1-\alpha)^{\sigma}\left(\frac{1+\gamma}{\gamma}w\right)^{1-\sigma}\right)^{\frac{\sigma\xi}{\sigma-1}-1}\left(\frac{1+\gamma}{\gamma}w\right)^{1-\sigma(1-\xi)} \\
& (1-\alpha)^{\sigma(1-\xi)}\boldsymbol{w}^{1-\xi}\frac{\gamma}{1+\gamma}w^{-[1+\gamma(1-\xi)]}=1 \\
\implies\quad & z\xi\left(\alpha^{\sigma}u^{1-\sigma}+(1-\alpha)^{\sigma}\left(\frac{1+\gamma}{\gamma}w\right)^{1-\sigma}\right)^{-\frac{1-\sigma(1-\xi)}{1-\sigma}} \\
& (1-\alpha)^{\sigma(1-\xi)}\left(\frac{\gamma}{1+\gamma}\right)^{\sigma(1-\xi)}\boldsymbol{w}^{(1-\xi)}w^{-(\gamma+\sigma)(1-\xi)}=1 \\
\implies\quad & (z\xi)^{\frac{1}{1-\xi}}\left(\alpha^{\sigma}u^{1-\sigma}+(1-\alpha)^{\sigma}\left(\frac{1+\gamma}{\gamma}w\right)^{1-\sigma}\right)^{-\frac{1-\sigma(1-\xi)}{(1-\sigma)(1-\xi)}} \\
& (1-\alpha)^{\sigma}w^{(1-\sigma)}\left(\frac{\gamma}{1+\gamma}\right)^{\sigma}=\boldsymbol{w}^{-1}w^{1+\gamma}=wl
\end{aligned}
$$

D.4 Output

Back to the FOCs:

$$
\begin{aligned}
(k)\quad & z\xi\left(\alpha k^{\frac{\sigma-1}{\sigma}}+(1-\alpha)l^{\frac{\sigma-1}{\sigma}}\right)^{\frac{\sigma\xi}{\sigma-1}-1}\alpha k^{-\frac{1}{\sigma}}=u \\
(w)\quad & z\xi\left(\alpha k^{\frac{\sigma-1}{\sigma}}+(1-\alpha)(\boldsymbol{w}^{-1}w^{\gamma})^{\frac{\sigma-1}{\sigma}}\right)^{\frac{\sigma\xi}{\sigma-1}-1}(1-\alpha)\boldsymbol{w}^{\frac{1}{\sigma}}\frac{\gamma}{1+\gamma}w^{-\frac{\gamma+\sigma}{\sigma}}=1
\end{aligned}
$$

Dividing (k) by (l) gives

$$
k^{\frac{\sigma-1}{\sigma}}=\left(\frac{\gamma}{1+\gamma}u\frac{1-\alpha}{\alpha}\right)^{1-\sigma}\boldsymbol{w}^{-\frac{\sigma-1}{\sigma}}w^{\frac{(\gamma+\sigma)(\sigma-1)}{\sigma}}
$$

Let's rewrite the FOCs as

$$
\begin{aligned}
(k) \quad & z^{\frac{\sigma-1}{\sigma\xi}} \xi y^{\frac{1-\sigma(1-\xi)}{\sigma\xi}} \alpha k^{-\frac{1}{\sigma}} = u \\
(w) \quad & z^{\frac{\sigma-1}{\sigma\xi}} \xi y^{\frac{1-\sigma(1-\xi)}{\sigma\xi}} (1-\alpha) \boldsymbol{w}^{\frac{1}{\sigma}} \frac{\gamma}{1+\gamma} w^{-\frac{\gamma+\sigma}{\sigma}} = 1
\end{aligned}
$$

or

$$
\begin{aligned}
(k) \quad & z^{\frac{\sigma-1}{\sigma\xi}} \left(\frac{\xi\alpha}{u}\right)^{\sigma-1} y^{\frac{(1-\sigma(1-\xi))(\sigma-1)}{\sigma\xi}} = k^{\frac{\sigma-1}{\sigma}} \\
(w) \quad & z^{\frac{(\sigma-1)^2}{\sigma\xi}} \left(\frac{\xi(1-\alpha)}{w} \frac{\gamma}{1+\gamma}\right)^{\sigma-1} y^{\frac{(1-\sigma(1-\xi))(\sigma-1)}{\sigma\xi}} = (\boldsymbol{w}^{-1} w^{\gamma})^{\frac{\sigma-1}{\sigma}}
\end{aligned}
$$

where I used $f = y/z$.

We can use this to substitute for k and l in the production function:

$$
\begin{aligned}
& y = z\left(\alpha k^{\frac{\sigma-1}{\sigma}} + (1-\alpha) l^{\frac{\sigma-1}{\sigma}}\right)^{\frac{\sigma\xi}{\sigma-1}} \\
\Longrightarrow \quad & y = z^{\frac{1}{(1-\xi)}} \xi^{\frac{\xi}{1-\xi}} \left(\alpha^{\sigma} u^{1-\sigma} + (1-\alpha)^{\sigma} \left(\frac{1+\gamma}{\gamma} w\right)^{1-\sigma}\right)^{\frac{\xi}{(\sigma-1)(1-\xi)}}
\end{aligned}
$$

or simply rearranging (w),

$$
y = \left(\frac{1+\gamma}{\gamma\xi(1-\alpha)}\right)^{\frac{\sigma\xi}{1-\sigma(1-\xi)}} z^{-\frac{\sigma-1}{1-\sigma(1-\xi)}} \boldsymbol{w}^{-\frac{\xi}{1-\sigma(1-\xi)}} w^{\frac{(\gamma+\sigma)\xi}{1-\sigma(1-\xi)}}
$$

and when $\xi = 1$,

$$
y = \left(\frac{1+\gamma}{\gamma(1-\alpha)}\right)^{\sigma} z^{1-\sigma} \boldsymbol{w}^{-1} w^{\gamma+\sigma}
$$

D.5 Labor share

We can easily compute a firm's labor share, s_l, with our last results:

$$
\begin{aligned}
s_l &= \frac{wl}{y} \\
&= \frac{(z\xi)^{\frac{1}{1-\xi}} \left(\alpha^\sigma u^{1-\sigma} + (1-\alpha)^\sigma \left(\frac{1+\gamma}{\gamma} w\right)^{1-\sigma}\right)^{-\frac{1-\sigma(1-\xi)}{(1-\sigma)(1-\xi)}} (1-\alpha)^\sigma w^{(1-\sigma)} \left(\frac{\gamma}{1+\gamma}\right)^\sigma}{z^{\frac{1}{(1-\xi)}} \xi^{\frac{\xi}{1-\xi}} \left(\alpha^\sigma u^{1-\sigma} + (1-\alpha)^\sigma \left(\frac{1+\gamma}{\gamma} w\right)^{1-\sigma}\right)^{\frac{\xi}{(\sigma-1)(1-\xi)}}} \\
&= \xi \frac{(1-\alpha)^\sigma w^{1-\sigma} \left(\frac{\gamma}{1+\gamma}\right)^\sigma}{\alpha^\sigma u^{1-\sigma} + (1-\alpha)^\sigma \left(\frac{1+\gamma}{\gamma} w\right)^{1-\sigma}} \\
&= \xi \frac{\gamma}{1+\gamma} \frac{(1-\alpha)^\sigma \left(\frac{1+\gamma}{\gamma} w\right)^{1-\sigma}}{\alpha^\sigma u^{1-\sigma} + (1-\alpha)^\sigma \left(\frac{1+\gamma}{\gamma} w\right)^{1-\sigma}}
\end{aligned}
$$

D.6 Capital share

From the FOC:

$$
k = \left(\frac{\gamma}{1+\gamma} \frac{u}{w} \frac{1-\alpha}{\alpha}\right)^{-\sigma} \boldsymbol{w}^{-1} w^\gamma
$$

Thus, the firm-level capital share is

$$
\begin{aligned}
s_k &= \frac{rk}{y} \\
&= \left(\frac{\gamma}{1+\gamma} \frac{u}{w} \frac{1-\alpha}{\alpha}\right)^{-\sigma} r \frac{l}{y} \\
&= \left(\frac{\gamma}{1+\gamma} \frac{u}{w} \frac{1-\alpha}{\alpha}\right)^{-\sigma} \frac{r}{w} s_l \\
&= \left(\frac{\gamma}{1+\gamma} \frac{u}{w} \frac{1-\alpha}{\alpha}\right)^{-\sigma} \frac{r}{w} \xi \frac{\gamma}{1+\gamma} \frac{(1-\alpha)^\sigma \left(\frac{1+\gamma}{\gamma} w\right)^{1-\sigma}}{\alpha^\sigma u^{1-\sigma} + (1-\alpha)^\sigma \left(\frac{1+\gamma}{\gamma} w\right)^{1-\sigma}} \\
&= \frac{1-\tau}{1-\lambda\tau} \xi \frac{\alpha^\sigma u^{1-\sigma}}{\alpha^\sigma u^{1-\sigma} + (1-\alpha)^\sigma \left(\frac{1+\gamma}{\gamma} w\right)^{1-\sigma}} \\
&= \frac{1-\tau}{1-\lambda\tau} \left(\xi - \frac{1+\gamma}{\gamma} s_l\right)
\end{aligned}
$$

D.7 Labor income elasticity

$$wl = (z\xi)^{\frac{1}{1-\xi}} \left(\alpha^\sigma u^{1-\sigma} + (1-\alpha)^\sigma \left(\frac{1+\gamma}{\gamma} w \right)^{1-\sigma} \right)^{-\frac{1-\sigma(1-\xi)}{(1-\sigma)(1-\xi)}} (1-\alpha)^\sigma w^{(1-\sigma)} \left(\frac{\gamma}{1+\gamma} \right)^\sigma$$

$$\begin{aligned} d\ln(wl) &= -\frac{1-\sigma(1-\xi)}{(1-\sigma)(1-\xi)} d\ln \left(\alpha^\sigma u^{1-\sigma} + (1-\alpha)^\sigma \left(\frac{1+\gamma}{\gamma} w \right)^{1-\sigma} \right) + (1-\sigma) d\ln(w) \\ &= -\frac{1-\sigma(1-\xi)}{(1-\xi)} \left(1 - \frac{1+\gamma}{\gamma} \frac{s_l}{\xi} \right) d\ln u \\ &\quad + \left[(1-\sigma) - \frac{1-\sigma(1-\xi)}{(1-\xi)} \frac{1+\gamma}{\gamma} \frac{s_l}{\xi} \right] d\ln w \end{aligned}$$

Using

$$\begin{aligned} wl = \boldsymbol{w}^{-1} w^{1+\gamma} &\implies d\ln(wl) = -d\ln(\boldsymbol{w}) + (1+\gamma) d\ln(w) \\ &\implies d\ln(w) = \frac{1}{1+\gamma} [d\ln(wl) + d\ln(\boldsymbol{w})] \end{aligned}$$

we can express the log change in wage bill as

$$d\ln(wl) = -\frac{\frac{1-\sigma(1-\xi)}{(1-\xi)} \left(1 - \frac{1+\gamma}{\gamma} \frac{s_l}{\xi} \right)}{1 - \frac{1-\sigma}{1+\gamma} + \frac{1-\sigma(1-\xi)}{(1-\xi)} \frac{s_l}{\gamma\xi}} d\ln u - \frac{\left[\frac{1-\sigma}{1+\gamma} + \frac{1-\sigma(1-\xi)}{(1-\xi)} \frac{s_l}{\gamma\xi} \right]}{1 - \frac{1-\sigma}{1+\gamma} + \frac{1-\sigma(1-\xi)}{(1-\xi)} \frac{s_l}{\gamma\xi}} d\ln \boldsymbol{w}$$

The elasticity of labor income with respect to the net-of-tax rate is

$$\begin{aligned} \epsilon_{wl,1-\tau} &= \frac{d\ln(wl)}{d\ln(1-\tau)} \\ &= -\frac{[1-\sigma(1-\xi)] \left(1 - \frac{1+\gamma}{\gamma} \frac{s_l}{\xi} \right)}{1 - \xi - \frac{(1-\xi)(1-\sigma)}{1+\gamma} + [1-\sigma(1-\xi)] \frac{s_l}{\gamma\xi}} \frac{d\ln u}{d\ln(1-\tau)} \\ &\quad + \frac{\left[\frac{(1-\xi)(1-\sigma)}{1+\gamma} - [1-\sigma(1-\xi)] \frac{s_l}{\gamma\xi} \right]}{1 - \xi - \frac{(1-\xi)(1-\sigma)}{1+\gamma} + [1-\sigma(1-\xi)] \frac{s_l}{\gamma\xi}} \frac{d\ln \boldsymbol{w}}{d\ln(1-\tau)} \end{aligned}$$

If $\xi = 1$,

$$\epsilon_{wl,1-\tau} = -\frac{\gamma - (1+\gamma)s_l}{s_l} \frac{d\ln u}{d\ln(1-\tau)} - \frac{d\ln \boldsymbol{w}}{d\ln(1-\tau)}$$

In partial equilibrium, i.e. $dr = d\boldsymbol{w} = 0$,

$$\epsilon^{PE}_{wl,1-\tau} = \frac{\frac{1-\sigma(1-\xi)}{(1-\xi)}\left(1 - \frac{1+\gamma}{\gamma}\frac{s_l}{\xi}\right)}{1 - \frac{1-\sigma}{1+\gamma} + \frac{1-\sigma(1-\xi)}{(1-\xi)}\frac{s_l}{\gamma\xi}} \frac{1-\lambda}{1-\lambda\tau} > 0$$

If $\xi = 1$,

$$\epsilon^{PE}_{wl,1-\tau} = -(1+\gamma)\frac{\frac{\gamma}{1+\gamma} - s_l}{s_l}\frac{1-\lambda}{(1-\tau)^2} r$$

The indirect effect is summarized by the following elasticity:

$$\begin{aligned} \epsilon^{GE}_{wl,1-\tau} &= \epsilon_{wl,1-\tau} - \epsilon^{PE}_{wl,1-\tau} \\ &= -\frac{\frac{1-\sigma(1-\xi)}{(1-\xi)}\left(1 - \frac{1+\gamma}{\gamma}\frac{s_l}{\xi}\right)}{1 - \frac{1-\sigma}{1+\gamma} + \frac{1-\sigma(1-\xi)}{(1-\xi)}\frac{s_l}{\gamma\xi}} \frac{1-\lambda\tau}{1-\tau}\frac{d\ln r}{d\ln(1-\tau)} + \frac{\left[\frac{1-\sigma}{1+\gamma} - \frac{1-\sigma(1-\xi)}{(1-\xi)}\frac{s_l}{\gamma\xi}\right]}{1 - \frac{1-\sigma}{1+\gamma} + \frac{1-\sigma(1-\xi)}{(1-\xi)}\frac{s_l}{\gamma\xi}}\frac{d\ln \boldsymbol{w}}{d\ln(1-\tau)} \end{aligned}$$

D.8 Wage elasticity

From our previous results,

$$\begin{aligned} d\ln(wl) = &-\frac{1-\sigma(1-\xi)}{(1-\xi)}\left(1 - \frac{1+\gamma}{\gamma}\frac{s_l}{\xi}\right) d\ln u \\ &+ \left[(1-\sigma) - \frac{1-\sigma(1-\xi)}{(1-\xi)}\frac{1+\gamma}{\gamma}\frac{s_l}{\xi}\right] d\ln w \end{aligned}$$

Using

$$wl = \frac{w^{1+\gamma}}{\boldsymbol{w}} \implies d\ln(wl) = (1+\gamma)d\ln(w) - d\ln\boldsymbol{w}$$

then,

$$\begin{aligned} d\ln w &= \frac{-\frac{1-\sigma(1-\xi)}{(1-\xi)}\left(1 - \frac{1+\gamma}{\gamma}\frac{s_l}{\xi}\right) d\ln u + d\ln\boldsymbol{w}}{\gamma + \sigma + \frac{1-\sigma(1-\xi)}{(1-\xi)}\frac{1+\gamma}{\gamma}\frac{s_l}{\xi}} \\ &= \frac{-[1-\sigma(1-\xi)]\left(1 - \frac{1+\gamma}{\gamma}\frac{s_l}{\xi}\right) d\ln u + (1-\xi)d\ln\boldsymbol{w}}{(1-\xi)(\gamma+\sigma) + [1-\sigma(1-\xi)]\frac{1+\gamma}{\gamma}\frac{s_l}{\xi}} \end{aligned}$$

and,

$$\epsilon_{w,1-\tau} = \underbrace{-\frac{[1-\sigma(1-\xi)]\left(1-\frac{1+\gamma}{\gamma}\frac{s_l}{\xi}\right)}{(1-\xi)(\gamma+\sigma)+[1-\sigma(1-\xi)]\frac{1+\gamma}{\gamma}\frac{s_l}{\xi}}}_{<0}\frac{d\ln u}{d\ln(1-\tau)} + \underbrace{\frac{(1-\xi)}{(1-\xi)(\gamma+\sigma)+[1-\sigma(1-\xi)]\frac{1+\gamma}{\gamma}\frac{s_l}{\xi}}}_{>0}\frac{d\ln \boldsymbol{w}}{d\ln(1-\tau)}$$

If $\xi = 1$,

$$d\ln w = \left(1-\frac{\gamma}{(1+\gamma)s_l}\right)d\ln u$$

and

$$\epsilon_{w,1-\tau} = \underbrace{-\left(\frac{\gamma/(1+\gamma)}{s_l}-1\right)}_{<0}\frac{d\ln u}{d\ln(1-\tau)}$$

In partial equilibrium, i.e. $dr = d\boldsymbol{w} = 0$,

$$\epsilon^{PE}_{w,1-\tau} = \frac{[1-\sigma(1-\xi)]\left(1-\frac{1+\gamma}{\gamma}\frac{s_l}{\xi}\right)}{(1-\xi)(\gamma+\sigma)+[1-\sigma(1-\xi)]\frac{1+\gamma}{\gamma}\frac{s_l}{\xi}}\frac{1-\lambda}{1-\lambda\tau} > 0$$

If $\xi = 1$,

$$\epsilon^{PE}_{w,1-\tau} = \left(\frac{\gamma/(1+\gamma)}{s_l}-1\right)\frac{1-\lambda}{1-\lambda\tau} > 0$$

The indirect effect is summarized by the following elasticity:

$$\begin{aligned}\epsilon^{GE}_{w,1-\tau} &= \epsilon_{w,1-\tau} - \epsilon^{PE}_{w,1-\tau} \\ &= -\frac{[1-\sigma(1-\xi)]\left(1-\frac{1+\gamma}{\gamma}\frac{s_l}{\xi}\right)}{(1-\xi)(\gamma+\sigma)+[1-\sigma(1-\xi)]\frac{1+\gamma}{\gamma}\frac{s_l}{\xi}}\frac{1-\lambda\tau}{1-\tau}\frac{d\ln r}{d\ln(1-\tau)} \\ &\quad + \frac{(1-\xi)}{(1-\xi)(\gamma+\sigma)+[1-\sigma(1-\xi)]\frac{1+\gamma}{\gamma}\frac{s_l}{\xi}}\frac{d\ln \boldsymbol{w}}{d\ln(1-\tau)}\end{aligned}$$

If $\xi = 1$,

$$\epsilon^{GE}_{w,1-\tau} = -\left(\frac{\gamma/(1+\gamma)}{s_l} - 1\right)\frac{1-\lambda\tau}{1-\tau}\frac{d\ln r}{d\ln(1-\tau)}$$

D.9 Aggregate wage effect

$$\mathbb{E}\left[\epsilon^{PE}_{w,1-\tau}\right] = [1-\sigma(1-\xi)]\frac{1-\lambda}{1-\lambda\tau}\mathbb{E}\left[\frac{\left(1-\frac{1+\gamma}{\gamma}\frac{s_l}{\xi}\right)}{(1-\xi)(\gamma+\sigma)+[1-\sigma(1-\xi)]\frac{1+\gamma}{\gamma}\frac{s_l}{\xi}}\right]$$

$$\mathbb{C}\mathrm{ov}\left(l_j, \epsilon^{PE}_{w,1-\tau}\right) = [1-\sigma(1-\xi)]\frac{1-\lambda}{1-\lambda\tau}\mathbb{C}\mathrm{ov}\left(l_j, \frac{\left(1-\frac{1+\gamma}{\gamma}\frac{s_l}{\xi}\right)}{(1-\xi)(\gamma+\sigma)+[1-\sigma(1-\xi)]\frac{1+\gamma}{\gamma}\frac{s_l}{\xi}}\right)$$

$$\begin{aligned}\mathbb{E}\left[\epsilon^{GE}_{w,1-\tau}\right] &= -[1-\sigma(1-\xi)]\frac{1-\lambda\tau}{1-\tau}\mathbb{E}\left[\frac{\left(1-\frac{1+\gamma}{\gamma}\frac{s_l}{\xi}\right)}{(1-\xi)(\gamma+\sigma)+[1-\sigma(1-\xi)]\frac{1+\gamma}{\gamma}\frac{s_l}{\xi}}\right]\frac{d\ln r}{d\ln(1-\tau)} \\ &+ \mathbb{E}\left[\frac{(1-\xi)}{(1-\xi)(\gamma+\sigma)+[1-\sigma(1-\xi)]\frac{1+\gamma}{\gamma}\frac{s_l}{\xi}}\right]\frac{d\ln \boldsymbol{w}}{d\ln(1-\tau)}\end{aligned}$$

$$\begin{aligned}\mathbb{C}\mathrm{ov}\left(l_j, \epsilon^{GE}_{w,1-\tau}\right) &= -[1-\sigma(1-\xi)]\frac{1-\lambda\tau}{1-\tau}\mathbb{C}\mathrm{ov}\left(l_j, \frac{\left(1-\frac{1+\gamma}{\gamma}\frac{s_l}{\xi}\right)}{(1-\xi)(\gamma+\sigma)+[1-\sigma(1-\xi)]\frac{1+\gamma}{\gamma}\frac{s_l}{\xi}}\right)\frac{d\ln r}{d\ln(1-\tau)} \\ &+ \mathbb{C}\mathrm{ov}\left(l_j, \frac{(1-\xi)}{(1-\xi)(\gamma+\sigma)+[1-\sigma(1-\xi)]\frac{1+\gamma}{\gamma}\frac{s_l}{\xi}}\right)\frac{d\ln \boldsymbol{w}}{d\ln(1-\tau)}\end{aligned}$$

or

$$\begin{aligned}\mathbb{E}\left[\epsilon^{PE}_{w,1-\tau}\right] &= [1-\sigma(1-\xi)]\frac{1-\lambda}{1-\lambda\tau}\mathbb{E}\left[\Lambda_r(s_l)\right] \\ \mathbb{C}\mathrm{ov}\left(l_j, \epsilon^{PE}_{w,1-\tau}\right) &= [1-\sigma(1-\xi)]\frac{1-\lambda}{1-\lambda\tau}\mathbb{C}\mathrm{ov}\left(l_j, \Lambda_r(s_l)\right) \\ \mathbb{E}\left[\epsilon^{GE}_{w,1-\tau}\right] &= -[1-\sigma(1-\xi)]\frac{1-\lambda\tau}{1-\tau}\mathbb{E}\left[\Lambda_r(s_l)\right]\frac{d\ln r}{d\ln(1-\tau)} \\ &+ \mathbb{E}\left[\Lambda_w(s_l)\right]\frac{d\ln \boldsymbol{w}}{d\ln(1-\tau)} \\ \mathbb{C}\mathrm{ov}\left(l_j, \epsilon^{GE}_{w,1-\tau}\right) &= -[1-\sigma(1-\xi)]\frac{1-\lambda\tau}{1-\tau}\mathbb{C}\mathrm{ov}\left(l_j, \Lambda_r(s_l)\right)\frac{d\ln r}{d\ln(1-\tau)} \\ &+ \mathbb{C}\mathrm{ov}\left(l_j, \Lambda_w(s_l)\right)\frac{d\ln \boldsymbol{w}}{d\ln(1-\tau)}\end{aligned}$$

where

$$\Lambda_r(s_l) = \frac{\left(1 - \frac{1+\gamma}{\gamma}\frac{s_l}{\xi}\right)}{(1-\xi)(\gamma+\sigma) + [1-\sigma(1-\xi)]\frac{1+\gamma}{\gamma}\frac{s_l}{\xi}}$$

$$\Lambda_w(s_l) = \frac{(1-\xi)}{(1-\xi)(\gamma+\sigma) + [1-\sigma(1-\xi)]\frac{1+\gamma}{\gamma}\frac{s_l}{\xi}}$$

Moreover, if $\xi = 1$,

$$\mathbb{E}\left[\epsilon^{PE}_{w,1-\tau}\right] = \frac{1-\lambda}{1-\lambda\tau}\left(\frac{\gamma}{1+\gamma}\mathbb{E}\left[\frac{1}{s_l}\right] - 1\right)$$

$$\mathbb{Cov}\left(l_j, \epsilon^{PE}_{w,1-\tau}\right) = \frac{1-\lambda}{1-\lambda\tau}\frac{\gamma}{1+\gamma}\mathbb{Cov}\left(l_j, \frac{1}{s_l}\right)$$

$$\mathbb{E}\left[\epsilon^{GE}_{w,1-\tau}\right] = -\frac{1-\lambda\tau}{1-\tau}\left(\frac{\gamma}{1+\gamma}\mathbb{E}\left[\frac{1}{s_l}\right] - 1\right)\frac{d\ln r}{d\ln(1-\tau)}$$

$$\mathbb{Cov}\left(l_j, \epsilon^{GE}_{w,1-\tau}\right) = -\frac{1-\lambda\tau}{1-\tau}\frac{\gamma}{1+\gamma}\mathbb{Cov}\left(l_j, \frac{1}{s_l}\right)\frac{d\ln r}{d\ln(1-\tau)}$$

E Model inversion

Let N denote the number of firms in the economy. For a given labor supply elasticity and an initial normalization of $\boldsymbol{w}_0$, there is a one-to-one mapping between firms' observed employment shares $l_{j,0}$ and their wages $w_{j,0}$, defined by the labor supply equation (2). Using this mapping, I recover firms' initial wages from the observed distribution of employment in 2010.

Then, we can recover firms' capital intensity α_j from these wages and firms' observed labor share $s^j_{l,0}$ in 2010, using equation (14), for given values of the parameters $\{\sigma, \xi, \gamma\}$.

Finally, we can recover firms' TFP z_j from the vector of wages, the vector of capital intensities, parameters $\{\sigma, \xi, \gamma, \boldsymbol{w}_0\}$, and firms' FOC derived in appendix D.3.