Appendices for Online Publication
Do Higher Corporate Taxes Reduce Wages? Micro Evidence from Germany*

Clemens Fuest   Andreas Peichl   Sebastian Siegloch

September 22, 2017

*Fuest: ifo Institute, University of Munich and CESifo (fuest@ifo.de); Peichl: ifo Institute, University of Munich, CESifo, IZA and ZEW (peichl@ifo.de); Siegloch: University of Mannheim, IZA, ZEW and CESifo (siegloch@uni-mannheim.de).

A The theory of corporate tax incidence

The theoretical literature has produced various models of corporate tax incidence. These models lead to different predictions, depending on the assumptions made about factor and output markets, wage-setting institutions, the structure of the tax system and behavioral reactions to tax changes. In the seminal paper by Harberger (1962), the economy is closed, labor markets are competitive and capital is in fixed supply. At least for plausible parameter values, the corporate tax burden is almost fully borne by capital.[1] The subsequent literature has emphasized the importance of international capital mobility in open economies (Diamond and Mirrlees, 1971*a*,*b*; Bradford, 1978; Kotlikoff and Summers, 1987; Harberger, 1995).[2] In these models, the share of the (source-based) corporate tax burden bore by domestic immobile factors increases as the size of the economy relative to the rest of the world decreases. In the case of a small open economy that faces a perfectly elastic supply of capital, the burden of the corporate tax is fully borne by factors other than capital. If profits of a firm are the result of location specific rents, the tax will partly fall on these rents. By contrast, if rents are firm specific and firms are mobile, the tax burden will be fully shifted to owners of immobile factors like land or labor.[3]

However, complete immobility of labor is a strong assumption, in particular when considering corporate taxes at the sub-national level. Another restrictive assumption of standard models is that labor markets are competitive. Relatively little attention has been paid to the role of wage-setting institutions and labor market frictions in the context of corporate taxation, two exceptions the studies by Felix and Hines (2009) and Arulampalam, Devereux and Maffini (2012).

In this Appendix, we discuss the implications of various wage-setting models for the impact of corporate tax changes on wages. As will be explained further below, the model will be varied slightly to incorporate different assumptions about wage setting and two aspects of the tax system relating to formula apportionment and income shifting.

Consider an economy which consists of n jurisdictions. There is a large number of firms in the economy. To ease notation we normalize the number of firms per jurisdiction to unity. Firms use the following factors of production: capital (K) and labor of two

[1] Feldstein (1974) and Ballentine (1978) study tax incidence in models with endogenous savings and find that part of the tax burden is shifted to labor.

[2] Other important extensions of the canonical Harberger model focus on the sectoral composition (Shoven, 1976), savings behavior (Feldstein, 1974; Bradford, 1978) and the presence of uncertainty in the economy (Ratti and Shome, 1977).

[3] From a global perspective, a tax increase in one jurisdiction reduces the income of immobile factors in that jurisdiction but increases the income of immobile factors and reduces capital income in the rest of the world. In principle, the burden of corporate taxes may also fall on suppliers or on customers, provided input and output prices are not pinned down by international markets.

skill levels. Labor of skill type k, $k = h, l$, is denoted by L^k.[4] We will consider different production technologies. In the base version of the model we consider a concave production function $F(K, L^h, L^l)$, which is assumed to exhibit declining returns to scale. One interpretation is that there is an implicit fourth factor, which may be interpreted as a location-specific rent. While capital and both types of labor are mobile across municipal borders, firms are immobile, due to the location-specific rent.

The after-tax profit of firm i located in jurisdiction j , $j = 1...n$, is given by

$$P_{ij} = p_i F_i(K_i, L_i^h, L_i^l)(1 - \tau_j) - \sum_k w_i^k L_i^k (1 - \tau_j) - (1 - \alpha\tau_j) r_i K_i \tag{1}$$

where p_i is the output price, r_i is the non-tax cost of capital and w_i^k is the wage labor of skill type k. In some variants of the model, labor markets may not clear. In these cases, we assume that unemployed workers of skill type k receive unemployment benefits denoted by $\overline{w}^k$. The tax rate on corporate profits in jurisdiction j is denoted by τ_j.

The variable α, with $0 \leq \alpha \leq 1$, is a tax base parameter representing the share of the capital cost which can be deducted from the tax base. This parameter is the same in all jurisdictions. A cash-flow tax would imply $\alpha = 1$, that is full deductibility of all costs. Most existing corporate tax systems are more restrictive, however. Costs of debt financing are usually deductible while costs of equity financing are not and loss offset is typically restricted. These properties of the corporate tax base are important for theoretical predictions about the incidence of the tax, as will be shown below.

In the following we drop the index j for firm variables to ease notation. Total differentiation of the profit equation and using the standard first order conditions for profit-maximization yields

$$dP_i = -d\tau_j T_i + dp_i F_i(K_i, L_i^h, L_i^l)(1 - \tau_j) - \sum_k dw_i^k L_i^k (1 - \tau_j) - dr_i (1 - \alpha\tau_j) K_i \tag{2}$$

where $T_i = p_i F_i(K_i, L_i^h, L_i^l) - \sum_k w_i^k L_i^k - \alpha r_i K_i$ is the profit tax base. Equation (2) shows that a tax increase may lead to lower profits for firm owners, higher output prices charged to customers, a decline in wages received by workers, lower income for capital owners or a combination of these effects. It is also possible that some of these groups lose while others gain.

The distribution of the tax burden depends on how the model is closed, that is,

[4] To keep the notation simple we abstract from other input factors like land, energy or other intermediate goods. Clearly, the prices of these goods could also be affected by corporate tax changes and the suppliers might bear part of the corporate tax burden. Corporate tax changes could also be capitalized in house prices.

on the assumed overall structure of the economy, in particular the supply and demand elasticities in factor markets and the wage-setting institutions. In the following, we discuss the corporate tax incidence on wages under different assumptions about the labor market regime. As a benchmark, we start with the case of competitive labor markets. We then turn to models with wage bargaining, fair wage models, models where wages affect worker productivity and monopsonistic labor markets. In all of the following cases, we assume that output markets are perfectly competitive and normalize the price p of the output good to equal 1.

A.1 Competitive labor markets

Assume that input markets are perfectly competitive, so that factor prices will adjust to equate demand and supply. Factor demand functions are given by the firm's first order conditions

$$\frac{\partial F_i(K_i, L_i^h, L_i^l)}{\partial K_i} = \frac{(1-\alpha\tau_i)}{(1-\tau_i)} r \tag{3}$$

and

$$\frac{\partial F_i(K_i, L_i^h, L_i^l)}{\partial L_i^k} = w_i^k, \qquad k = h, l. \tag{4}$$

Equations (3) and (4) implicitly define the factor demand functions

$$K_i^D(w_i^h, w_i^l, R_i) \quad \text{and} \quad L_i^{kD}(w_i^h, w_i^l, R_i) \quad k = h, l$$

where $R_i = r\frac{1-\alpha\tau_i}{1-\tau_i}$ is the tax inclusive cost of capital. While the interest rate r is assumed to be independent of capital demand in jurisdiction j, wage rates are determined by equating labor demand and labor supply. Labor supply is derived from worker utility maximization. Denote the utility of a worker of skill type k by $U_i^k(C_i^k, L_i^k)$. C_i^k is the worker's consumption and her budget constraint is given by $C_i^k = w_i^k(1-t)L_i^k$ where t is the personal income tax rate. Standard utility maximization leads to a labor supply function which can be expressed as $L_i^{kS}(w^k), k = h, l.$[5]. Standard comparative static analysis of the labor market equilibrium conditions $L_i^{kD}(w_i^h, w_i^l, R_i) = L^{kS}(w^k), k = h, l$ yields expressions for the impact of a tax rate change on the skill-specific wage. Consider

[5] For notational convenience we express the labor supply function as a function of the wage rate before income taxation

for example the effect on wages of skill type h:

$$\begin{aligned}\frac{dw_i^h}{d\tau_i} = &\frac{L_i^{hD}L_i^{lD}}{\varphi}\left(\varepsilon_{lR}\frac{1-\alpha}{(1-\alpha)(1-\alpha\tau_i)}\right)\left(\varepsilon_{hh}\frac{1}{w_i^h}\right)\\ &-\frac{L_i^{hD}L_i^{lD}}{\varphi}\left(\varepsilon_{hR}\frac{1-\alpha}{(1-\alpha)(1-\alpha\tau_i)}\right)\left((\varepsilon_{ll}-\mu_l)\frac{1}{w_i^h}\right)\end{aligned} \tag{5}$$

where φ is a positive parameter (the determinant of the matrix of coefficients). Parameter ε_{st} is the labor demand elasticity of skill group s with respect to wage changes of skill type t and is defined as $\varepsilon_{st} = \frac{\partial L_i^{sD}(w_i^h,w_i^l,R_i)}{\partial w_i^t}\frac{w_i^t}{L_i^{sD}(w_i^h,w_i^l,R_i)},\ s,t=h,l$. The labor supply elasticity of skill type k is given by $\mu_k = \frac{\partial L_i^{kS}(w^k)}{\partial w^k}\frac{w^k}{L_i^{kS}(w^k)},\ k=h,l$.

Equation (5) shows that, in general, the impact of a tax change on the wage depends on demand and supply elasticities in the labor market. However, if the corporate tax is a cash-flow tax ($\alpha = 1$), a change in the corporate tax rate will be neutral for factor demand and, hence, will leave wages unchanged. As a result, the corporate tax is a lump sum tax and the tax burden falls entirely on profits:

$$\frac{\partial P_i}{\partial \tau_i} = -[p_iF_i(K_i,L_i^1,L_i^2) - \sum_{k=1}^{2} w_i^kL_i^k - \alpha rK_i] < 0, \frac{\partial w_i^k}{\partial \tau_i} = 0 \quad k=1,2.$$

This may be stated as

Result 1: *Competitive labor markets*: The impact of a tax change on wages depends on the demand and supply elasticities in the labor market. If all costs are perfectly deductible, the burden of the corporate income tax is fully borne by firm owners. Then a tax rate change does not affect the wage rate.

Interestingly, the cash-flow tax result also carries over to various (but not all) standard models of *imperfect* labor markets, as we will show below. Most real world corporate tax systems deviate from the polar case of a profit tax with perfect cost deductibility, though. Accordingly, models of tax incidence in the literature typically consider settings where either capital or labor costs are less than fully deductible.

A.2 Wage bargaining

Various labor market theories assume that wages are set via bargaining between firms and their employees. Bargaining models imply that firm owners and employees share a surplus generated by the firm. If corporate taxes reduce this surplus, it is straightforward to expect that employees share part of the loss through lower wages. The magnitude of these wage effects depends on the level where bargaining takes place. We consider individual and collective (firm and sector-level) bargaining.

A.2.1 Individual wage bargaining

Assume that the wage is set via bargaining between the firm and the employee. The most widely used labor market model where this happens is the job search model, where firms and individual employees bargain over a matching rent (see Rogerson, Shimer and Wright, 2005, for a survey).

Let the output a worker of type k in firm i be given by $Q_i^k(K_i^k)$. The additional profit the firm earns is $P_i^{IB} = Q_i^k(K_i^k)(1-\tau_i) - w_i^k(1-\tau_i) - (1-\alpha\tau_i)rK_i^k$. The variable K_i^k is the capital the firm invests to equip the worker. The outcome of the bargaining process is given by

$$w_i^{k*} = \arg\max_{w_i^k} \Omega_i$$

where

$$\Omega_i = \beta_i^k \ln(w_i^k - \overline{w}^k) + (1-\beta_i^k)\ln P_i^{IB}.$$

The variable $\beta_i^k \in (0,1)$ stands for the relative bargaining power of the employee. The first order conditions of the bargaining problem yield

$$w_i^{k*} = (1-\beta_i^k)\overline{w}^k + \beta_i^k \frac{Q_i^k(K_i^k)(1-\tau_i) - (1-\alpha\tau_i)rK_i^k}{(1-\tau_i)}. \tag{6}$$

The effect of a change in the corporate tax rate on the wage is

$$\frac{\partial w_i^{k*}}{\partial \tau_i} = -\beta_i^k \frac{(1-\alpha)rK_i^k}{(1-\tau_i)^2} \leq 0. \tag{7}$$

A higher corporate tax reduces the wage unless capital costs are fully deductible. Since the employee's share of the surplus generated by the firm is increasing in the employee's bargaining power, it is plausible that she also bears a larger loss if her bargaining power is higher. This may be stated as

Result 2: *Individual wage bargaining*: If capital costs are less than fully deductible, an increase in the local corporate tax rate reduces the wage.

This wage change increases with the bargaining power of the employee. If the employee receives a large part of the surplus generated by the firm, she also bears a large loss if the surplus declines due to taxation.

A.2.2 Collective bargaining

Assume that trade union represent workers. We consider two cases: The first case is firm-level bargaining, where firm-level unions bargain with individual firms. The second case is sector-level bargaining, where sector-level unions bargain with sector-level employer organizations.

Firm-level bargaining. Denote the wage for a worker of skill type k employed by a firm located in jurisdiction i by $w_i^k = \overline{w}_i^k + s_i^k$, where s_i^k is the wage premium generated by bargaining at the firm-level. The bargaining model we use for the firm-level is a standard efficient bargaining model (McDonald and Solow, 1981), where unions and firms bargain over the wage premium, s_i^k, and employment L_i^k. Each skill type is represented by one trade union and each firm negotiates with the two unions simultaneously (Barth and Zweimüller, 1995). The objective function of the trade union representing the workers of skill type k in firm i is given by

$$Z_i^k = L_i^k(w_i^k - \overline{w}^k) = L_i^k s_i^k.$$

In case of disagreement, the rent of the union Z_i^k and the firm's profit P_i^{FB} are equal to zero. After wages and employment levels are determined, firms set K_i to maximize profits:

$$\frac{\partial F(K_i, L_i^h, L_i^l)}{\partial K_i} = R_i \tag{8}$$

where R_i denotes the cost of capital:

$$R_i = r\frac{(1-\alpha\tau_i)}{(1-\tau_i)}.$$

The outcome of the bargaining process is given by

$$s_i^{k*}, L_i^{k*} = \arg\max_{s_i^k, L_i^k} \Omega_i^k$$

where

$$\Omega_i^k = \beta_i^k \ln Z_i^k + (1-\beta_i^k)\ln P_i^{FB}.$$

The variable $\beta_i^k \in (0,1)$ stands for relative bargaining power of the skill type k union in firm i. The first order conditions of the bargaining problem yield

$$s_i^{k*} = \frac{(1-\beta_i^j)\beta_i^k}{(1-\beta_i^k\beta_i^j)} \frac{\Pi_i^{FB}}{L_i^k(1-\tau_i)} \quad k,j = h,l, \quad k \neq j \tag{9}$$

where

$$\Pi_i^{FB} = F(K_i, L_i^h, L_i^l)(1-\tau_i) - \textstyle\sum_k \overline{w}^k L_i^k (1-\tau_i) - (1-\alpha\tau_i) r K_i.$$

For employment we find

$$\frac{\partial F(K_i, L_i^h, L_i^l)}{\partial L_i^k} = \overline{w}^k \quad k = h,l. \tag{10}$$

The wage premium s_i^{k*} is equal to a share of the surplus per employee generated by the firm. The size of this share is increasing in the relative bargaining power of the skill group and decreasing in the bargaining power of the other group of employees. Employment is set so that the marginal productivity of labor is equal to the skill-specific reservation wage. Differentiating (9) yields

$$\frac{ds_i^{k*}}{d\tau_i} L_i^k + s_i^{k*} \frac{dL_i^k}{d\tau_i} = -\beta_0 \left((1-\alpha) r K_i\right) \leq 0 \tag{11}$$

where

$$\beta_0 = \frac{(1-\beta_i^j)\beta_i^k}{(1-\beta_i^k\beta_i^j)(1-\tau_i)^2} > 0.$$

The left-hand side of (11) is equal to the change in the rent accruing to the workers of skill type k employed by firm i. This rent unambiguously declines because of the tax change. Whether the wage rate declines depends on how employment changes in response to the tax change. Equations (8) and (10) implicitly define the factor demand functions $K_i(\overline{w}^k, \overline{w}^j, \tau_i, ..)$, $L_i^k(\overline{w}^k, \overline{w}^j, \tau_i, ..)$. Standard comparative static analysis shows that the impact of a tax change on demand for labor of type k may be positive or negative, depending on whether the different production factors are complements or substitutes. The effect on wages is therefore also ambiguous.

This may be summarized as:

Result 3: *Firm-level bargaining*: If capital costs are less than fully deductible, an increase in the local corporate tax rate reduces the rent of each skill group. The effect on the wage rate is ambiguous and depends on potential changes in employment.

This result is similar to that of individual bargaining. Higher taxes reduce the rent that can be shared between the firm and its employees. For given levels of employment, wages unambiguously decline in response to a tax increase. In the literature, this effect has been referred to as the "direct effect" of a corporate tax change on wages in firms where wages are set via collective bargaining (Arulampalam, Devereux and Maffini, 2012; Fuest, Peichl and Siegloch, 2013). Taking into account changes in employment may change the wage effect ("indirect effect"). If the number of employees declines in response to a tax increase, the rent generated by the company is shared among a smaller number of employees and the overall wage effect can be positive or negative.

Sector-level bargaining. We now assume that bargaining takes place at the sector-level. To ease notation we normalize the number of sectors in the unionized part of the labor market to unity. This implies that there are n firms in the sector. An employer organization bargains with sector-level unions over the sector wide wage. We continue to assume that each skill group is represented by its own trade union. The employer organization has the objective of maximizing aggregate profits of the firms in the sector. Following the seniority model proposed by Oswald (1993), we assume that each union wishes to maximize the premium over the reservation wage for the skill group it represents, which is given by $v^k = w^k - \overline{w}^k$. For given wages, firms set profit-maximizing employment. The outcome of the sector-level bargaining process is given by

$$v^{k*} = \arg\max_{v^k} \Omega_i^{Sk}$$

where

$$\Omega_i^{Sk} = \gamma^k \ln v^k + (1 - \gamma^k) \ln \sum_{i=1}^{m} P_i^{SB}.$$

The variable $\gamma^k \in (0, 1)$ stands for the relative bargaining power of the sector-level skill type k union. Rearranging the first order condition of the bargaining problem yields

$$v^{k*} = \gamma_0 \frac{\sum_{i=1}^{n} \Pi_i^{SB}}{\sum_{i=1}^{n} L_i^k (1 - \tau_i)} \quad k, j = h, l, \quad k \neq j \tag{12}$$

where

$$\gamma_0 = \frac{(1-\gamma^j)\gamma^k}{(1-\gamma^j\gamma^k)} > 0.$$

The sector wide wage premium is equal to a share of the average surplus per worker generated by the firms in the sector. Employment and investment decisions are now given by

$$\frac{\partial F(K_i, L_i^h, L_i^l)}{\partial L_i^k} = w^k \quad k = h, l \tag{13}$$

and

$$\frac{\partial F(K_i, L_i^h, L_i^l)}{\partial K_i} = R_i.$$

We now analyze the effect of a corporate tax change in jurisdiction m , $m \in (1, ..., n)$, on v^{k*}. Total differentiation of equation (12) yields

$$dv^{k*} = \gamma_0 \frac{\left[L_m^k d\tau_m - \sum_{i=1}^n dL_i^k(1-\tau_i)\right] \sum_{i=1}^n \Pi_i^{SB} + \sum_{i=1}^n d\Pi_i^{FB} \sum_{i=1}^n L_i^k(1-\tau_i)}{\left[\sum_{i=1}^n L_i^k(1-\tau_i)\right]^2} \quad k, j = h, l, \quad k \neq j \tag{14}$$

where

$$\sum_{i=1}^n d\Pi_i^{FB} = -\left[F(K_m, L_m^h, L_m^l) - \textstyle\sum_k \overline{w}^k L_i^k - \alpha r K_i\right] d\tau_m + \left(v^{h*} \sum_{i=1}^n dL_i^h(1-\tau_i) + v^{l*} \sum_{i=1}^n dL_i^l(1-\tau_i)\right).$$

In general, the impact of a tax change on the wage is ambiguous.

The wage effect converges to zero if the firm in the jurisdiction where the tax change occurs is small, relative to the sector as a whole. The conditions for the wage effect to be negligible $dv^{k*} \to 0$, which implies $dL_i^k = 0$ for all $i \neq m, k = h, l$ follow from (14) and are given by

$$\frac{\left[L_m^k - \frac{\partial L_m^k}{\partial \tau_m (1-\tau_m)}\right]}{\sum_{i=1}^{n} L_i^k (1-\tau_i)} \rightarrow 0, \frac{F(K_m, L_m^h, L_m^l) - \sum_k w^k L_m^k - \alpha r K_m}{\sum_{i=1}^{n} L_i^k (1-\tau_i)} \rightarrow 0. \tag{15}$$

The effect is thus negligible if employment (including the tax induced change in employment) as well as the tax base in jurisdiction m are small, relative to the number of employees in the sector as a whole, weighted with the tax factors $(1 - \tau_i)$.

This may be summarized as

Result 4: *Sector-level bargaining*: If capital costs are less than fully deductible, an increase in the tax rate may increase or decrease wages. The wage effect converges to zero if the activity of the sector in the jurisdiction where the tax change occurs is small, relative to the rest of the sector.

Result 4 suggests that local tax changes will have a smaller or negligible effect on wages if wage bargaining takes place at the sector level, rather than the firm level, because the sector will usually include many jurisdictions.[6]

A.3 Fair wage models

In fair wage models (Akerlof, 1982) the wage is usually assumed to be a function of i) wages of other employees of the same firm, ii) an external reference wage[7] and iii) profits of the firm (Amiti and Davis, 2010; Egger and Kreickemeier, 2012).

Consider a firm i with two types of workers. Assume that the fair wage for type k workers employed by firm i is given by the function $w_i^{kf} = f_i^k(\overline{w}_i^k, w_i^{-k}, P_i)$, where $\overline{w}_i^k$ are unemployment benefits, w_i^{-k} are wages of the other skill group in the firm and profits P_i^{FW} are given by

$$P_i^{FW} = F_i(K_i, L_i^h, L_i^l)(1-\tau_i) - \sum_k w_i^k L_i^k (1-\tau_i) - (1-\alpha\tau_i) r K_i.$$

[6] Some labor markets are characterized by two tier bargaining, where sector-level bargaining sets a minimum wage and wage premiums on top of the minimum wage are negotiated at the firm-level (Boeri, 2014). In such a setting, one would expect local tax changes to have a more significant impact on local wages than in the case of pure sector-level wage bargaining.

[7] We assume that the reference wage, which can be the average wage level paid in other firms, a statutory minimum wage or a transfer to the unemployed, is given. It may of course be the case that the reference wage is affected by local tax changes. This would not alter the result that higher taxes lead to lower wages and vice versa.

We assume that the fair wage function has the following standard properties:

$$\frac{\partial f_i^k}{\partial \overline{w}_i^k}, \frac{\partial f_i^k}{\partial w_i^{-k}}, \frac{\partial f_i^k}{\partial P_i} > 0, \tag{16}$$

$$\frac{\partial f_i^k}{\partial w_i^{-k}} - \frac{\partial f_i^k}{\partial P_i} L_{-k}(1-\tau_i) > 0, \tag{17}$$

$$1 - \frac{\partial f_i^k}{\partial w_i^{-k}} \frac{\partial f_i^{-k}}{\partial w_i^k} > 0. \tag{18}$$

The fair wage is increasing in unemployment benefits $\overline{w}_i^k$, in the wage of the other skill group employed by the firm and in the firm's profits. Equation (17) implies that the fair wage for skill group k increases if the wage of the other skill group $-k$ increases. This does not follow directly from the first derivatives, as an increase in the wage of the other skill group reduces profits. The effect on profits reduces the fair wage. Equation (18) implies that an increase in any of the reservation wages raises the fair wages of both groups.

In equilibrium, the firm pays fair wages to both types of employees and sets factor inputs to maximize after-tax profits. Optimal factor inputs are given by the standard marginal productivity conditions. Equilibrium wages are given by

$$w_i^{k*} = f_i^k(\overline{w}_i^k, w_i^{-k*}, P_i^*) \quad k = h, l. \tag{19}$$

Equation (19) implicitly defines the equilibrium wage rates w_i^{h*} and w_i^{l*} as functions of, among other things, the corporate tax rate τ_i. Standard comparative static analysis shows that the effect of a change in τ_i on wages is given by

$$\frac{\partial w_i^{kf*}}{\partial \tau_i} = -\frac{T_i}{\xi}\left[1 + \frac{\partial f_i^{-k}}{\partial P_i} L_k(1-\tau_i) + \frac{\partial f_i^k}{\partial w_i^{-k}} - \frac{\partial f_i^k}{\partial P_i} L_{-k}(1-\tau_i)\right] < 0$$

where

$$T_i = F_i(K_i, L_i^h, L_i^l) - \textstyle\sum_k w_i^k L_i^k - \alpha r K_i$$

is the profit tax base and

$$\xi = 1 - \frac{\partial f_i^k}{\partial w_i^{-k}} \frac{\partial f_i^{-k}}{\partial w_i^k} + \left(\frac{\partial f_i^k}{\partial P_i}(L_i^k + \frac{\partial f_i^{-k}}{\partial w_i^k} L_i^{-k}) + \frac{\partial f_i^{-k}}{\partial P_i}(L_i^{-k} + \frac{\partial f_i^k}{\partial w_i^{-k}} L_i^k)\right)(1-\tau_i) > 0.$$

This may be summarized as

Result 5: *Fair wage model*: An increase in the local corporate tax rate reduces the wages of all skill groups.

The intuition behind Result 5 is that if higher corporate taxes reduce after-tax profits, fairness considerations would suggest that employees will bear part of this burden and vice versa. This effect is independent of whether or not wage and capital costs are fully deductible from the tax base. The neutrality property of cash-flow taxes does not hold here because wage fairness is assumed to depend directly on after-tax profits.

A.4 Models where wages affect labor productivity

Some labor market models emphasize that firms may want to raise wages because higher wages lead to higher labor productivity and, hence, higher output. These models include efficiency wage models, where higher wages lead to more effort or lower worker fluctuation, and models of directed job search, where higher wages lead to better matches between workers and firms.[8]

Following Acemoglu and Shimer (1999), we assume that output is uncertain and depends on the quality of firm worker matches.[9] There is only one type of labor. If a firm offers a higher wage, more workers will apply for the job and the chances of a good match increase, given the wages offered by other firms. With probability $\rho_i(w_i, \mathbf{q})$ the additional output produced by filling a vacancy i in a firm located in jurisdiction j equals $Q_i(K_i)$, with probability 1− $\rho_i(w_i, \mathbf{q})$ it is equal to zero. The wages paid by other firms as well as other factors which may be relevant for the likelihood of success are summarized by the vector $\mathbf{q}$. The function $\rho_i(w_i, \mathbf{q})$ has the following properties:[10]

$$\frac{\partial \rho_i}{\partial w_i} > 0, \frac{\partial_i^2 \rho}{\partial {w_i}^2} < 0, \frac{\partial_i^2 \rho}{\partial w_i^k \partial \mathbf{q}} = 0. \tag{20}$$

[8] The key difference to the fair wage model discussed in the preceding section is that the latter emphasizes the *direct* link between the profits of a firm and the wage that is perceived to be fair. No such direct link exists here. However, fair wage models may also be considered as models where wages affect labor productivity because wages deemed as unfair would reduce worker effort or increase costly fluctuation.

[9] The results would be similar in an efficiency wage model following Solow (1979) with continuous effort. In shirking models with discrete effort (such as Shapiro and Stiglitz, 1984), we would not expect a direct effect on wages (for given employment) but only an indirect effect through changes in unemployment rates and hence the shirking constraint.

[10] The assumption that all cross derivatives are equal to zero is made to simplify the exposition, it is not necessary for the results.

Expected profits are now given by

$$P_i^e = \rho_i(w_i, \mathbf{q})Q_i(K_i)(1-\tau_j) - w_i(1-\tau_j) - (1-\alpha\tau_j)rK_i. \tag{21}$$

The first order conditions for the optimal wage and optimal investment are given by

$$\frac{\partial \rho_i}{\partial w_i}Q_i(K_i)(1-\tau_j) - (1-\tau_j) = 0 \tag{22}$$

and

$$\rho_i(w_i, \mathbf{q})Q_i'(K_i)(1-\tau_j) - (1-\alpha\tau_j)r = 0. \tag{23}$$

Equations (22) and (23) imply that we can write the equilibrium wage rate as a function $w_i^* = w_i^*(\tau_i, \phi, \alpha, r)$. Standard comparative static analysis leads to

$$\frac{\partial w_i^*}{\partial \tau_j} = \frac{-r}{\Delta(1-\tau_j)^2}\left[\frac{\partial \rho_i}{\partial w_i}Q_i'(K_i)(1-\alpha)\right] \leq 0 \tag{24}$$

where

$$\Delta = \rho_i(w_i, \mathbf{q})Q_i''(K_i)\frac{\partial^2 \rho_i}{\partial {w_i}^2}Q_i(K_i) - \left[\frac{\partial \rho_i}{\partial w_i}Q_i'(K_i)\right]^2 > 0.$$

Note that $\Delta > 0$ follows from the second order conditions for profit maximization. A higher corporate tax rate thus reduces the wage if there is limited deductibility of capital costs. This may be summarized as

Result 6: *Models where wages affect productivity*: If capital costs are less than fully deductible, an increase in the local corporate tax rate reduces wages.

The optimal wage trades off higher output against the cost of higher wages. The increase in output achieved through a wage increase is higher, the higher the capital stock of the firm. In the presence of imperfect deductibility of capital costs, investment declines when the tax rate increases. Therefore the firm's marginal productivity gain from a wage increase falls. As a result, it is optimal for the firm to adjust its wage policy towards lower wages and a lower quality of worker firm matches.

A.5 Monopsonistic labor market

Consider a firm facing the labor supply function by $L^s = L^s(w)$, $L^{s\prime}(w) > 0$. Output is produced using a standard, strictly concave production technology $F(K_i, L_i)$ with complementarity between labor and capital: $\frac{\partial^2 F(K_i, L^s(w_i))}{\partial K_i \partial L_i} > 0$. Profits are given by

$$P_i^M(K_i, w_i) = F(K_i, L^s(w_i))(1-\tau_j) - w_i L^s(w_i)(1-\tau_j) - (1-\alpha\tau_i) r K_i$$

The first order conditions for profit maximization are

$$\frac{\partial F(K_i, L^s(w_i))}{\partial L_i} L^{s\prime}(w_i)(1-\tau_j) - (L^{s\prime}(w_i) w_i + L^s(w_i))(1-\tau_j) = 0 \tag{25}$$

$$\frac{\partial F(K_i, L^s(w_i))}{\partial K_i}(1-\tau_j) - (1-\alpha\tau_j) r = 0 \tag{26}$$

Equations (25) and (26) implicitly define the profit-maximizing wage rate w_i^* and the capital stock set by the monopsonist, as functions of the tax corporate rate. Standard comparative static analysis leads to

$$\frac{\partial w_i^*}{\partial \tau_j} = -\frac{1}{\Gamma}\left[\frac{\partial^2 F(K_i, L^s(w_i))}{\partial K_i \partial L_i} L^{s\prime}(w_i)(1-\alpha)\right] < 0.$$

where the second order conditions imply

$$\Gamma = \frac{\partial^2 P_i^M(K_i, w_i)}{\partial K_i^2}\frac{\partial^2 P_i^M(K_i, w_i)}{\partial w_i^2} - \left[\frac{\partial^2 P_i^M(K_i, w_i)}{\partial K_i \partial w_i}\right]^2 > 0.$$

This implies

Result 7: *Monopsonistic labor market*: If capital costs are less than fully deductible, an increase in the local corporate tax rate reduces wages.

A higher corporate tax rate reduces investment so that the marginal productivity of labor falls. As a result, firms employ less labor. In a monopsonistic labor market this implies a lower wage.[11]

A.6 Extensions

In this subsection, we consider two extensions of the model that are both related to particular aspects of corporate taxation. The first extension takes into account that firms

[11] This result holds in models of monopsonistic wage setting with constant labor supply elasticities. If this assumption is relaxed, the result on tax shifting is theoretically ambiguous.

may operate in more than one jurisdiction. Many countries use formula apportionment to allocate corporate profits to different jurisdictions for taxation purposes. The second extension is to allow for tax avoidance through different types of income shifting.

A.6.1 Firms operating in multiple jurisdictions with formula apportionment

Consider a company with plants in two jurisdictions, 1 and 2. As a first step, we assume that there is just one type of labor.[12] Employment (capital) in jurisdiction j is denoted by L_j $(K_j), j = 1, 2$. The wage rate is the same in both plants. After-tax profits of the company are

$$P_i^{FA} = F(K_1, K_{2,} L_1, L_2)(1 - \tau_i) - (1 - \tau_i)w[L_1 + L_2] - (1 - \alpha\tau_i)r[K_1 + K_2]$$

Assume that the tax apportionment formula is based on payroll as the only apportionment factor.[13] Given that there is a uniform wage rate in the two plants, the profit tax rate is given by

$$\tau_i = \frac{\tau_1 L_1 + \tau_2 L_2}{L_1 + L_2}. \tag{27}$$

The effect of a tax rate change in one jurisdiction on the firm's effective profit tax rate τ, given the level of employment, is

$$\frac{\partial \tau_i}{\partial \tau_j} = \frac{L_j}{L_1 + L_2}, \quad j = 1, 2$$

where τ_j is the tax rate of jurisdiction j.

Assume that wages are set via collective bargaining which takes place at the firm-level, not at the plant-level, and that wages paid to workers of a given skill group are the same in the two plants. The objective function of the skill type k union is now given by

$$Z^{FA} = (L_1 + L_2)(w - \overline{w}) = (L_1 + L_2)s^{FA}.$$

[12] The case for two skill types is discussed below.

[13] This is the case for the LBT in Germany. In the US, apportionment for state taxes is based on payroll, sales, and assets, see Suárez Serrato and Zidar (2016).

The outcome of the bargaining process is given by

$$s^{FA*}, L_1^*, L_2^* = \arg \max_{s^{FA}, L_1, L_2} \Omega^{FA}$$

where

$$\Omega^{FA} = \lambda \ln Z_i^{FA} + (1-\lambda) \ln P_i^{FA}.$$

The variable $\lambda \in (0,1)$ stands for the relative bargaining power of the union. The first order condition for the wage rate yields

$$s^{FA*} = \lambda \frac{\Pi_i^{FA}}{[(L_1 + L_2)(1-\tau_i)]}$$

where

$$\Pi_i^{FA} = F(K_1, K_2, L_1, L_2)(1-\tau_i) - (1-\tau_i)\overline{w}[L_1 + L_2] - (1-\alpha\tau_i)r[K_1 + K_2].$$

For given levels of employment, the change in the wage premium caused by a change in the tax rate is given by

$$\frac{\partial s^{FA*}}{\partial \tau_j} = -\lambda \frac{(1-\alpha)r(K_1 + K_2)L_j}{(L_1 + L_2)^2(1-\tau_j)^2} \leq 0.$$

This implies:

Result 8: *Formula apportionment and firm-level bargaining*: In firms with plants in many jurisdictions and homogeneous labor, where corporate taxation is based on formula apportionment, wages are set via collective bargaining at the firm-level, and capital costs are less than fully deductible, an increase in the corporate tax rate in one jurisdiction decreases wages in the entire firm. If employment in the jurisdiction that changes the tax rate is small, relative to employment in the firm as a whole, the tax effect is also small.

Consider next the case of two skill types, $k = h, l$. After-tax profits of the company are now

$$P_i^{FA_k} = F(K_1, K_2, L_1^h, L_1^l, L_2^h, L_2^l)(1-\tau_i) - \left(\sum_j \sum_k w^k L_j^k\right)(1-\tau_i) - (1-\alpha\tau_i)r[K_1 + K_2]$$

with obvious notation. The profit tax rate is given by

$$\tau_i = \frac{\sum_j \sum_k \tau_j w^k L_j^k}{\sum_j \sum_k w^k L_j^k}.$$

For given employment, the effect of a tax rate change in one jurisdiction on the firm's effective profit tax rate τ_i is

$$\frac{\partial \tau_i}{\partial \tau_j} = \frac{\sum_k w^k L_j^k}{\sum_j \sum_k w^k L_j^k}.$$

The effect of a wage change for workers of skill type h on the effective profit tax rate is:

$$\frac{\partial \tau_i}{\partial w^h} = [\tau_1 - \tau_2] \left[\frac{L_1^h}{L_1^l} - \frac{L_2^h}{L_2^l} \right] L_1^l L_2^l \frac{1}{\sigma}$$

where

$$\sigma = \left[1 + \frac{w^h L_1^h + w^l L_1^l}{w^h L_2^h + w^l L_2^l} \right]^2 [w^h L_2^h + w^l L_2^l]^2 > 0.$$

Assume, for instance, that municipality 1 has a higher tax rate than municipality 2. The effect of an increase in the wage of the high skilled w^h on the tax burden will depend on whether this increases the payroll share of the high tax municipality, or that of the low tax municipality. If the share of high skilled is higher in jurisdiction 1, so that $\left[\frac{L_1^h}{L_1^l} - \frac{L_2^h}{L_2^l} \right] > 0$, the tax rate τ_i will increase, and vice versa. The effect of a wage change on the profit tax rate a firm effectively pays is therefore generally ambiguous.

Once again assuming firm-level collective bargaining and homogeneous wages for a skill group across plants, the objective function of the skill type k union is now given by

$$Z^{FAk} = (L_1^k + L_2^k)(w_1^k - \overline{w}^k) = (L_1^k + L_2^k) s^{FA^k}.$$

The outcome of the bargaining process is given by

$$s^{FA^{k*}}, L_1^{k*}, L_2^{k*} = \arg \max_{s^k, L_1^k, L_2^k} \Omega^{FAk}$$

where

$$\Omega^{FAk} = \lambda^k \ln Z_i^{FAk} + (1-\lambda^k) \ln P_i^{FAt}.$$

As above, the variable $\lambda^k \in (0,1)$ stands for relative bargaining power of the skill type k union. The first order condition for the wage rate yields

$$s^{FA^{k*}} = \frac{\lambda^k}{(1-\lambda^k)} \frac{P^{FAt}}{[(L_1^k + L_2^k)(1-\tau_i) - \Phi_w^k]}, \qquad k = h, l \tag{28}$$

where

$$\Phi_w^k = \frac{\partial P_i^{FA}}{\partial \tau_i} \frac{\partial \tau_i}{\partial w^k}.$$

The key difference between this case and that with homogeneous labor is that a wage change now affects the effective tax rate. It thus influences the outcome of union-firm bargaining. For instance, if a higher wage increases the effective tax rate, which implies $\Phi_{wk} < 0$, the wage premium achieved by the union will be smaller, other things equal, and vice versa. Equation (28) implicitly defines the two firm-specific wage premiums emerging from the bargaining process as functions of the type $s^{FAk*} = s^{FAk*}(\tau_i, \tau_j, T, L_i^{k*}, L_j^{k*}...)$. Differentiating (28) shows that the change in the local corporate tax rate on wages is, in general, ambiguous.

A.6.2 Income shifting

Income shifting to avoid taxes may occur in different forms. Multinational firms can use debt financing or transfer pricing to shift profits across national borders. Income shifting may also occur between different tax bases within a country. For instance, firm owners may shift income between the corporate and the personal income tax base by changing wages paid to family members. We discuss the two cases in turn.

International income shifting. Assume that the firm's profits are given by

$$P_{ij}^S = p_i F_i(K_i, L_i^h, L_i^l)(1-\tau_j) - \textstyle\sum_k w_i^k L_i^k (1-\tau_j) - (1-\alpha_j \tau_j) r_i K_i + \theta_{ij} S_i - c(S_i). \tag{29}$$

The variable S_i is income shifted from the profit tax base to the personal income tax base of the firm owners, which may be positive or negative, θ_{ij} is the tax benefit per unit of income shifted and $c(S_i)$ is a convex shifting cost function.[14] Profit maximization factor input decisions lead to the usual marginal productivity conditions, and optimal income shifting implies $c'(S_i) = \theta_{ij}$ so that the profit-maximizing amount of shifted income S_i^* can be expressed as a function of the tax benefit $S_i^* = S_i^*(\theta_{ij})$, with $S_i^{*\prime} > 0$. Consider first the case of a multinational company which is able to shift income abroad. If the firm can do so, for instance, through a foreign subsidiary charging a fully deductible cost to the domestic parent company, the tax advantage from income shifting is given by $\theta_{ij} = \tau_j - \tau_f$, where τ_f is the foreign profit tax rate. Assume that wages in the multinational firm are determined by firm-level bargaining. In this case, the wage premium generated by union firm bargaining is given by

$$z_i^{k*} = \frac{(1-\beta_i^j)\beta_i^k}{(1-\beta_i^k\beta_i^j)} \frac{\Pi_i^S}{L_i^k(1-\tau_i)} \qquad k, j = h, l, \quad k \neq j \tag{30}$$

where

$$\Pi_i^S = F(K_i, L_i^h, L_i^l)(1-\tau_i) - \textstyle\sum_k \overline{w}^k L_i^k(1-\tau_i) - (1-\alpha\tau_i)rK_i + (\tau_j - \tau_f)S_i - c(S_i).$$

Differentiating (30) yields

$$\frac{dz_i^{k*}}{d\tau_i} L_i^k + z_i^{k*}\frac{dL_i^k}{d\tau_i} = -\beta_0^S[(1-\alpha)rK_i - (S_i(1-\tau_f) - c(S_i))] \leq 0 \tag{31}$$

where

$$\beta_0^S = \frac{(1-\beta_i^j)\beta_i^k}{(1-\beta_i^k\beta_i^j)(1-\tau_i)^2} > 0 \qquad k, j = h, l, \quad k \neq j.$$

The right-hand side of (31) is increasing in S_i (given that $S_i = S_i^*$), which implies that the decline in the rent accruing to labor is smaller, the higher the equilibrium level of income shifting. This yields

Result 9 *International income shifting*: If firms engage in international income shifting and wages are set by firm-level bargaining, the decline in the rent accruing to

[14] Here we assume that profit shifting is carried out by changing the wages of firm owners working in the firm or family members of the firm owner. This implies that s_i would be reported as wage income. Another way of shifting income is to provide capital in the form of debt, rather than equity. Many countries have introduced anti-tax-avoidance legislation, which limits income shifting. We therefore take into account costs of income shifting. This can be interpreted as the cost of hiring tax consultants or the cost of concealing income shifting. For notational simplicity we assume that shifting costs are not tax deductible.

labor caused by a higher corporate tax decreases as the equilibrium level of income shifting increases.

National income shifting. We now consider the possibility of domestic income shifting between the profit tax base and wage income. In this case the tax advantage from income shifting is given by $\theta_{ij} = \phi_j \tau_j - t_{pi}$, where t_{pi} is the marginal tax rate on wage income of the relevant employee. This is relevant in settings where the wages of some employees are effectively profit distributions, so that wage bargaining plays no role for them. Assume that the wages paid in the absence of incentives for income shifting, that is for equal taxes on profits and labor income, would be given by the function $w_i^{kS}(\tau_j, ...)$. Then the *observed* change in the wages paid out by the firm would equal $\sum_k \frac{dw_i^{kS}}{d\tau_j} L_i^k + \frac{dS_i}{d\tau_j}$. While 'true' wages are likely to decline in response to higher taxes, albeit by less than they would in the absence of income-shifting possibilities, we now have the additional effect that the income-shifting effect $\frac{dS_i}{d\tau_j} > 0$ increases reported wages. Thus if income shifting is important, we would expect observed wages to decline less, or even increase, in response to higher corporate taxes. This may be summarized as

Result 10 *National income shifting*: If firms shift income between the profit tax base and the labor income tax base, a higher corporate tax rate will lead to a smaller decline in reported wages than in the absence of income shifting. Wages may even increase.

Unfortunately, we cannot test this mechanism directly with our data because we do not know whether there are employees who are members of the owner family.

B Institutional background

B.1 German business taxes

In 2007, profit taxes accounted for about 6.2% of total tax revenue (including social security) in Germany (OECD, 2015).[15] In terms of tax revenues, the LBT is the most important profit tax, accounting for about 60–70% of total profit tax revenues from corporate firms. Overall, the share of profit tax revenues from local taxes is relatively high in Germany compared with other countries. In the US, for instance, state and local corporate taxes together account only for about 20% of total corporate taxes (NCSL, 2009). In addition, the LBT is the most important source of financing at the disposal of municipalities, generating roughly three quarters of municipal tax revenue.

As mentioned in Section I, there are two other profit taxes in Germany, the corporate income tax (CIT), which applies to corporations, and the personal income tax (PIT), which applies to non-corporate firms. We discuss the most important features of these two taxes in turn.

Corporate income tax. The rate of the nationwide corporate income tax, τ_{CIT}, has undergone several changes in recent years. Until 2000, a split rate imputation system existed in Germany, where retained profits were subject to a tax rate of 45% in 1998 and 40% in 1999 and 2000. Distributed profits were taxed at a rate of 30% from 1998 to 2000. As of 2001, retained and distributed profits were taxed equally at 25% (26.5% in 2003). In 2008, τ_{CIT} was lowered to 15%. In all years, a so-called solidarity surcharge (to finance the costs of reunification), *soli*, of 5.5% of the corporate tax rate was added.

There are two steps to calculating the total statutory tax rate for corporate firms. First, LBT and CT rates are added. Second, the deduction of the LBT payments from the tax base has to be taken into account. The statutory tax rate for corporate firms, τ^{corp}, from 1998 to 2007, is $\tau^{corp} = \frac{\tau_{CIT} \cdot (1+soli) + t^{fed}_{LBT} \cdot \theta^{mun}_{LBT}}{1+t^{fed}_{LBT} \cdot \theta^{mun}_{LBT}}$. Since 2008, the denominator of the equation is equal to 1, as the LBT can no longer be deducted from the tax base.

Personal income tax. Non-corporate firms (*Personengesellschaften*) are subject to the progressive personal income tax (on operating profits assigned to the proprietor). Non-corporate firms have an LBT allowance of 24,500 euros and a reduced t^{fed}_{LBT} for small

[15] This is below the OECD average of about 10.6% (US: 10.8%, UK: 9.4%). Part of this relatively low share of profit taxes is due to the rather high share of social insurance contributions (SIC) in Germany. If SIC are excluded, the share in total taxes is about 11.5%. A high share of unincorporated firms in Germany is a second factor. These firms pay PIT, in addition to the LBT, and the OECD does not classify PIT as profit taxes.

non-corporate firms prior to 2008: for every 12,000 euros exceeding the allowance of 24,500 euros, t_{LBT}^{fed} was raised by one percentage point so that the full basic federal rate of 5.0% had to be paid only for taxable income exceeding 72,500 euros. The tax rate for a non-corporate firms $\tau^{non-corp}$ from 1998 to 2007, is $\tau^{non-corp} = \frac{\tau_{PIT} \cdot (1+soli) + t_{LBT}^{fed} \cdot \theta_{LBT}^{mun}}{1+t_{LBT}^{fed} \times 1.8}$. The denominator of the equation shows that a fixed share of the LBT liabilities can be deducted from the personal income tax base. This share amounted to $t_{LBT}^{fed} \cdot 1.8 \cdot Y$ from 2001 to 2007 and $t_{LBT}^{fed} \cdot 3.8 \cdot Y$ from 2008 onwards.

B.2 German labor market institutions

Traditionally, German labor unions have been very influential.[16] Collective bargaining agreements (CBAs) at the sector-level are the most important mechanism for wage determination. Nevertheless, there has been a significant decline in bargaining coverage. In West (East) Germany, CBA coverage decreased from 76% (63%) in 1998 to 65% (51%) in 2009. The share of workers covered by sectoral agreements fell from 68% (52%) to 56% (38%) (Ellguth, Gerner and Stegmaier, 2012).[17] In addition to sector-level CBA, some firms have firm-level agreements, while other firms are not covered by a CBA and rely on individual contracts with each employee.

The average duration of a CBA increased from 12 months in 1991 to 22 months in 2011. Usually, negotiations take place in the first half of a year. Firms may pay wages above those negotiated in CBAs. Except for a few industries, there was no legal minimum wage in Germany during our period of analysis. However, the social security and welfare system provides an implicit minimum wage and CBAs ensure that wages are above that level.

[16] See Dustmann et al. (2014) for an overview and analysis of the development of German labor market institutions during our period of investigation.

[17] Coverage rates vary by industry: collective bargaining is slightly above average in the manufacturing sector, while the highest coverage is in the public sector and the lowest in ICT, agriculture and restaurant industries. Overall, union coverage rates in Germany are lower than in other European countries – except the UK and some Eastern European countries – but higher than in the US (Du Caju et al., 2008).

C Descriptive Statistics

Jurisdictional changes Analogously to Figure 1, Figure C.1 shows the cross-sectional and time variation in LBT rates for the full sample of municipalities, including municipalities that underwent a jurisdictional change. The right panel clearly shows that the number of tax changes for these merged municipalities is relatively high. However, the variation in tax rates is artificial and related to the way we impute tax rates. As described in Section I.B, the wage data contains geographical information for the jurisdictional boundaries as of December 31, 2010. In order to match the tax data, we have to bring it to the same boundaries. This generates artificial variation in tax rates, as we need to calculate population weighted average tax rates for those merged jurisdictions.

Consequently, we find a large number of (small) tax changes for East German municipalities. Table C.3 shows that on average 12.4% of the municipalities change their tax rate per year. Among the merged municipalities, however, the share is 33% (with a much smaller average change). Given this measurement error in tax rate changes, we focus on non-merged municipalities in our baseline analysis (and check whether results for merged and non-merged municipalities differ). Due to this restriction, we are left with about 10,000 municipalities and 18,000 tax changes for identification (instead of 11,441 municipalities with about 27,000 partly artificial tax changes).

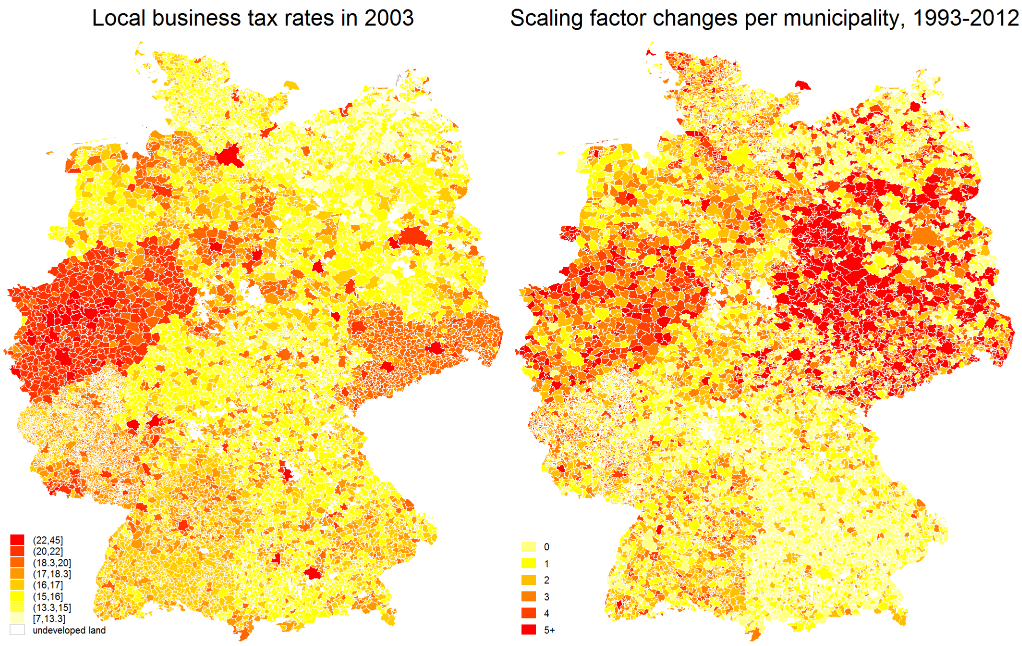


Figure C.1: Cross-sectional and time variation in local tax rates

Source: Statistical Offices of the Laender. Maps: GeoBasis-DE / BKG 2015. *Notes:* This figure shows the cross-sectional and time variation in municipal scaling factors of the German LBT. This figure includes both non-merged and merged municipalities. The left graph depicts the cross-sectional variation in LBT rates (in %) induced by different scaling factors for 2003 (the mid-year of our sample). The right graph indicates the number of scaling factor changes per municipality between 1993 and 2012. Jurisdictional boundaries are as of December 31, 2010.

Table C.1: Municipal scaling factors, 1993-2012

	mean	min	p5	p50	p95	max
1993	3.12	2.00	2.50	3.10	3.70	7.37
1994	3.15	2.00	2.59	3.13	3.72	5.15
1995	3.17	2.00	2.60	3.20	3.80	5.15
1996	3.19	2.00	2.70	3.20	3.80	5.15
1997	3.21	2.00	2.70	3.20	3.80	5.15
1998	3.22	2.00	2.74	3.20	3.80	9.00
1999	3.23	2.00	2.75	3.20	3.80	9.00
2000	3.24	2.00	2.75	3.20	3.80	9.00
2001	3.26	2.00	2.75	3.27	3.80	9.00
2002	3.27	2.00	2.80	3.30	3.85	9.00
2003	3.29	2.00	2.80	3.30	4.00	9.00
2004	3.31	2.00	2.80	3.30	4.00	9.00
2005	3.33	2.00	2.85	3.30	4.00	9.00
2006	3.34	2.00	2.90	3.30	4.00	9.00
2007	3.34	2.00	2.90	3.30	4.00	9.00
2008	3.35	2.00	2.90	3.30	4.00	9.00
2009	3.36	2.00	2.90	3.35	4.00	9.00
2010	3.38	2.00	3.00	3.40	4.00	9.00
2011	3.44	2.00	3.00	3.50	4.00	9.00
2012	3.47	2.00	3.00	3.50	4.03	9.00
Average	3.28	2.00	2.80	3.30	3.95	9.00

Source: Statistical Offices of the Laender. *Notes:* The table provides descriptive statistics on the municipal scaling factors for all non-merged municipalities (N=10,001) in Germany over time.

Table C.2: Municipal scaling factors changes per municipality, 1993-2012

	any increase		large increases	
changes	municipalities	in %	municipalities	in %
all municipalities (N=11,441)				
0	2041	17.80	6969	60.90
1	3218	28.10	3583	31.30
2	3091	27.00	784	6.90
3	1667	14.60	95	0.80
4	720	6.30	9	0.10
5+	704	6.20	1	0.00
all non-merged municipalities (N=10,001)				
0	1902	19.00	6358	63.60
1	3025	30.20	3012	30.10
2	2862	28.60	566	5.70
3	1465	14.60	58	0.60
4	536	5.40	6	0.10
5+	211	2.10	1	0.00
non-merged municipalities in LIAB (N=3,522)				
0	672	19.08	2290	65.02
1	1018	28.90	993	28.19
2	914	25.95	213	6.05
3	541	15.36	22	0.62
4+	377	10.70	4	0.11
all merged municipalities (N=1,440)				
0	139	9.70	611	42.40
1	193	13.40	571	39.70
2	229	15.90	218	15.10
3	202	14.00	37	2.60
4	184	12.80	3	0.20
5+	493	34.20	0	0.00

Source: Statistical Offices of the Laender. *Notes:* The table summarizes the number of tax increases and large tax increases for all, non-merged and merged municipalities from 1993 to 2012. Large increases are defined as the top 25% of the tax increase distribution, that is an increase of the business tax rate of 1.1 percentage points or more.

Table C.3: Time variation in municipal scaling factors, 1993–2012

municip. with a(n) ...	... change		... increase		... decrease	
	share	mean change	share	mean increase	share	mean decrease
all municip.	12.2	0.15	10.3	0.20	1.9	-0.14
non-merged municip. (all)	9.4	0.19	8.8	0.22	0.6	-0.30
non-merged municip. (LIAB)	10.2	0.17	9.4	0.21	0.8	-0.26
merged municip.	31.9	0.07	20.6	0.15	11.3	-0.08
by year (all non-merged municipalities)						
1994	10.9	0.18	10.0	0.23	0.9	-0.45
1995	15.5	0.19	14.9	0.22	0.6	-0.40
1996	11.2	0.16	10.7	0.19	0.5	-0.37
1997	8.5	0.17	8.0	0.21	0.5	-0.41
1998	8.7	0.18	8.2	0.21	0.5	-0.32
1999	4.2	0.13	3.6	0.20	0.6	-0.31
2000	8.7	0.13	7.8	0.17	0.8	-0.23
2001	12.8	0.14	11.7	0.18	1.1	-0.23
2002	8.3	0.17	7.8	0.20	0.4	-0.35
2003	9.6	0.19	9.2	0.21	0.4	-0.28
2004	8.4	0.19	8.1	0.21	0.3	-0.30
2005	11.5	0.17	11.0	0.19	0.5	-0.27
2006	8.3	0.13	7.4	0.18	0.9	-0.28
2007	4.0	0.10	3.2	0.19	0.8	-0.26
2008	4.0	0.18	3.2	0.28	0.8	-0.26
2009	4.2	0.18	3.4	0.27	0.8	-0.20
2010	8.8	0.27	8.4	0.29	0.4	-0.22
2011	18.4	0.28	18.1	0.29	0.3	-0.21
2012	12.8	0.25	12.5	0.27	0.3	-0.30

Source: Statistical Offices of the Laender. *Notes:* The top part of the table summarizes the frequency, signs, and sizes of municipal scaling factor changes for all municipalities (N=11,441), non-merged municipalities (N=10,001), and merged municipalities (N=1,440). The bottom part of the table shows the frequency, sign and size of municipal scaling factor changes for non-merged municipalities over time.

Table C.4: Percentiles of the share of non-wage-censored workers across firms

	p1	p5	p10	p25	p50	p75	p90	p95	p99	obs
manuf.	0.38	0.68	0.78	0.89	0.96	1	1	1	1	23,137
service	0.32	0.59	0.73	0.88	0.98	1	1	1	1	21,490
total	0.36	0.63	0.75	0.89	0.97	1	1	1	1	44,627

Source: LIAB. *Notes:* This table shows the distribution of the share of non-wage-censored workers across firms in different sectors. Workers are defined as wage-censored if they earned more than the social security contributions earnings ceilings at least once in the sample. In this table, manufacturing includes construction and services include trade.

Table C.5: Descriptive statistics, plant sample, non-merged municipalities, 1999-2008

	mean	p50	sd
Wage	2,733	2,717	877
Local scaling factor	3.85	3.90	0.52
LBT rate (in %)	18.65	19.00	3.09
Municipal spending (in millions)	2,648	110	6,155
Municipal population	436,255	49,856	904,957
District unemployment rate	0.12	0.10	0.05
District GDP (in millions)	18,977	6,758	28,198
Share: West German municipalities	0.80	1.00	0.40
Number of employees	265	53	1,136
Share: Liable plants	0.64	1.00	0.48
Share: Sector level bargaining	0.56	1.00	0.50
Share: Firm level bargaining	0.08	0.00	0.28
Share: No collective bargaining	0.36	0.00	0.48
Share: Manufacturing	0.26	0.00	0.44
Share: Construction	0.08	0.00	0.26
Share: Trade	0.11	0.00	0.32
Share: Services	0.23	0.00	0.42
Share: Public/Utilities	0.32	0.00	0.45
Share: High profitability	0.37	0.00	0.48
Share: Medium profitability	0.34	0.00	0.47
Share: Low profitability	0.29	0.00	0.46
Share: Single plant firms	0.62	1.00	0.49
Share: German owner	0.94	1.00	0.24

Source: LIAB and Statistical Offices of the Laender. *Notes:* Total number of plant-year observations: 69,249. Number of plants: 21,253. All monetary variables in 2008 euros.

Table C.6: Descriptive statistics, worker sample, non-merged municipalities, 1999-2008

	mean	p50	sd
Wage	3,491	3,363	1,092
Local scaling factor	4.00	4.10	0.53
LBT rate (in %)	19.50	19.50	3.85
Municipal spending (in millions)	2,605	334	5,667
Municipal population	470,429	120,136	833,344
District unemployment rate	0.11	0.10	0.04
District GDP (in millions)	22,233	9,211	28,541
Share: West German municipalities	0.88	1.00	0.32
Number of employees	5,802	1,138	10,345
Share: Liable firms	0.73	1.00	0.44
Age	41	42	10
Share: Male	0.72	1.00	0.45
Share: High-skilled	0.14	0.00	0.34
Share: Medium skilled	0.71	1.00	0.45
Share: Blue collar	0.53	1.00	0.50
Share: Never censored individuals	0.81	1.00	0.39

Source: LIAB and Statistical Offices of the Laender. *Notes:* Number of person-year observations: 12,673,576. Number of individuals: 4,091,932. All monetary variables in 2008 euros.

D Additional Results

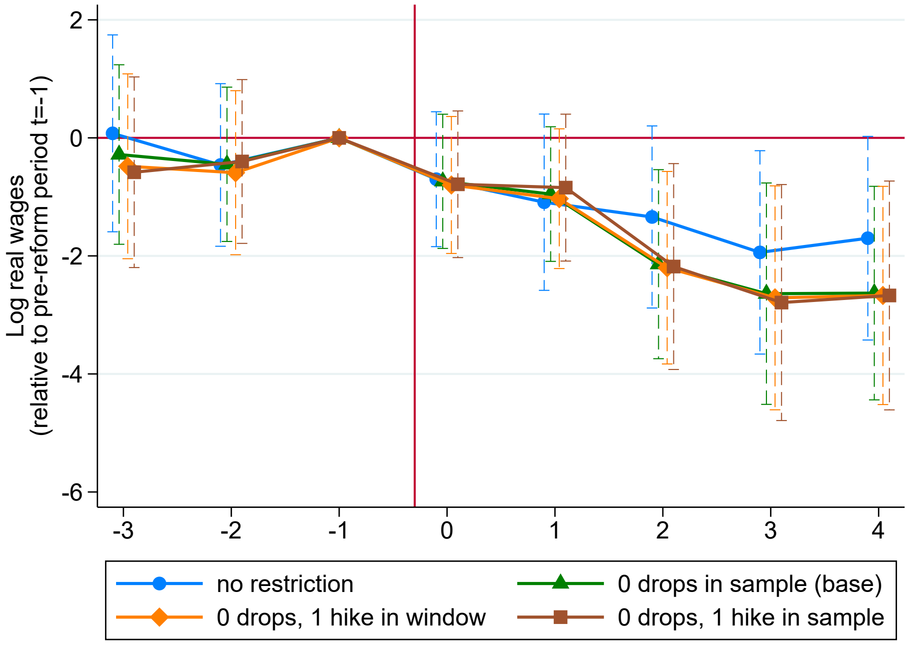


Figure D.1: Event study graphs: wage effects by event window cut

Source: LIAB and Statistical Offices of the Laender. *Notes:* The graph plots event study estimates ($\hat{\gamma}_j, j \in [-3, 4]$) and corresponding 95% confidence bands of different specifications of equation (1). Dependent variable is the log median firm wage (observed on 30 June for each year). Event dummies are equal to one for tax increases greater than or equal to the 75th percentile of the tax increase distribution. The tax change occurred for the treatment group on 1 January in event year $t = 0$, as indicated by the vertical red line. All regression models include municipal, firm and "state × year" fixed effects. The estimation sample comprises all establishments liable to the LBT in non-merged municipalities. Depending on the specification, we additionally restrict the sample to municipalities without a tax decrease during the observation period, not more than one increase in the event window, and/or only one tax increase in the whole observation period (see legend). Standard errors are clustered at the municipal level. Estimates are reported in Table D.11.

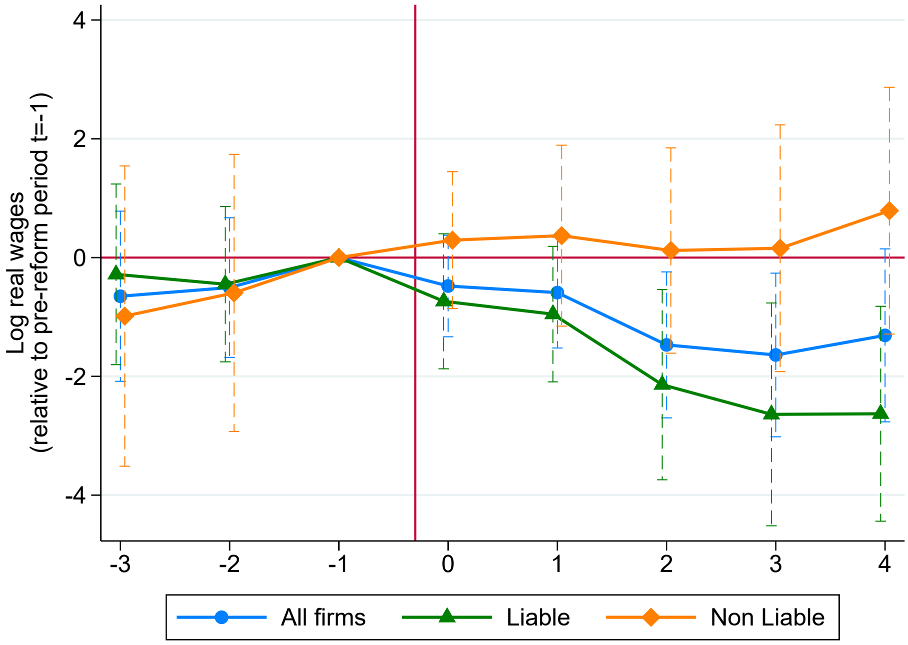


Figure D.2: Event study graphs: wage effects by firm liability

Source: LIAB and Statistical Offices of the Laender. *Notes:* The graph plots event study estimates ($\hat{\gamma}_j, j \in [-3, 4]$) and corresponding 95% confidence bands of different specifications of equation (1). Dependent variable is the log median firm wage (observed on 30 June for each year). Event dummies are equal to one for tax increases greater than or equal to the 75th percentile of the tax increase distribution. The tax change occurred for the treatment group on 1 January in event year $t = 0$, as indicated by the vertical red line. All regression models include municipal, firm and "state $\times$ year" fixed effects. The estimation sample comprises all establishments in non-merged municipalities that did not experienced a tax decrease during the observation period. Depending on the specification, we additionally restrict the sample to firms that are liable to or exempt from the LBT (see legend). Standard errors are clustered at the municipal level. Estimates are reported in Table D.12.

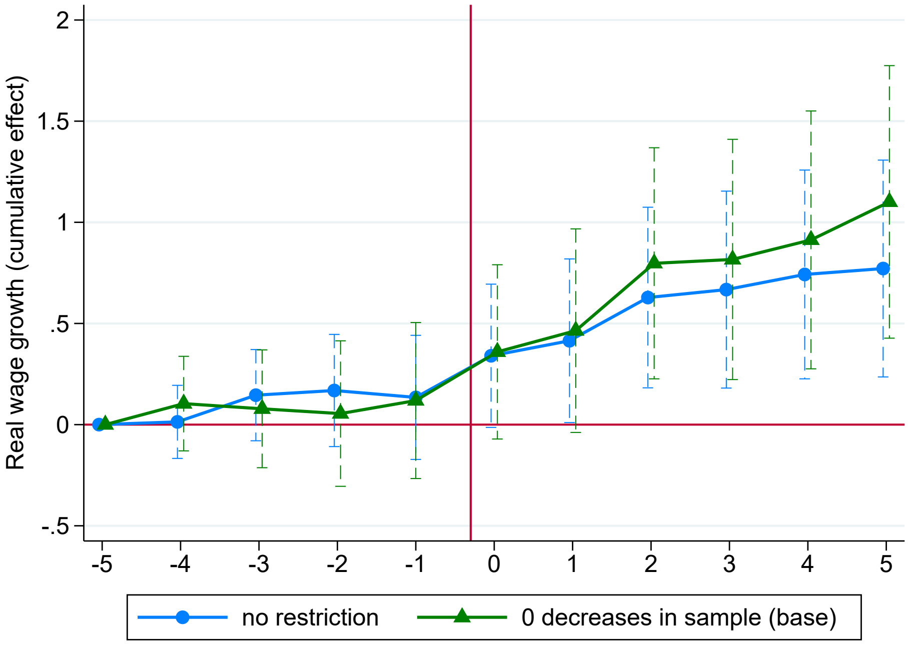
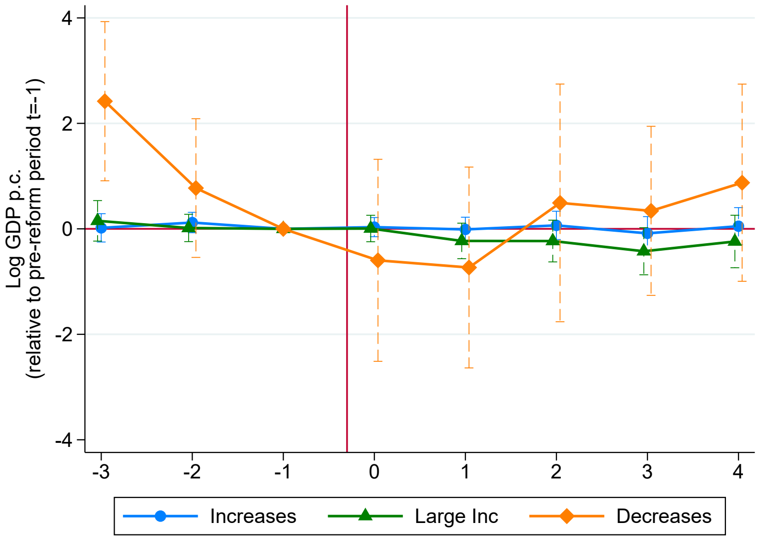


Figure D.3: Distributed lag model estimates: wage effects by event window cut

Source: LIAB and Statistical Offices of the Laender. *Notes:* The graph plots distributed lag model estimates ($\hat{\beta}_j, j \in [-4, 5]$) and corresponding 95% confidence bands of different specifications of equation (2). Dependent variable is the yearly change in the log median firm wage (observed on 30 June for each year). Main regressors are leads and lags of the yearly change in the net-of-local-business-tax rate. All regression models include municipal, firm and "state × year" fixed effects. The estimation sample comprises all establishments liable to the LBT in non-merged municipalities. Depending on the specification, we additionally restrict the sample to municipalities without a tax decrease during the observation period, not more than one increase in the event window, and/or only one tax increase in the whole observation period (see legend). Standard errors are clustered at the municipal level. Estimates are reported in Table D.14.

Panel A: GDP



Panel B: Unemployment

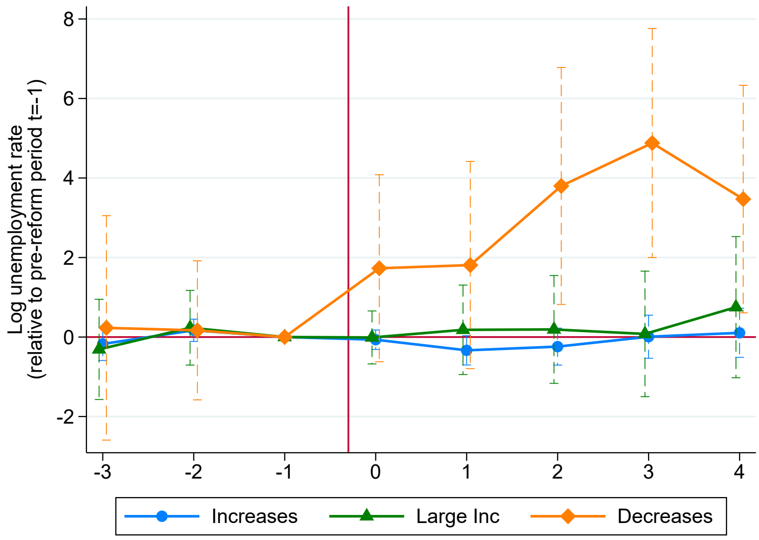


Figure D.4: Event study graphs: local business cycle effects including tax decreases

Source: Statistical Offices of the Laender. *Notes:* The graph plots event study estimates ($\hat{\gamma}_j, j \in [-3, 4]$) and corresponding 95% confidence bands of different specifications of equation (1). Dependent variables are log county GDP per capita (Panel A) and unemployment rate (Panel B). Event variables are dummies equal to one for a tax increase, a large tax increase (greater than or equal to the 75th percentile of the tax increase distribution), or a tax decrease (see legend). The tax change occurred for the treatment group on 1 January in event year $t = 0$, as indicated by the vertical red line. All regression models include municipal and "state $\times$ year" fixed effects. In specifications with tax increase (decrease) dummies, we exclude all municipalities that experienced a tax decrease (increase) during the observation period. Standard errors are clustered at the municipal level. Estimates are reported in Tables D.15 and D.16, respectively.

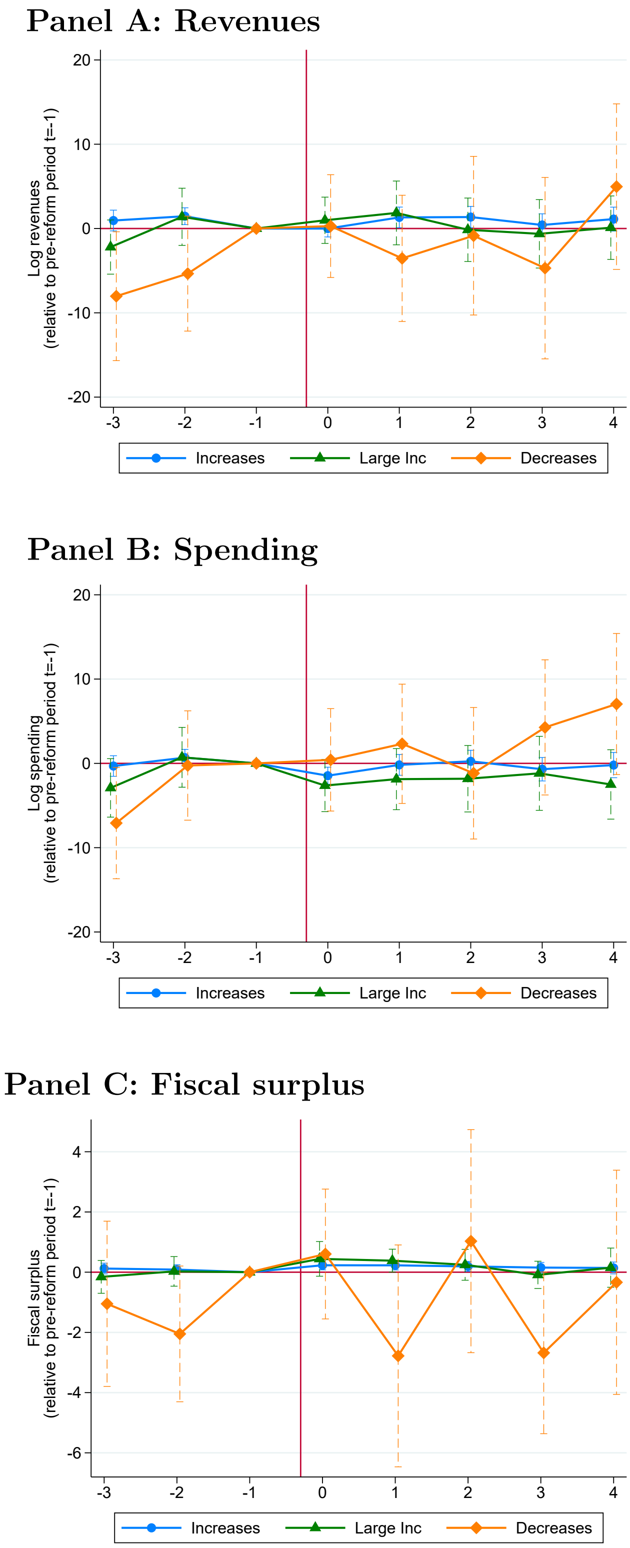


Figure D.5: Event study graphs: municipal fiscal budget variables

Source: Statistical Offices of the Laender. *Notes:* The graph plots event study estimates ($\hat{\gamma}_j, j \in [-3, 4]$) and corresponding 95% confidence bands of different specifications of equation (1). Dependent variables are log municipal revenues per capita (Panel A), log municipal spending per capita (Panel B), and municipal fiscal surplus, i.e. revenues – spending, per capita (Panel C). Event variables are dummies equal to one for a tax increase or a large tax increase (greater than or equal to the 75th percentile of the tax increase distribution, see legend). The tax change occurred for the treatment group on 1 January in event year $t = 0$, as indicated by the vertical red line. All regression models include municipal and "state × year" fixed effects. We exclude all municipalities that experienced a tax decrease during the observation period. Standard errors are clustered at the municipal level. Estimates are reported in Tables D.17, D.18, and D.19 respectively.

Table D.1: Differences-in-differences estimates: wage effects at different levels of aggregation

Aggregation level	(1) worker	(2) firm	(3) municipality
Log net-of-LBT rate	0.374	0.388	0.416
	(0.114)	(0.127)	(0.252)
N	9,295,488	44,654	15,433

Source: LIAB and Statistical Offices of the Laender. *Notes:* This table presents the DiD estimates $\hat{\delta}$ of regression model (3), estimated on different levels of aggregation as indicated at the top of the table. Dependent variable at the worker levels is the log individual wage, at the municipal level the log mean municipal wage. Coefficients measure the wage elasticity with respect to the net-of-local-business-tax rate. All specifications include municipal fixed effects, as well as "state × year" fixed effects. The model at the firm level additionally includes firm fixed effects, at the individual firm and worker fixed effects are added. The estimation sample comprises ([workers in] establishments in) non-merged municipalities. Standard errors are clustered at the municipal level. Standard errors are clustered at the municipal level. Specification (2) replicates the baseline estimate, presented in column (1) of Table 1.

Table D.2: Differences-in-differences estimates: effects on worker composition

Dependent var.	(1) ln share high-skilled	(2) ln share med-skilled	(3) ln share male	(4) ln share full-time	(5) ln share blue-collar	(6) ln mean age
Log net-of-LBT rate	0.054	−0.161	0.001	−0.139	0.425	−0.108
	(0.648)	(0.224)	(0.176)	(0.170)	(0.309)	(0.062)
N	22,978	44,289	43,446	44,654	40,115	44,654

Source: LIAB and Statistical Offices of the Laender. *Notes:* This table presents the DiD estimates $\hat{\delta}$ of regression model (3). Instead of the log wage, the dependent variables are log worker shares at the firm level, and the log mean worker age as indicated at the top of the table. Coefficients measure the wage elasticity with respect to the net-of-local-business-tax rate. All specifications include firm and municipal fixed effects, as well as "state × year" fixed effects. The estimation sample comprises all establishments liable to the LBT in non-merged municipalities. Standard errors are clustered at the municipal level.

Table D.3: Differences-in-differences estimates: robustness of wage effects to other controls

	(1)	(2)	(3)
Log net-of-LBT rate	0.388	0.436	0.476
	(0.127)	(0.138)	(0.131)
Future muni. spending		✓	
Share never-censored			✓
N	$44,654$	$40,558$	$44,654$

Source: LIAB and Statistical Offices of the Laender. *Notes:* This table presents the DiD estimates $\hat{\delta}$ of regression model (3). Coefficients measure the wage elasticity with respect to the net-of-local-business-tax rate. All specifications include firm and municipal fixed effects, as well as "state × year" fixed effects. In addition, control variables are added as indicated at the bottom of the table: (i) current and future (lead 1 and 2) municipal spending, (ii) the share of workers in the firm that are never wage-censored during the observation period. The estimation sample comprises all establishments liable to the LBT in non-merged municipalities. Standard errors are clustered at the municipal level. Specification replicates the baseline estimate, presented in column (1) of Table 1.

Table D.4: Differences-in-differences estimates at firm level: robustness to other dependent variables

	(1)	(2)	(3)	(4)
Log net-of-LBT rate	0.388	0.220	0.317	0.152
	(0.127)	(0.104)	(0.136)	(0.166)
Dep. var: log firm wage	P50	Mean	P25	P75
N	$44,654$	$44,654$	$44,654$	$44,654$

Source: LIAB and Statistical Offices of the Laender. *Notes:* This table presents the DiD estimates $\hat{\delta}$ of regression model (3). The dependent variable are specific measures (median, mean, p25, p75) of the firm wage (in logs), as indicated at the top of the table. Coefficients measure the wage elasticity with respect to the net-of-local-business-tax rate. All specifications include firm and municipal fixed effects, as well as "state × year" fixed effects.The estimation sample comprises all establishments liable to the LBT in non-merged municipalities. Standard errors are clustered at the municipal level. Specification (1) replicates the baseline estimate, presented in column (1) of Table 1.

Table D.5: Differences-in-differences estimates: robustness of wage effects to different estimation samples

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Log net-of-LBT rate	0.388	0.185	0.188	0.409	0.406	0.408	0.367
	(0.127)	(0.097)	(0.102)	(0.146)	(0.122)	(0.151)	(0.143)
Municipalities	Non-merged	Non-merged	All	Non-merged	Non-merged	Non-merged	Non-merged
Firms	Liable	All	Liable	Liable	Liable	Liable	Liable
Years	99-08	99-08	99-08	99-08	99-08	99-08	99-07
Add. condition				0 drops	+ incorp. changers	+ firms < 4 workers	
N	44,654	69,249	58,062	36,828	49,886	56,066	39,975

Source: LIAB and Statistical Offices of the Laender. *Notes:* This table presents the DiD estimates $\hat{\delta}$ of regression model (3). Coefficients measure the wage elasticity with respect to the net-of-local-business-tax rate. All specifications include firm and municipal fixed effects, as well as "state × year" fixed effects. The estimation sample varies across specifications as indicated at the bottom of the table. Standard errors are clustered at the municipal level. Specification (1) replicates the baseline estimate, presented in column (1) of Table 1.

Table D.6: Differences-in-differences estimates: wage effects at individual level

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Log net-of-LBT rate	0.374	0.347	0.353	0.414	0.298	0.361	0.468	0.367
	(0.114)	(0.087)	(0.104)	(0.116)	(0.173)	(0.114)	(0.144)	(0.116)
Workers	ft	ft	ft	ft	ft	ft	non-cens	ft+pt
State × year FE	✓			✓	✓	✓	✓	✓
Year FE		✓						
CZ × year FE			✓					
Municipal controls $t-2$				✓				
Firm controls $t-2$					✓			
Worker characteristics						✓		
N (in million)	9.295	9.295	9.295	9.295	6.430	9.295	7.275	10.091

Source: LIAB and Statistical Offices of the Laender. *Notes:* This table presents the DiD estimates $\hat{\delta}$ of regression model (3) with the log individual wage as dependent variable. Coefficients measure the wage elasticity with respect to the net-of-local-business-tax rate. All regression models include municipal, firm and worker fixed effects. Additional control variables and fixed effects (year, "state × year" or "commuting zone (CZ) × year") vary depending on the specification (as indicated at the bottom of the table). For specifications (1) to (6), the estimation sample comprises all full-time (ft) workers in establishments liable to the LBT in non-merged municipalities. In model (7), the sample is restricted to workers whose wages have never been right-censored at the ceiling for social security contributions. In specification (8), part-time workers are added to the full-time worker sample.

Table D.7: Differences-in-differences estimates: robustness of wage effects with respect to clustering

	(1)	(2)	(3)	(4)	(5)	(6)
Log net-of-LBT rate	0.388	0.388	0.388	0.388	0.388	0.388
	(0.127)	(0.091)	(0.129)	(0.131)	(0.119)	(0.129)
N	44,654	44,654	44,654	44,654	44,654	44,654
Clustering at level of	muni	muni×year	county	CZ	state	firm
Clusters	2,820	14,610	394	253	16	14,221

Source: LIAB and Statistical Offices of the Laender. *Notes:* This table presents the DiD estimates $\hat{\delta}$ of regression model (3). Coefficients measure wage the elasticity with respect to the net-of-local-business-tax rate. All specifications include firm and municipal fixed effects, as well as "state × year" fixed effects. The estimation sample comprises all establishments liable to the LBT in non-merged municipalities. Standard errors are clustered at different levels as indicated at the bottom of the table. Our preferred specification is shown in column (1), where standard errors are clustered at the municipal level.

Table D.8: Differences-in-differences estimates: wage effects by worker type, robustness with respect to censoring

Stratified by ...	Effect of the log net-of-LBT rate by worker type			N
Skill	High	Medium	Low	
All workers	0.013	0.357	0.377	9,295,488
	(0.120)	(0.115)	(0.168)	
Not wage-censored	0.011	0.431	0.428	7,275,134
	(0.230)	(0.139)	(0.192)	
Gender	Female	Male		
All workers	0.530	0.325		9,295,488
	(0.129)	(0.119)		
Not wage-censored	0.583	0.429		7,275,134
	(0.140)	(0.153)		
Occupation	Blue-collar	White-collar		
All workers	0.363	0.250		9,295,422
	(0.132)	(0.104)		
Not wage-censored	0.424	0.333		7,275,090
	(0.161)	(0.128)		
Age	Young	Medium	Old	
All workers	0.507***	0.317***	0.329***	9,295,488
	(0.127)	(0.111)	(0.106)	
Not wage-censored	0.526	0.370	0.401	7,275,134
	(0.151)	(0.136)	(0.124)	

Source: LIAB and Statistical Offices of the Laender. *Notes:* This table presents the DiD estimates $\hat{\delta}$ of regression model (3) with the log individual wage as dependent variables for different worker types as indicated in the table. The heterogeneous effects are estimated by interacting the LBT rate with dummy variables for different firms types. Coefficients measure the wage elasticity with respect to the net-of-local-business-tax rate. All specifications include worker, firm and municipal fixed effects, as well as "state × year" and "firm type × year" fixed effects. The estimation sample comprises all establishments liable to the LBT in non-merged municipalities. Standard errors are clustered at the municipal level.

Table D.9: Effect of incidence assumptions on average tax rates across income distribution

Groups	PIT	CIT	Total	Ratio	PIT	CIT	Total	Ratio
	US (2004)				**Germany (2015)**			
Population average	11.5	2.3	13.7		12.3	2.0	14.4	
Panel A: Piketty-Saez Baseline (CIT incidence: 0% wages, 100% capital)								
P0-90	5.4	1.5	7.0		5.5	0.2	5.7	
P90-100	14.7	2.3	16.9	1.4	21.8	2.7	24.6	4.3
P99-100	22.7	4.0	26.8	2.9	27.4	7.4	34.8	6.1
Panel B: Counterfactual 1 (CIT incidence: 50% wages, 50% capital)								
P0-90	5.4	2.4	7.8		5.5	1.2	6.7	
P90-100	14.7	1.1	15.8	1.0	21.8	1.4	23.2	3.5
P99-100	22.7	2.0	24.8	2.2	27.4	3.7	31.1	4.6
Panel C: Counterfactual 2 (CIT incidence: 100% wages, 0% capital)								
P0-90	5.4	2.5	7.9		5.5	2.0	7.5	
P90-100	14.7	0.0	14.7	0.8	21.8	0.0	21.8	2.9
P99-100	22.7	0.0	22.7	1.9	27.4	0.0	27.4	3.7

Source: Own calculations based on Piketty and Saez (2007) for the US-2004 and Bach, Beznoska and Steiner (2016) for Germany-2015. *Notes:* This table shows the average income tax rates for the bottom 90%, top 10% and top 1% of the market income distribution. The total tax rates are decomposed into personal and corporate income tax rates (PIT and CIT). The CIT for Germany includes the LBT. The "ratio" column reports the ratio of the top tax rate (top 10% or top 1%) to the tax rate for the bottom 90% as a measure of progressivity. Panel A reports tax rates under the incidence assumption of Piketty and Saez (2007), i.e. the full corporate tax incidence being on capital income. Panels B and C report two counterfactuals with 50% (100%) of the incidence on wages. Note that formula (4) calculates the share of the tax burden borne by workers in terms of welfare – as discussed in Section II.B. Given that the back-of-the-envelope calculation reported in this table is meant for illustrative purposes only, we assume here for simplicity reasons that 50% (100%) of the effective tax burden is shifted onto workers. In both counterfactuals, the wage incidence is only affecting wages of workers in the the bottom 90% (in line with the heterogeneous effects that we find).

Table D.10: Event study estimates: baseline wage effects

Specification	(1) Increases	(2) Large Inc	(3) Decreases
F4	0.559	-0.435	0.231
	(0.352)	(0.816)	(1.110)
F3	0.423	-0.282	0.697
	(0.305)	(0.776)	(1.220)
F2	0.069	-0.448	0.916
	(0.228)	(0.667)	(0.876)
L0	-0.073	-0.736	1.370
	(0.206)	(0.580)	(0.724)
L1	-0.226	-0.952	0.279
	(0.281)	(0.582)	(0.907)
L2	-0.622	-2.140	0.490
	(0.309)	(0.817)	(0.799)
L3	-0.576	-2.640	0.674
	(0.318)	(0.957)	(0.710)
L4	-0.450	-2.630	-0.574
	(0.359)	(0.923)	(1.030)
L5	-0.899	-3.100	0.729
	(0.349)	(1.030)	(0.659)
N	36,826	36,826	6,001

Source: LIAB and Statistical Offices of the Laender. *Notes:* The table shows the event study estimates plotted in Panel A of Figure 3. Please refer to figure note for further information.

Table D.11: Event study estimates: wage effects by event window cut

Specification	(1) no res.	(2) 0D in S	(3) 0D, 1H in W	(4) 0D, 1H in S
F4	0.566	-0.435	-0.644	-0.807
	(0.935)	(0.816)	(0.839)	(0.851)
F3	0.077	-0.282	-0.481	-0.582
	(0.851)	(0.776)	(0.799)	(0.824)
F2	-0.459	-0.448	-0.590	-0.400
	(0.703)	(0.667)	(0.709)	(0.708)
L0	-0.700	-0.736	-0.798	-0.786
	(0.583)	(0.580)	(0.592)	(0.634)
L1	-1.090	-0.952	-1.030	-0.843
	(0.762)	(0.582)	(0.604)	(0.635)
L2	-1.340	-2.140	-2.200	-2.180
	(0.787)	(0.817)	(0.832)	(0.890)
L3	-1.940	-2.640	-2.710	-2.790
	(0.879)	(0.957)	(0.968)	(1.020)
L4	-1.700	-2.630	-2.670	-2.670
	(0.880)	(0.923)	(0.943)	(0.989)
L5	-2.030	-3.100	-3.280	-3.330
	(0.976)	(1.030)	(1.070)	(1.130)
N	44,630	36,826	36,086	33,554

Source: LIAB and Statistical Offices of the Laender. *Notes:* The table shows the event study estimates plotted in Figure D.1. Please refer to figure note for further information.

Table D.12: Event study estimates: wage effects by firm liability

Specification	(1) All firms	(2) Liable	(3) Non Liable
F4	-0.771	-0.435	-1.040
	(0.812)	(0.816)	(1.530)
F3	-0.651	-0.282	-0.985
	(0.731)	(0.776)	(1.290)
F2	-0.505	-0.448	-0.595
	(0.600)	(0.667)	(1.190)
L0	-0.479	-0.736	0.294
	(0.436)	(0.580)	(0.588)
L1	-0.590	-0.952	0.369
	(0.476)	(0.582)	(0.777)
L2	-1.470	-2.140	0.119
	(0.627)	(0.817)	(0.882)
L3	-1.640	-2.640	0.157
	(0.703)	(0.957)	(1.060)
L4	-1.310	-2.630	0.789
	(0.743)	(0.923)	(1.060)
L5	-1.460	-3.100	1.400
	(0.790)	(1.030)	(1.240)
N	57,032	36,826	20,206

Source: LIAB and Statistical Offices of the Laender. *Notes:* The table shows the event study estimates plotted in Figure D.2. Please refer to figure note for further information.

Table D.13: Distributed lag model estimates: baseline wage effects

Specification	(1) Lead/Lag	(2) Lag
F4	0.104	
	(0.119)	
F3	-0.026	
	(0.128)	
F2	-0.023	
	(0.109)	
F1	0.064	
	(0.117)	
L0	0.236	0.237
	(0.115)	(0.115)
L1	0.109	0.111
	(0.152)	(0.152)
L2	0.333	0.327
	(0.158)	(0.158)
L3	0.019	0.013
	(0.152)	(0.151)
L4	0.097	0.104
	(0.151)	(0.151)
L5	0.188	0.186
	(0.126)	(0.126)
N	24,626	24,626

Source: LIAB and Statistical Offices of the Laender. *Notes:* The table shows the estimates of the distributed lag model whose cumulative effects are plotted in Panel B of Figure 3. Please refer to figure note for further information.

Table D.14: Distributed lag model estimates: wage effects by event window cut

Specification	(1) no res.	(2) 0D in S
F4	0.014	0.104
	(0.092)	(0.119)
F3	0.132	-0.026
	(0.103)	(0.128)
F2	0.023	-0.023
	(0.093)	(0.109)
F1	-0.034	0.064
	(0.110)	(0.117)
L0	0.206	0.236
	(0.101)	(0.115)
L1	0.074	0.109
	(0.109)	(0.152)
L2	0.214	0.333
	(0.115)	(0.158)
L3	0.039	0.019
	(0.117)	(0.152)
L4	0.075	0.097
	(0.113)	(0.151)
L5	0.029	0.188
	(0.100)	(0.126)
N	29,634	24,626

Source: LIAB and Statistical Offices of the Laender. *Notes:* The table shows the estimates of the distributed lag model whose cumulative effects are plotted in Figure D.3. Please refer to figure note for further information.

Table D.15: Event study estimates: GDP

Specification	(1) Increases	(2) Large Inc	(3) Decreases
F4	-0.146	0.134	2.310
	(0.164)	(0.241)	(1.080)
F3	0.019	0.152	2.420
	(0.137)	(0.196)	(0.770)
F2	0.119	0.016	0.773
	(0.099)	(0.132)	(0.671)
L0	0.033	0.006	-0.597
	(0.093)	(0.128)	(0.977)
L1	-0.011	-0.229	-0.733
	(0.118)	(0.172)	(0.972)
L2	0.066	-0.231	0.492
	(0.137)	(0.202)	(1.150)
L3	-0.085	-0.425	0.341
	(0.162)	(0.228)	(0.818)
L4	0.050	-0.240	0.875
	(0.180)	(0.254)	(0.954)
L5	0.115	-0.450	0.048
	(0.197)	(0.278)	(1.030)
N	31,023	31,023	6,479

Source: LIAB and Statistical Offices of the Laender. *Notes:* The table shows the event study estimates plotted in Panel A of Figure 4. Please refer to figure note for further information.

Table D.16: Event study estimates: unemployment

Specification	(1) Increases	(2) Large Inc	(3) Decreases
F4	-0.364	-0.863	-0.112
	(0.284)	(0.767)	(1.640)
F3	-0.174	-0.310	0.231
	(0.212)	(0.643)	(1.440)
F2	0.170	0.234	0.168
	(0.143)	(0.479)	(0.892)
L0	-0.067	-0.010	1.730
	(0.125)	(0.340)	(1.200)
L1	-0.334	0.182	1.810
	(0.188)	(0.574)	(1.330)
L2	-0.241	0.191	3.800
	(0.237)	(0.692)	(1.520)
L3	0.008	0.079	4.880
	(0.277)	(0.806)	(1.470)
L4	0.106	0.751	3.470
	(0.315)	(0.906)	(1.460)
L5	-0.003	1.710	2.250
	(0.337)	(0.975)	(2.320)
N	31,023	31,023	6,479

Source: LIAB and Statistical Offices of the Laender. *Notes:* The table shows the event study estimates plotted in Panel B of Figure 4. Please refer to figure note for further information.

Table D.17: Event study estimates: municipal revenues

Specification	(1) Increases	(2) Large Inc	(3) Decreases
F4	1.150	0.659	-8.820
	(0.663)	(1.910)	(4.470)
F3	0.949	-2.200	-8.030
	(0.627)	(1.640)	(3.900)
F2	1.460	1.390	-5.350
	(0.509)	(1.730)	(3.480)
L0	-0.008	0.980	0.288
	(0.506)	(1.400)	(3.110)
L1	1.320	1.850	-3.540
	(0.624)	(1.930)	(3.820)
L2	1.360	-0.148	-0.851
	(0.647)	(1.920)	(4.800)
L3	0.421	-0.629	-4.700
	(0.676)	(2.070)	(5.490)
L4	1.120	0.102	4.970
	(0.722)	(1.920)	(5.010)
L5	1.830	1.660	-3.090
	(0.748)	(2.040)	(3.900)
N	30,984	30,984	6,477

Source: LIAB and Statistical Offices of the Laender. *Notes:* The table shows the event study estimates plotted in Panel A of Figure D.5. Please refer to figure note for further information.

Table D.18: Event study estimates: municipal spending

Specification	(1) Increases	(2) Large Inc	(3) Decreases
F4	-0.169	-0.255	-6.010
	(0.689)	(2.040)	(2.930)
F3	-0.313	-2.910	-7.080
	(0.623)	(1.770)	(3.370)
F2	0.682	0.720	-0.251
	(0.501)	(1.810)	(3.310)
L0	-1.460	-2.630	0.421
	(0.515)	(1.580)	(3.100)
L1	-0.178	-1.870	2.320
	(0.629)	(1.850)	(3.610)
L2	0.246	-1.820	-1.170
	(0.667)	(2.010)	(3.980)
L3	-0.692	-1.180	4.270
	(0.709)	(2.240)	(4.090)
L4	-0.203	-2.500	7.040
	(0.765)	(2.100)	(4.270)
L5	0.046	0.547	-2.520
	(0.798)	(2.240)	(3.610)
N	30,982	30,982	6,476

Source: LIAB and Statistical Offices of the Laender. *Notes:* The table shows the event study estimates plotted in Panel B of Figure D.5. Please refer to figure note for further information.

Table D.19: Event study estimates: municipal fiscal surplus

Specification	(1) Increases	(2) Large Inc	(3) Decreases
F4	0.169	0.110	-1.330
	(0.090)	(0.263)	(1.310)
F3	0.121	-0.156	-1.050
	(0.091)	(0.278)	(1.400)
F2	0.086	0.027	-2.050
	(0.081)	(0.251)	(1.150)
L0	0.230	0.442	0.604
	(0.078)	(0.294)	(1.100)
L1	0.228	0.383	-2.780
	(0.079)	(0.194)	(1.880)
L2	0.192	0.246	1.030
	(0.085)	(0.262)	(1.890)
L3	0.153	-0.089	-2.680
	(0.088)	(0.231)	(1.370)
L4	0.141	0.150	-0.336
	(0.100)	(0.332)	(1.900)
L5	0.255	-0.081	-0.080
	(0.095)	(0.252)	(1.200)
N	30,983	30,983	6,477

Source: LIAB and Statistical Offices of the Laender. *Notes:* The table shows the event study estimates plotted in Panel C of Figure D.5. Please refer to figure note for further information.

References

Acemoglu, Daron, and Robert Shimer. 1999. "Efficient Unemployment Insurance." *Journal of Political Economy*, 107(5): 893–928.

Akerlof, G.A. 1982. "Labor Contracts as Partial Gift Exchange." *Quarterly Journal of Economics*, 97: 543–569.

Amiti, Mary, and Donald R. Davis. 2010. "Trade, Firms, and Wages: Theory and Evidence." *Review of Economic Studies*, 79(1): 1–36.

Arulampalam, Wiji, Michael P. Devereux, and Giorgia Maffini. 2012. "The Direct Incidence of Corporate Income Tax on Wages." *European Economc Review*, 56(6): 1038–1054.

Bach, Stefan, Martin Beznoska, and Viktor Steiner. 2016. "Who Bears the Tax Burden in Germany? Tax Structure Slightly Progressive." *DIW Economic Bulletin*, 51/52: 601–608.

Ballentine, J. Gregory. 1978. "The Incidence of a Corporation Income Tax in a Growing Economy." *Journal of Political Economy*, 86(5): 863–875.

Barth, Erling, and Josef Zweimüller. 1995. "Relative Wages under Decentralized and Corporatist Bargaining Systems." *Scandinavian Journal of Economics*, 97(3): 369–384.

Boeri, Tito. 2014. "Two-Tier Bargaining." *IZA Discussion Paper No. 8358.*

Bradford, David F. 1978. "Factor prices may be constant but factor returns are not." *Economics Letters*, 1(3): 199–203.

Diamond, P. A., and J. Mirrlees. 1971*a*. "Optimal Taxation and Public Production I: Production Efficiency." *American Economic Review*, 61(1): 8–27.

Diamond, P. A., and J. Mirrlees. 1971*b*. "Optimal Taxation and Public Production II: Tax Rules." *American Economic Review*, 61(3): 261–278.

Du Caju, P., E. Gautier, D. Momferatou, and M. Ward-Warmedinger. 2008. "Institutional Features of Wage Bargaining in 23 European Countries, the US and Japan." *ECB Working Paper Series No 974.*

Dustmann, Christian, Bernd Fitzenberger, Uta Schönberg, and Alexandra Spitz-Oehner. 2014. "From Sick Man of Europe to Economic Superstar: Germany's Resurgent Economy." *Journal of Economic Perspectives*, 28(1): 167–188.

Egger, Hartmut, and Udo Kreickemeier. 2012. "Fairness, trade, and inequality." *Journal of International Economics*, 86(2): 184–196.

Ellguth, Peter, Hans-Dieter Gerner, and Jens Stegmaier. 2012. "Wage Bargaining in Germany – the Role of Works Councils and Opening Clauses." *IAB Discussion Paper 05/2012.*

Feldstein, Martin. 1974. "Incidence of a Capital Income Tax in a Growing Economy with Variable Savings Rates." *The Review of Economic Studies*, 41(4): 505–513.

Felix, R. Alison, and James R. Hines. 2009. "Corporate Taxes and Union Wages in the United States." *NBER Working Paper No. 15263.*

Fuest, Clemens, Andreas Peichl, and Sebastian Siegloch. 2013. "Do Higher Corporate Taxes Reduce Wages? Micro Evidence from Germany." *IZA Discussion Paper No. 7390.*

Harberger, Arnold C. 1962. "The Incidence of the Corporation Income Tax." *Journal of Political Economy*, 70(3): 215–240.

Harberger, Arnold C. 1995. "The ABCs of Corporate Tax Incidence: Insights into the Open-Economy Case." In *Tax Policy and Economic Growth: Proceedings of a Symposium sponsored by the American Council for Capital Formation.* 51–73. Washington:ACCF Center for Policy Research.

Kotlikoff, Laurence J., and Lawrence H. Summers. 1987. "Tax Incidence." In *Handbook of Public Economics.* Vol. 2, , ed. Alan J. Auerbach and Martin Feldstein, 1043–1092. Amsterdam:Elsevier.

McDonald, Ian M., and Robert E. Solow. 1981. "Wage Bargaining and Employment." *The America Economic Review*, 71(5): 896–908.

NCSL. 2009. "State, Federal and Local Taxes." *http://www.ncsl.org/documents/fiscal/statefederalandlocaltaxes.pdf*.

OECD. 2015. "Tax on corporate profits (indicator)." *doi: 10.1787/d30cc412-en.*

Oswald, Andrew J. 1993. "Efficient contracts are on the labour demand curve: Theory and facts." *Labour Economics*, 1(1): 85–113.

Piketty, Thomas, and Emmanuel Saez. 2007. "How Progressive is the U.S. Federal Tax System? A Historical and International Perspective." *Journal of Economic Perspectives*, 21(1): 3–24.

Ratti, Ronald A., and Parthasarathi Shome. 1977. "On a General Equilibrium Model of the Incidence of the Corporation Tax under Uncertainty." *Journal of Public Economics*, 8(2): 233–238.

Rogerson, Richard, Robert Shimer, and Randall Wright. 2005. "Search-Theoretic Models of the Labor Market: A Survey." *Journal of Economic Literature*, 43(4): 959–988.

Shapiro, C., and J. Stiglitz. 1984. "Equilibrium Unemployment as a Worker Discipline Device." *The American Economic Review*, 74(3): 433–444.

Shoven, John B. 1976. "The Incidence and Efficiency Effects of Taxes on Income from Capital." *Journal of Political Economy*, 84(6): 1261–1283.

Solow, Robert M. 1979. "Another possible source of wage stickiness." *Journal of Macroeconomics*, 1(1): 79–82.

Suárez Serrato, Juan Carlos, and Owen Zidar. 2016. "Who Benefits from State Corporate Tax Cuts? A Local Labor Markets Approach with Heterogeneous Firms." *The Amercian Economic Review*, 106(9): 2582–2624.