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Wage Incidence of Local Corporate Taxation - Micro Evidence from Germany*

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Abstract

In this paper we provide empirical evidence on the wage incidence of the German business tax, which is set at the municipal level. For our analysis, we use very rich administrative linked employer-employee panel data, covering 11 years, and link it to data on the business tax rates of about 11,100 German municipalities. On average 8% of the municipalities adjust their business tax rate per year. We are thus able to exploit multiple quasi-natural experiments to identify the tax incidence on wages. While the unique German setting allows us to gauge general equilibrium wage effects, the detailed administrative data enables us to estimate heterogeneous incidence effects and to explore different channels of how the business tax burden is passed on. Consistent with our theoretical model, we find a negative direct effect of corporate taxation on wage, arising in a collective wage bargaining context. A one euro increase in the annual tax liabilities yields a 50 cent decrease of the annual wage bill. This burden is borne high- and medium-skilled labor. Furthermore, we show that the general equilibrium effect on wages is negligible in the context of our study due to the high regional labor mobility.

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1 Introduction

The debate about who bears the burden of corporate taxation has recently shifted from the theoretical to the empirical arena. Compared to the multitude of theoretical contributions that followed Harberger (1962)'s seminal work and converged to the view that labor bears a substantial share of the corporate tax burden¹, there are only a few empirical studies on the wage incidence of corporate taxation. The main reason for this lack of empirical evidence is that the requirements to comprehensively *and* cleanly identify the effect of corporate taxation on wages are high. There are one conceptual and two econometric conditions that have to be met. First, conceptually, it is important to account for general equilibrium effects in order to capture the full wage incidence. Second, there needs to be sufficient exogenous variation in the corporate tax rates. Third, the researcher needs to be able to control the economic environment in which the tax changes occur. Clearly, the latter two conditions are necessary to establish a quasi-experimental setting which is crucial for identification.

It is difficult to find a research design in which all three requirements are met. One possibility is to use cross-country data (Hassett and Mahur, 2006; Felix, 2007; Desai et al., 2007), which is necessary to capture general equilibrium effects. Yet, cross-country studies exploiting differentials in corporate taxation over time to estimate the wage incidence often have troubles to defend the common trend assumption which is crucial for identification. In general, it is not likely that differences in the wage paths of, say, Germany and the U.S., can be purely attributed to changes in national corporate tax policies. Moreover, endogeneity issues are usually not negligible.

An alternative to using cross-country data is to look at a single country and exploit regional and/or industry-specific cross-sectional and time variation in corporate taxation to identify the wage incidence (Dwenger et al., 2011; Liu and Altshuler, 2011). Here, the common trend assumption is arguably more credible, while the variation in the tax rates is often not as clear as in the first group of studies. The influential paper by Arulampalam et al. (2012) acknowledges that by exploiting both cross-firm and cross-country variation in tax *burdens*. Nevertheless, as Arulampalam et al. (2012) state, studies using firm data are generally not able

¹ The literature following Harberger (1962) extended the model to the open economy case (Diamond and Mirrlees, 1971; Bradford, 1978; Kotlikoff and Summers, 1987; Harberger, 1995), incorporated more sectors (Shoven, 1976) and introduced uncertainty (Ratti, 1977). Surveys are provided by Auerbach (2005); Harberger (2006). Recent computational general equilibrium (CGE) models find that labor bears a substantial share of the corporate tax burden under reasonable assumptions see Gravelle (2010) for an overview.

to measure the general equilibrium effect. The authors, therefore, refrain from estimating the full incidence but only focus on what they call the direct wage effect which arises in a collective bargaining setting. The indirect wage effect through investment, which is essentially Harberger’s general equilibrium effect, cannot be measured in their research design.

In this paper, we rely on an institutional setting and adopt a research design that is able to meet the three mentioned conditions for a clean identification of the full wage incidence of corporate taxes. We exploit the quasi-experimental setting of German local business taxation from 1998 to 2008 where, every year, on average 8% of the 11,100 municipalities adjust their corporate tax rates. At the same time the German municipalities are comparable and face the same economic conditions thus the necessary common trend assumption is likely to hold.² We combine administrative panel data on the universe of the German municipalities with high-quality administrative linked employer-employee micro data taken from the German social security records, enabling us to test for heterogeneous worker *and* firms effects.

Despite their comparability the German municipalities can be interpreted as many small open economies in a setting where the German economy as whole is seen as the world. This institutional setting enables to identify general equilibrium effects. Thus, we set up a theoretical model that combines the rationale from Harberger’s type general equilibrium models (adjusted to our local setting) with a wage bargaining model following Arulampalam et al. (2012). The theoretical model shows that under the assumption that labor is regionally mobile, the full incidence of corporate taxation is determined by the direct effect via collective bargaining, while the indirect effect going through investments and labor/capital complementarities is negligible.

Our empirical findings are as follows: First, in line with the theoretical model, we find that parametric and non-parametric evidence for a sizeable direct effect. Our central estimate of the direct wage elasticity with respect to the effective corporate tax rate is -0.35 . In money terms this implies that a one euro increase in annual tax liabilities yields a 50 cent decrease of the annual wage bill, which is very similar to the findings of Arulampalam et al. (2012). As the theory predicts, the effect is larger if the wage bargaining takes place at the firm level rather than at the sectoral level. Intuitively, high and medium-skilled workers, i.e. those with higher

² A similar set-up is used by Felix and Hines Jr. (2009) who exploit the variation in corporate tax rates among U.S. states. Yet, their results are based on a single cross-section which makes it impossible to control for potential state fixed effects.

rents, experience relative higher wage decreases if corporate tax rates increase. We run several tests to show that our estimates are well-identified. Reassuringly, including industry-year or labor market region-year fixed effects does not render our estimates. Thus, it is highly unlikely that our estimates are biased by unobserved, time-variant confounders. Moreover, a placebo test on non-liable firms shows a zero effect of the local business tax on wages. Second, we find no evidence of a significant indirect effect on wages. While we find that investments decrease as a response to corporate tax increases, negative employment effects due to the mobility of labor within regions mitigates the downward pressure on wages, which would result in a standard Harberger model with immobile labor.³

Our study adds to the existing literature in three important ways. First, we extend the theoretical bargaining model by Arulampalam et al. (2012) to municipal tax competition, accounting for heterogeneous worker and firms effects. Moreover, the institutional and data set-up enables us to provide evidence on the general equilibrium effect. Second, we are the first to exploit compelling variation in tax rates induced by numerous quasi-experimental local tax reforms to cleanly identify the tax incidence on wages, while keeping the overall economic environment constant.⁴ Third, the particular institutional setting of the German business tax allows us to estimate the full wage incidence comprising both the direct and the indirect effect. Last, we are the first to use rich administrative linked employer-employee data, enabling us to estimate heterogeneous worker and firm effects.

The remainder of the paper is structured as follows. In Section 2 we sketch the tax treatment of German firms in general, describe the German business tax in detail and give a short introduction on wage bargaining arrangements in Germany. In Section 3 we setup a theoretical wage bargaining model to demonstrate how municipal corporate taxes affect the wages of heterogeneous workers. The dataset used for the empirical analysis is described in Section 4. Results are shown in Section 5. Section 6 concludes.

³ Detailed employment effects of the German business tax are analyzed in a companion paper (Siegloch, 2013).

⁴ The only other study with a similar set-up is the one by Bauer et al. (2012), which was conducted simultaneously and independently of our study (cf. earlier working paper version of this study Fuest et al., 2011; ?). Yet, Bauer et al. (2012) do not have tax information on the municipal but run the analysis on the more aggregate county (11,441 municipalities vs. 343 counties). This makes the variation imprecise. Moreover, they do not have information on the firm level to disentangle liable from non-liable firms, firms with and without collective agreement and corporate vs. non-corporate firms, which proves to be crucial for the analysis.

2 Institutional Background

2.1 Corporate Taxation in Germany

Besides the VAT, corporate firms (*Kapitalgesellschaften*) face two taxes in Germany, the local business tax (LBT) and the corporate tax (CT), the LBT being the more important tax with a revenue of about €40 billion, which corresponds to approximately 6 percent of Germany's total tax revenue.

The local business tax applies to both corporate and non-corporate firms (*Personengesellschaften*)⁵, while most firms in certain industries such as farming or the public sector exempt as well as certain free professions such as journalists, physicians or lawyers. Since 1998, the LBT base, Y_{LBT} , essentially consists of operating profits.⁶ Importantly, until 2007 LBT liabilities could be deducted from its own tax base. The tax rate of the local business tax, τ_{LBT} , consists of two components: the basic federal rate (*Steuermesszahl*), τ_{fed} , and the collection rate (*Hebesatz*), cr . Thus $\tau_{LBT} = \tau_{fed} \cdot cr$. As the name implies, the basic federal rate is set at the national level. The tax was at 5.0% from 1998 to 2007 and decreased to 3.5% in 2008. The collection rate is set by the municipalities and usually varies between 250% and 450% in the period from 1998 to 2008. Each year, during the budgeting for the next year, the city council has to vote on the tax rate. It is important to note that municipalities can only adjust the collection rate which applies to all (liable) firms in the municipality; they cannot change the tax base nor liability criteria.

The tax base for the corporate tax is similar to the tax base of the LBT. The corporate tax rate has undergone several changes in recent years. Until 2000 a corporate tax imputation system existed in Germany, where retained profits were subject to a corporate tax rate, τ_{CT} , of 45% in 1998 and 40% in 1999 and 2000.⁷ As of 2001 retained and distributed profits were equally taxed at 25%.⁸ In 2008 τ_{CT} was lowered to 15%. In all years, a solidary surcharge, *sol*, of 5.5% of the tax rate is added.

In order to calculate the effective corporate tax burden for corporate firms,

⁵ Taxation of non-corporate firms will be discussed below.

⁶ From 1998 to 2007 half of the long-term debt service was added to the Y_{LBT} . This changed with the tax reform of 2008. Instead of long-term debt services 25% of all interest payments exceeding €100,000 are included in Y_{LBT} . The interest payments comprise a lump sum interest portion of rents, leasing rates and royalties.

⁷ Dividends were taxed at a rate of 30% from 1998 to 2000.

⁸ In 2003 this rate was raised by 1.5 percentage points to finance the costs of a major flood in Germany.

first, the local business tax burden as well as the corporate tax burden have to be determined. Second, the deduction of the LBT liabilities from its own tax base has to be taken into account. The effective (statutory) marginal tax rate⁹ for corporate firms, τ_{EMTR}^{corp} , from 1998 to 2007

$$\tau_{EMTR}^{corp} = \frac{\tau_{CT} \cdot (1 + soli) + \tau_{fed} \cdot cr}{1 + \tau_{fed} \cdot cr}.$$

Since 2008 the denominator of equation () is 1, since the local business tax cannot be deducted from its own tax base anymore.

2.2 Wage Bargaining in Germany

As our theoretical and empirical analysis takes into account collective bargaining, we briefly sketch the situation of labor unions in Germany. Traditionally, union are quite strong in Germany. Collective bargaining agreements (CBA) on the industry-level are the most important bargaining mechanism for wage determination (Ellguth et al., 2012). Establishments can exceed regulations from CBAs (Günstigkeitssprinzip), but only opening clauses provide a (legal) way to fall below these standards. However, wages are sometimes also negotiated at the establishment-level either due to opening clauses or company agreements. Some employers are not at all covered by a CBA and can completely rely on individual contracts with each employee. Note that, with a few exemptions, there is no legal minimum wage in Germany. However, the social security and welfare system provides an implicit minimum wage and CBA ensure that the wages are above these levels (Lohnabstandsgebot)

The average duration of a CBA is usually between one and two years. There has been a significant decline in bargaining coverage. In West (East) Germany, the total proportion of employees covered by CBA 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 et al., 2012).

3 Theoretical framework

Consider an open economy which consists of n jurisdictions. There are many firms in each jurisdiction but to simplify notation we normalize the number of firms per jurisdiction to unity. Firms use the following factors of production: capital (K),

⁹ Note that this is an effective statutory marginal tax rate, as opposed to more conventional measures of the effective marginal tax rate which include tax base parameters.

which is homogeneous, and workers with differing skill levels. There are 2 skill levels. Labor of skill type k , $k = 1, 2$, is denoted by L^k . The production function $F(K, L^1, L^2)$ has the usual neoclassical properties and exhibits declining returns to scale in capital and labor, i.e. there is an implicit factor which can be thought of as a location specific rent. While all production factors are mobile across municipal borders firms are immobile, due to the location specific rent.

Firm profits are taxed by the individual jurisdictions and by the central government. The rate of the local profit tax in jurisdiction i ($i = 1 \dots n$) is denoted by t_i , the rate of the profit tax levied by the central government is denoted by T . Both taxes have the same base, apart from the fact that the local tax is deductible from the base of the profit tax levied by the central government. Given this, the after tax profit of the representative firm located in jurisdiction i is given by

$$P_i = [F(K_i, L_i^1, L_i^2) - \sum_{k=1}^2 w_i^k L_i^k](1 - \tau_i) - (1 - \alpha \tau_i) r K_i \quad (1)$$

where w_i^k is the wage for labor of skill type k , $\tau_i = T + t_i(1 - T)$ is the effective statutory tax rate on profits and r is the non-tax cost of capital. The variable α is the share of the capital costs which can be deducted from the tax base.¹⁰

Firms operate under conditions of perfect competition in output and input markets, with the exception of the labor market, where wages are set by bargaining between firms and trade unions. The bargaining model we use is a standard right to manage model, where each skill type is represented by one trade union.

3.1 Corporate tax incidence with firm level bargaining

First, we consider the case where bargaining takes place at the firm level.¹¹ Each firm negotiates with all unions simultaneously (Barth and Zweimüller, 1995).¹² Following Oswald (1993), we assume that trade unions are dominated by members which are interested in higher wages but not in adding new employees, so that the objective function of the trade union representing the workers of skill type k in firm i is given by

¹⁰ Most existing tax systems imply $0 < \alpha < 1$, which means that capital costs are partly but not fully deductible.

¹¹ Further below we will also analyze bargaining at the sector level.

¹² Assuming that there is one union which represents all skill levels would lead to the same qualitative results regarding the impact of corporate tax changes.

$$Z_i^k = w_i^k - \bar{w}_i^k$$

where \bar{w}_i^k is the reservation wage.¹³ In the case of disagreement between the union and the firm on the wage of skill type j , we assume the rent of the union, Z_i^k and the firm's profit P_i to be equal to zero.¹⁴

After wages are determined, firms choose employment and investment. For given wages and capital costs, the profit maximizing input decisions of the firm are given by the first order conditions

$$\begin{aligned} \frac{\partial F(K_i, L_i^1, L_i^2)}{\partial L_i^k} &= w_i^k \\ \frac{\partial F(K_i, L_i^1, L_i^2)}{\partial K_i} &= R_i \end{aligned}$$

where R_i denotes the cost of capital, which is given by

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

The outcome of the wage bargaining process is given by

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

where

$$\Omega_i^k = \beta^k \ln Z_i^k + (1 - \beta^k) \ln P_i.$$

The variable $\beta^k \in (0,1)$ stands for relative bargaining power of the skill type k union. The first order condition of the bargaining problem can be rearranged to yield

$$w_i^{k*} = \bar{w}_i^k + \frac{\beta^k}{(1 - \beta^k)} \frac{P_i}{L_i^k(1 - \tau_i)} \quad (2)$$

The wage rate is equal to the reservation wage plus a share of the firm's profit

¹³ It is straightforward to show that our key results regarding the incidence of the profit tax on wages would be very similar if we used an efficient bargaining model, where unions are interested in the employment level and bargain over both wages and employment.

¹⁴ An alternative assumption would be that the other skill groups work and receive their wages and that output and investment would be lower than in the case of agreement. This would add notation without changing the signs of the results derived below.

per worker. The size of this share depends on the bargaining power of the trade union.

The focus of our analysis is how changes in local profit taxes affect wages. We distinguish between two channels through which taxes affect wages. Following Arulampalam et al. (2012), we refer to the first channel as the direct impact. Through wage bargaining workers receive part of the profits generated by the firm. If higher taxes reduces these profits, this will affect wages, for given levels of capital and labor inputs. The second channel, referred to as the indirect channel, is the change in wages caused by the adjustment of other input factors or input prices as a reaction to the change in tax.

To define the two effects more precisely, we can solve (2) for the equilibrium wage rate of skill type k , w_i^{k*} :

$$w_i^{k*} = \frac{1}{(1 - \beta^k \beta^j)} \left[\bar{w}_i^k (1 - \beta^k) - \bar{w}_i^j (1 - \beta^j) \beta^k \frac{L_i^j}{L_i^k} + \frac{(1 - \beta^j) \beta^k}{L_i^k} \left(F(K_i, L_i^1, L_i^2) - \frac{(1 - \alpha \tau_i)}{(1 - \tau_i)} r K_i \right) \right] \quad (3)$$

Equation (3) is the focus of our interest. It defines the wage rate of skill group k as a function if the profit tax rate, the firm's factor inputs and a number of other variables like relative bargaining power, i.e. $w_i^{k*} = w_i^{k*}(\tau_i, K_i, L_i^k, L_i^j, \dots)$. Given this, we can define the direct effect as

$$\frac{\partial w_i^{k*}}{\partial \tau_i} = -r \frac{(1 - \beta^j) \beta^k}{(1 - \beta^k \beta^j)} \frac{(1 - \alpha)}{(1 - \tau_i)^2} \frac{K_i}{L_i^k} < 0 \quad (4)$$

We may thus state:

Result 1: Direct effect: For given factor input levels and a given interest rate, an increase in the corporate tax rate reduces the wage rate of all skill groups.

A large part of our empirical analysis focuses on measuring the direct effect of the changes in local profit tax rates on wages. It is an important aspect of our analysis, though, that these effects do not only differ across skill groups but also across firms with different characteristics. One important difference between firms is that wage setting institutions may differ. So far we have assumed that bargaining takes place at the firm level. This is true for some firms in our sample, but in other firms wages are determined at the sector level. Another source of heterogeneity is that some firms operate only in one jurisdiction while others have plants in several jurisdictions. In the latter case, the local tax is determined through formula apportionment. Again, this has implications for the incidence of the tax.

In the following, we extend our theoretical analysis to address these issues.

3.2 Corporate tax incidence with sector level bargaining

So far, we have assumed that bargaining takes place at the firm level. But in many countries including Germany, wage bargaining often takes place at the sectoral level. In this case, if firms in a sector are located in many different municipalities, one would expect that the impact of a change in the local corporate tax in one jurisdiction has a small or possibly a negligible effect on the wage rate. Assume that $m < n$ firms in the economy belong to one sector. We model wage negotiations at the sector level as follows. We assume that wages for each skill group are identical in all firms, and the objective function of the union is given by $\sum_{i=1}^m Z_i^k = \sum_{i=1}^m w^k - \bar{w}_i^k$. The firms pursue the objective to maximize the sum of their profits $\sum_{i=1}^m P_i$. The derivation of the equilibrium wages for the two skill groups is equivalent to the derivation described in the preceding section. The equilibrium wage rate for skill group k is now given by

$$w^{k**} = \frac{1}{(1 - \beta^k \beta^j)} \left[\Xi + \frac{(1 - \beta^j) \beta^k}{\sum_{i=1}^m L_i^k} \left(\sum_{i=1}^n [F(K_i, L_i^1, L_i^2) - \frac{(1 - \alpha \tau_i)}{(1 - \tau_i)} r K_i] \right) \right] \quad k \neq j$$

where

$$\Xi = \bar{w}_i^k (1 - \beta^k) - \bar{w}_i^j (1 - \beta^j) \beta^k \frac{\sum_{i=1}^m L_i^j}{\sum_{i=1}^m L_i^k}$$

The direct effect of an increase in the tax rate of one jurisdiction on the sector wide wage rate is given by

$$\frac{\partial w^{k**}}{\partial \tau_i} = -r \frac{(1 - \beta^j) \beta^k}{(1 - \beta^k \beta^j)} \frac{(1 - \alpha)}{(1 - \tau_i)^2} \frac{K_i}{\sum_{i=1}^n L_i^k} < 0 \quad (5)$$

Comparing (5) to (4) shows that the effect of a change in the local tax rate on the wage rate is smaller in the case of sectoral wage bargaining, the difference being equal to the factor $L_i^k / \sum_{i=1}^m L_i^k$. As one would expect, the effect of a local corporate tax change on wages is smaller if wages are set at the sectoral level. This can be summarized as

Result 2:

The direct effect of a change in the corporate tax rate is smaller under sector level bargaining, compared to firm level bargaining.

3.3 Formula Apportionment

If firms have plants in more than one municipality, the local business tax in German uses formula apportionment to allocate the taxing rights to the different municipalities.

The formula used in Germany is based on payroll as the only apportionment factor.¹⁵ Given this, the impact of tax changes on wages may be different. Consider a company with plants in two jurisdictions i and j . After tax profits of the company are

$$P^{FA} = [F(K_i, K_j, L_i^1, L_i^2, L_j^1, L_j^2) - \sum_{k=1}^2 w^k L_i^k - \sum_{k=1}^2 w^k L_j^k](1 - \tau_{ij}) - (1 - \alpha\tau_{ij})r[K_i + K_j]$$

with obvious notation. We assume that wage bargaining 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 profit tax rate is now given by

$$\tau_{ij} = T + (1 - T) \frac{t_i \sum_{k=1}^2 w^k L_i^k + t_j \sum_{k=1}^2 w^k L_j^k}{\sum_{k=1}^2 w^k L_i^k + \sum_{k=1}^2 w^k L_j^k} \quad (6)$$

The main difference to the case where firms just operate in one jurisdiction is that the profit tax rate itself now depends on wages and the distribution of employment at the two plants, i.e. $\tau_{ij} = \tau_{ij}(w^1, w^2, L_1^1, \dots)$, with:

$$\frac{\partial \tau_{ij}}{\partial w^l} = [t_i - t_j] \left[\frac{L_i^l}{L_i^m} - \frac{L_j^l}{L_j^m} \right] L_i^m L_j^m \frac{(1 - T)}{\gamma} \quad l = 1, 2, l \neq m$$

where

$$\gamma = \left[1 + \frac{w^l L_i^l + w^m L_i^m}{w^l L_j^l + w^m L_j^m} \right]^2 [w^l L_j^l + w^m L_j^m]^2 > 0$$

Assume, for instance, that municipality i has a higher tax rate than munic-

¹⁵ In cases where this leads to an outcome which is obviously inappropriate, the tax rate can be divided differently. But in most cases the payroll based formula is applied.

ipality j , and assume that the wage of the low skilled increases. In this case the impact on the tax burden will depend on whether this increases the payroll share of the high or that of the low tax municipality. If the share of low skilled is higher in jurisdiction i , so that $\left[\frac{L_i^l}{L_i^m} - \frac{L_j^l}{L_j^m}\right] > 0$, the tax rate τ_{ij} will increase, and vice versa. Therefore the effect of a wage change on the tax rate is ambiguous for the general case.

The fact that the firm's profit tax rate is now a function of the wage rates also implies that the direct effect of a change in the local corporate tax rate t on wages as defined in the preceding sections is now ambiguous. The Nash maximand of the union-form bargaining problem is now given by

$$\Omega_i^{kFA} = \beta^k \ln Z_i^k + (1 - \beta^k) \ln P^{FA}$$

The equilibrium wage rates are now given by

$$w^{kFA*} = \bar{w}^k + \frac{\beta^k}{(1 - \beta^k)} \frac{P^{FA}}{[(L_i^k + L_j^k)(1 - \tau_{ij}) - \Phi]} \quad k = 1, 2 \quad (7)$$

where

$$\Phi = \frac{\partial P^{FA}}{\partial \tau_{ij}} \frac{\partial \tau_{ij}}{\partial w^k}$$

Equation (7) implicitly defines the two wage rates emerging from the bargaining process, as reaction functions of the type $w^{lFA*} = w^{lFA*}(w^{mFA*}, t_i, t_j, T...)$. Differentiating (7) shows that the direct effect of a change in the local corporate tax rates on the equilibrium wage rates is, in general, ambiguous.¹⁶ This suggests that the incidence of the local corporate tax on wages in firms with plants in multiple jurisdictions could differ systematically from the incidence in firms which operate in one jurisdiction only. This will be investigated further in our empirical analysis.

4 Data

For our analysis we combine two distinct data sources. First, administrative data on the universe of German municipalities containing information on their fiscal and budgetary situation and, second, detailed administrative linked employer-employee data.

¹⁶ Unambiguous results only emerge if there is only one skill group, as we show in the Appendix. In this case, it is straightforward to show that the effects of a profit tax change in one jurisdiction on wages in that jurisdiction is smaller than it would be in a single plant firm.

4.1 Municipality data

As far as the municipality data is concerned, we make use of statistics provided by the official statistical authorities of the 16 German federal states (*Statistische Landesämter*). The states collect information on all municipalities' fiscal and budgetary situation. We combine and harmonize the annual state specific datasets and construct a panel on the universe of municipalities from 1998 to 2008 covering roughly 125,000 data points – i.e., municipality-years. Most importantly, the dataset contains information on the local collection rate, but also information on the population size and fiscal information on the municipalities' expenses and revenues. Moreover, we added regional unemployment rates on a more aggregated level to control for local labor market conditions.¹⁷

Figure 1 depicts Germany's 11,441 municipalities and visualizes the substantial cross-sectional¹⁸ and time variation in the collection rates. While the left panel of the Figure shows the cross-sectional variation in local tax rates in 2008 with the darker colors showing higher tax rates, the right panel shows how the number of tax changes a municipality experienced over the observation period 1998-2008 with darker colors showing more changes.

We now take a closer look at the within-municipality, time variation of the collection rates, which is later used to identify the tax effect. Table 1 shows that every year, on average 8% of the municipalities change their collection rate – that is about 1,000 municipalities per year. As suggested above, most municipalities increase the collection rate over time and most of the increases in collection rate occurred between 2000 and 2006.

Next, Table 2 shows that the collection rates changes are not concentrated among a few communities but rather widespread. More than half of the communities have changed their tax rates at least once during the observation period. The average (and median) change amounts to 20 points, which corresponds to an increase of the effective statutory tax rate of 0.5% for a corporate firm during that period. When focusing on big tax changes only (defined as changes greater or equal than the median change of 20 points, corresponding to an increase in the effective marginal

¹⁷ The few studies on the German business tax find that these factors affect tax rates; and they could potentially have an effect on average wages as well (Büttner, 1999, 2001, 2003).

¹⁸ In terms of cross-sectional variation Figure 1 in the Appendix additionally shows the variation across states and municipality sizes. States such as North Rhine-Westphalia or Saxony have on average a higher rate, whereas in Hesse or Brandenburg the rates are lower. The figure further shows that, the bigger the municipality, the higher the collection rate on average. The largest variation is in the medium-sized municipalities (small cities with a population of 20,000 to 50,000).

Figure 1: Cross-sectional and time variation in collection rates

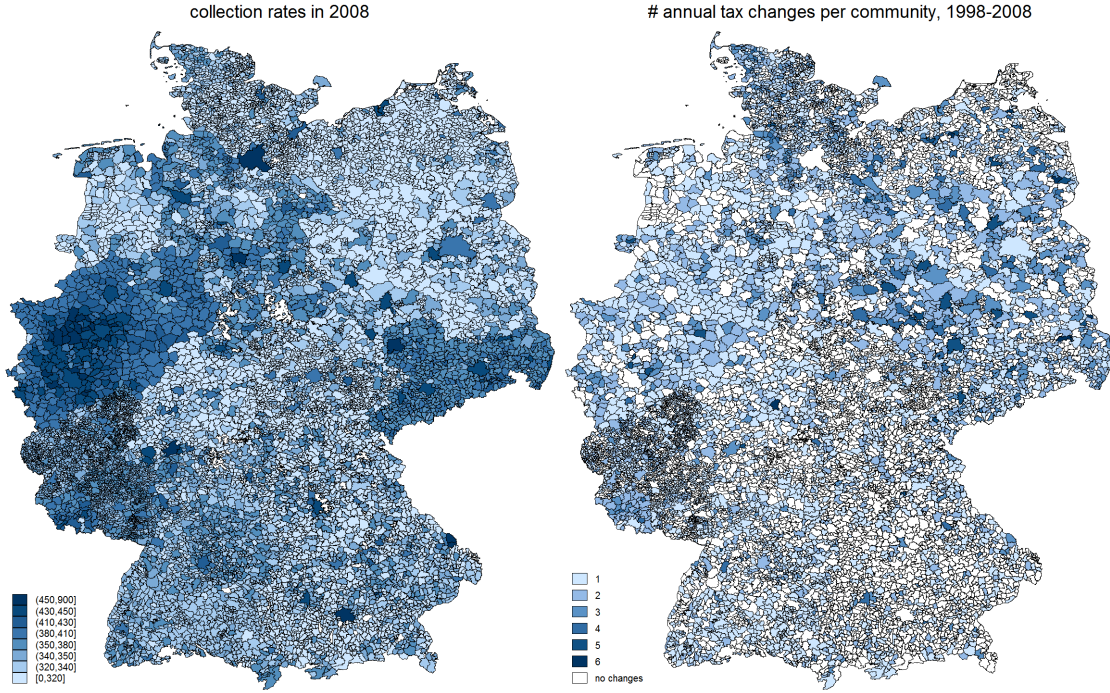


Table 1: Share of communities with changing collection rates (in %)

| | $\Delta\tau \neq 0$ | $\Delta\tau > 0$ | $\Delta\tau < 0$ | N |
|---------|---------------------|------------------|------------------|--------|
| Total | 8.1 | 7.2 | .9 | 114410 |
| by Year | | | | |
| 1999 | 5.4 | 4.3 | 1.1 | 11441 |
| 2000 | 8.4 | 7.4 | 1 | 11441 |
| 2001 | 12.7 | 11.5 | 1.3 | 11441 |
| 2002 | 8.6 | 7.9 | .7 | 11441 |
| 2003 | 9.8 | 9.1 | .8 | 11441 |
| 2004 | 8.8 | 8.2 | .6 | 11441 |
| 2005 | 11 | 10.4 | .7 | 11441 |
| 2006 | 7.8 | 7 | .8 | 11441 |
| 2007 | 4.4 | 3.7 | .8 | 11441 |
| 2008 | 4 | 3.2 | .8 | 11441 |

tax rate of 0.8%), about one third of the communities were affected.

Table 2: Number of tax changes per community, 1998-2008

| # changes | any change | | big change | |
|-----------|------------------|-------|------------------|-------|
| | # municipalities | in % | # municipalities | in % |
| 0 | 4977 | 43.50 | 7575 | 66.21 |
| 1 | 4376 | 38.25 | 3376 | 29.51 |
| 2 | 1552 | 13.57 | 430 | 3.76 |
| 3 | 402 | 3.51 | 57 | 0.50 |
| 4 | 96 | 0.84 | 2 | 0.02 |
| 5 | 32 | 0.28 | 1 | 0.01 |
| 6 | 6 | 0.05 | 0 | 0.00 |

Note: The average change is 21 points (corresponding to an increase of .54% in the effective statutory tax rate). A big change is more than 20 points. The average big change is 31 points (equal to an EMTR increase of .8%).

4.2 Worker and firm data

For workers and firm information we use the linked employer-employee dataset (LIAB) provided by the Institute of Employment Research (IAB) in Nuremberg, Germany (Alda et al., 2005). The employee data are a 2% sample of the administrative employment statistics of the German Federal Employment Agency (*Bundesagentur für Arbeit*), called the German employment register, which covers all employees paying social security contributions or receiving unemployment benefits (Bender et al., 2000). The employee information are recorded annually on June 30th of each year and include information on wages, age, tenure, occupation, employment type (full-time, part-time or irregular employment) and qualification. In terms of qualification we differentiate between three skill groups: high skilled workers have obtained a college/university degree; medium skilled have either completed a vocational training or obtain the highest high school diploma (*Abitur*). Low skilled have neither completed a vocational training nor obtained the (*Abitur*). Individuals with missing information are excluded. Moreover, civil servants are typically not observed in the social security data. Our worker panel consists of between 1.6 and 2.0 million workers annually observed from 1998 to 2008.

Importantly, the wages are right censored at the ceiling for the social security contributions. Although, the ceiling is quite high with €63,400 in 2008 for Western Germany, more than 10% of the observations are censored. In principle, there are two ways to tackle this problem: impute the censored wages or exclude the observations.

In contrast to Bauer et al. (2012) we opt for the latter alternative: we exclude all workers from the baseline sample which have at least once earned a wage above the contribution ceiling during the observation period. There are two reasons for this rather rigorous treatment. First, simply imputing the wages does not suffice since the standard errors of all regression estimates would have to be adjusted as well. Secondly, given that the imputation method cannot replicate the true data generating process, imputing parts of the wages creates an artificial variation in the left-hand side variable, which might lead to biased conclusions. In fact, if business taxes do affect wages, one must control for them in the imputation stage and would create endogeneity per definition. We check the sensitivity of our results with respect to the inclusion of the censored and imputed wages and large differences depending on the treatment of censored wages.

The firm component of the LIAB is the IAB Establishment Panel (Kölling, 2000), which is a stratified random sample of the universe of all German establishments. The term “establishment” refers to the fact that the observation unit is the individual plant, not the firm; there can be several plants per firm.¹⁹ The employer data covers establishments with at least one worker for whom social contributions were paid, in 16 industries and establishments from both the former West and East Germany. The panel dataset contains information on the establishment structure and personnel decisions from 1993 onwards. We extract the following variables: value added, investment, number of employees, export share, industry, total wage bill, legal form, union wage status (industry, firm or no collective agreement in place), wage payments above the union wage, profitability (measured on a five-point scale). Per year we observe roughly 12,000 establishments.

Sample selection and descriptive statistics. Our baseline sample only contains full-time workers in corporate firms in the manufacturing industry liable to the local business tax. We exclude part-time and marginally employed workers to rule out adjustments at different margins (notably hours of work) and solely focus on the wage effect. As stated above, we exclude all workers that have at least once earned a wage above the contribution ceiling during the observation period. As far as firm characteristics are concerned, the choice of focusing on firms that are liable to the LBT is obvious – yet we use non-labile firms for placebo tests below. We narrow the baseline to corporate firms since the effective statutory marginal tax for

¹⁹ As discussed above, the LBT tax base of firms with multiple establishments is divided between municipalities according to formula apportionment based on the wage bill of the individual establishments.

non-corporate firms cannot be directly observed without further assumptions. Nevertheless, we estimate the wage incidence for non-corporate firms as a sensitivity check. Last, we focus on manufacturing firms, which are the backbone of the German economy and make up the largest share of the corporate firm sample (66%). Again, we present effects for other industries as a robustness check.

Table 3 shows descriptive statistics of the linked employer-employee data. The average monthly wage in our sample is 3,147 euros (all money variables are in 2008 euros). Wages are increasing in qualification. The average is 40, the average firm specific tenure 11 years. As far as worker characteristics are concerned, men are clearly over-represented. The share of high-skilled workers is very low due to strict treatment of censored wages. The share in the whole is 14%. At the same time, low-skilled are overrepresented compared to the full sample (20% vs. 14%). The average firm in the sample 266 employees with an annual value added of 30.5 million euros. 45% (9%) of the firms have a sector (firm) level collective bargaining agreement in place, while 24% of the plants are part of a multi-establishment company. The average plant is located in a municipality with 22,000 inhabitants, a regional unemployment rate of 12% and collection rate of 345%.

Table 3: Descriptive statistics, LIAB 1998-2008

| | mean | sd | min | max | N |
|----------------------------------|----------|-----------|-----|----------|---------|
| monthly wage | 3147.34 | 817.76 | 421 | 5510 | 4340416 |
| high-skilled wage | 3730.56 | 867.56 | 441 | 5509 | 152730 |
| medium-skilled wage | 3190.64 | 825.79 | 421 | 5509 | 3296310 |
| low-skilled wage | 2887.26 | 687.52 | 464 | 5510 | 891376 |
| age | 40.47 | 10.03 | 16 | 64 | 4340416 |
| tenure | 11.21 | 8.10 | 0 | 34 | 4340416 |
| share: female | 0.20 | 0.10 | 0 | 1 | 4340416 |
| share: male | 0.80 | 0.40 | 0 | 1 | 4340416 |
| share: high-skilled | 0.04 | 0.02 | 0 | 1 | 4340416 |
| share: medium-skilled | 0.76 | 0.28 | 0 | 1 | 4340416 |
| share: low-skilled | 0.20 | 0.10 | 0 | 1 | 4340416 |
| share: blue collar | 0.83 | 0.37 | 0 | 1 | 4340416 |
| share: white collar | 0.17 | 0.37 | 0 | 1 | 4340416 |
| employees (fulltime) | 266.20 | 1292.51 | 1 | 47695 | 19373 |
| annual value added (in 1000) | 30438.43 | 196276.94 | 5 | 10570000 | 19373 |
| annual investments (in 1000) | 3457.99 | 27710.99 | 0 | 1755000 | 19373 |
| share: sector union contract | 0.45 | 0.50 | 0 | 1 | 19373 |
| share: firm union contract | 0.09 | 0.29 | 0 | 1 | 19373 |
| share: no union contract | 0.46 | 0.50 | 0 | 1 | 19373 |
| share: stand alone plant | 0.76 | 0.43 | 0 | 1 | 19373 |
| share: part of multi-plant firm | 0.24 | 0.42 | 0 | 1 | 19373 |
| collection rate (in %) | 345.35 | 41.49 | 100 | 520 | 8871 |
| population (in 1000) | 22.36 | 79.60 | 0 | 3387 | 8871 |
| local unemp. rate | 0.12 | 0.06 | 0 | 0 | 8871 |
| municipal revenues (in millions) | 50.89 | 212.35 | 4 | 4416 | 8871 |
| municipal expenses (in millions) | 44.79 | 190.31 | 3 | 5971 | 8870 |

Source: LIAB.

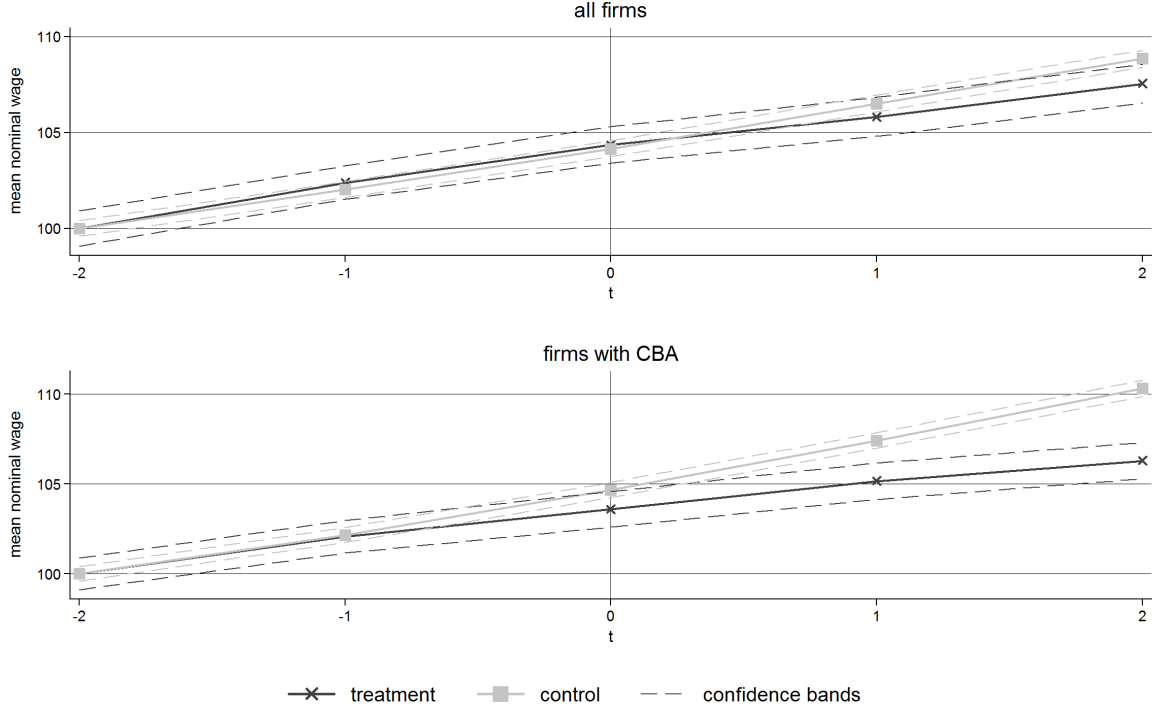
5 Results

In the following section, we estimate the incidence of corporate taxation on wages. We start off by presenting non-parametric evidence using an event study design (Section 5.1) and then present our regression model and baseline results 5.2). In the following subsection, we test our identification strategy, estimate heterogeneous worker and firm effects and check the sensitivity of our findings.

5.1 Event study

As a first check, we provide a non-parametric test whether corporate taxes affect wages using an event study design (similar to the studies by Chetty et al., 2009; Chetty and Saez, 2013; Kleven and Waseem, 2013). We look at differences in the development of average wages between municipalities that have changed the tax rate and municipalities that have not. We assign the municipalities to treatment and control group according to the following criteria: a municipality is *treated* if a tax *increase* occurred in period t and no tax changes happened in periods $t - 2, t - 1, t + 1, t + 2$. Conversely, a municipality is assigned to the *control* group if no tax change occurred from period $t - 2$ to $t + 2$. I thus analyze five-year spells of nominal wage growth around a change in the local business tax. Figure 2 plots the average municipal wage growth paths of treatment and control group around the time of the reform in period t (including bootstrapped confidence intervals). In the upper panel of the figures all firm types are used to calculate average wages. In the lower part only with with the collective bargaining agreement are considered.

Figure 2: Mean change in wages in %



Source: LIAB. Note: Tax reform occurred for treatment group in $t=0$. No other tax changes in any other period, neither for control nor treatment group. Wages are normalized to 100 in pre-reform period $t = -2$.

The figure clearly shows that there is a negative effect of profit taxation on wages, but – in line with the theory – the immediate effect is only present for firms with a collective agreement. Note that in upper and the lower panel of Figure 2 wage growth path are identical until period $t - 1$, that is one period before the tax change for the treatment group occurred. This shows that the common trend assumption, which is indispensable for the event study design, is fulfilled. In t , i.e. the year of the tax change, the growth path of average wages in firms with CBAs becomes flatter for the treatment group, while the path for the control group is not affected. In period $t + 1$ the growth path for the treated lies significantly below the one for the control group.

5.2 Baseline model

In order to assess the effects of the business tax rates on wages, we estimate a Mincerian type of wage equation. As dependent variable, we use the log monthly wage of individual i in firm f , municipality m and year t , $\ln w_{ifm,t}$. The independent variable of interest is municipality m 's collection rate, $\ln \tau_{m,t}$. We further include three sets of control variables on the worker, firm and municipality level. Controls on

the individual worker level are captured by the vector $\mathbf{X}_{i,t}$ and include age and firm (both in quadratic form). On the firm level, we control for the number of employees, output, investment (all in logs), the export share and we also add industry dummies ($\mathbf{Y}_{f,t}$). Municipality controls are denoted by $\mathbf{Z}_{m,t}$ and comprise the population size, the property tax rate, local unemployment rates and state dummies. In addition, we control for a large set of potential confounding wage trends by including skill-year, occupation-year, firm size-year, collective agreement type-year as well as state-year fixed effects (all trends are summarized in vector $\mathbf{T}_{ifm,t}$). Furthermore, we include four kinds of fixed effects: person, firm, municipal and year ($\mu_i, \mu_f, \mu_m, \mu_t$). The baseline model thus reads

$$\ln w_{ifm,t} = \alpha_{t-l} \ln \tau_{m,t-l} + \beta \mathbf{X}'_{i,t} + \gamma \mathbf{Y}'_{f,t} + \lambda \mathbf{Z}'_{m,t} + \mathbf{T}_{i,m,f} + \mu_i + \mu_f + \mu_m + \mu_t + \varepsilon_{ifm,t}. \quad (8)$$

Table 4 presents the set of baseline estimates of model (8). In the first specification we include all firm types – with and without a CBA in place. We find a significant and negative coefficient: An increase of the local collection rate by 1%, leads to a decrease of the average wage in a firm by 0.72%.²⁰ In the second and third specification we estimate our model separately for firms with and without a CBA. Following the theoretical prediction, we only find a significant tax effect for workers in firms with a CBA. We thus exclude firms without a CBA from the baseline sample in all further regressions unless stated differently. Interacting the collection rate with dummies for sector level vs. firm level bargaining reveals that there is hardly any difference between sector and firm level bargaining when it comes to point estimate (model (4)). In specification (5) we narrow the sample to firms that do not pay wages above the rates set in the CBA. The results confirm the intuition that these firms should not have the possibility to directly react to local tax changes by adjusting the wages.

As the estimates from Table 4 are not easy to interpret, we translate the log-log coefficient into two more intuitive measures, a wage elasticity and an incidence measure. While the wage elasticity measures the percent change in wages of a one percent increase of the effective (statutory) tax rate (EMTR), the incidence reports the euro change of the annual wage bill – for given employment levels – as a response to a one euro increase of the annual tax liabilities. We report the two measures for

²⁰ We provide wage elasticities with respect to the effective marginal tax rate and an incidence measure in money terms below.

Table 4: Effects on log wages: baseline results

| Model | (1) | (2) | (3) | (4) | (5) |
|-----------------------------------|---------------------|---------------------|---------------------|---------------------|---------------------|
| Selection | All firms | With CBA | No CBA | With CBA | |
| | | | | by CBA type | binding wages |
| log collection rate | -0.072** (0.035) | -0.086* (0.044) | -0.007 (0.035) | | |
| log collection rate: sector level | | | | -0.086* (0.044) | -0.026 (0.088) |
| log collection rate: firm level | | | | -0.087* (0.052) | -0.021 (0.079) |
| log value added | 0.004*** (0.001) | 0.004*** (0.002) | 0.008*** (0.002) | 0.004*** (0.002) | 0.007*** (0.001) |
| log investment | 0.000 (0.001) | -0.000 (0.001) | 0.004*** (0.001) | -0.000 (0.001) | 0.000 (0.001) |
| log employees | 0.039*** (0.007) | 0.034*** (0.009) | 0.070*** (0.008) | 0.034*** (0.009) | 0.061*** (0.014) |
| log full-time hours | 0.037 (0.034) | 0.038 (0.037) | 0.045 (0.068) | 0.038 (0.037) | 0.110** (0.052) |
| work council | 0.007** (0.003) | 0.006* (0.003) | 0.001 (0.004) | 0.006* (0.003) | 0.003 (0.006) |
| share high-skilled employees | -0.001 (0.050) | -0.002 (0.056) | -0.030 (0.043) | -0.002 (0.056) | -0.193** (0.085) |
| share medium-skilled employees | -0.005 (0.033) | -0.019 (0.045) | -0.003 (0.019) | -0.019 (0.045) | 0.059 (0.060) |
| corporate firm | 0.003 (0.003) | 0.003 (0.004) | 0.001 (0.006) | 0.003 (0.004) | -0.004 (0.011) |
| local unemp. rate | -0.073 (0.120) | -0.054 (0.140) | -0.070 (0.110) | -0.054 (0.141) | -0.469** (0.190) |
| community population | 0.077 (0.051) | 0.102* (0.059) | -0.110 (0.085) | 0.102* (0.059) | 0.104 (0.086) |
| log expenses | -0.010* (0.005) | -0.013** (0.006) | 0.006 (0.006) | -0.013** (0.006) | -0.011 (0.009) |
| log revenues | 0.013** (0.005) | 0.016** (0.006) | 0.006 (0.004) | 0.016** (0.006) | 0.030** (0.014) |
| local property tax rate | -0.050* (0.029) | -0.069** (0.034) | 0.067** (0.028) | -0.069** (0.034) | -0.097* (0.058) |
| Adjusted R^2 | 0.185 | 0.197 | 0.137 | 0.197 | 0.284 |
| Observations | 4266956 | 3714094 | 552862 | 3714094 | 1069198 |
| Groups | 1311169 | 1144983 | 228190 | 1144983 | 428475 |
| Clusters | 410 | 402 | 372 | 402 | 365 |

Note: All specifications include person, firm, municipal and year fixed effects as well as: skill-year, occupation-year, firm size-year, CBA type-year, state-year fixed effects. Standard errors (in parentheses) clustered at district level. Significance levels are 0.1 (*), 0.05 (**), and 0.01 (***).

all five models of Table 4 in Table 5. We find an average wage elasticity of -0.29 (model (1)). Column (4) reveals that despite very similar point estimates and the wage elasticities between firms with sector and with firm level CBAs, there quite a large difference in terms of the euro incidence. As predicted by the theoretical model, we find that the wage incidence is 27% higher (12 cents) in firms where the bargaining takes place at firm level compared to firms with a sector level CBA.

Table 5: Effects on individual wages: baseline results

| Model Selection | (1) All firms | (2) With CBA | (3) No CBA | (4) With CBA by CBA type | (5) binding wages |
|-------------------|------------------|-----------------|---------------|--------------------------------|----------------------|
| wage elasticities | | | | | |
| overall | -0.29** | -0.35* | -0.03 | -0.35* | -0.10 |
| sector CBA | | | | -0.36* | -0.11 |
| firm CBA | | | | -0.33* | -0.08 |
| euro incidence | | | | | |
| overall | -0.40** | -0.48* | -0.03 | -0.48* | -0.14 |
| sector CBA | | | | -0.44* | -0.13 |
| firm CBA | | | | -0.56* | -0.14 |

5.3 Identification

Next, we provide a further identification test by running placebo regressions exploiting the fact that certain firms are not liable to the local business tax. Most firms in the public sector are not liable as well agricultural or mining firms. Moreover, there are special exemption within the manufacturing sector and in other industries. Table 6 presents the result of various placebo test. No matter whether we look at all non-labile firms, only those in the manufacturing sector or/and only those with a collective bargaining agreement, regression results show that the effect of local business tax changes on non-labile firms is zero.

Table 6: Placebo: Tax effects on log wages for non-labile firms

| Model | (1) | (2) | (3) | (4) |
|--------------------------------|----------------------|----------------------|----------------------|----------------------|
| | all non-labile firms | manufacturing only | CBA in place | manuf. and CBA |
| log collection rate | -0.002 (0.035) | 0.040 (0.478) | -0.001 (0.041) | -0.011 (0.277) |
| log value added | 0.004** (0.002) | 0.005 (0.006) | 0.003 (0.002) | 0.016*** (0.006) |
| log investment | 0.002*** (0.001) | 0.004 (0.004) | 0.002** (0.001) | 0.008*** (0.003) |
| log employees | 0.003 (0.007) | -0.043 (0.058) | -0.001 (0.008) | -0.026 (0.089) |
| log full-time hours | 0.083 (0.085) | 0.616*** (0.165) | 0.126 (0.104) | 0.872*** (0.253) |
| work council | 0.003 (0.004) | -0.057*** (0.019) | 0.002 (0.004) | -0.063 (0.059) |
| share high-skilled employees | 0.008 (0.036) | -0.431* (0.247) | 0.058 (0.054) | -0.479* (0.280) |
| share medium-skilled employees | -0.026 (0.021) | -0.160 (0.166) | -0.038 (0.028) | -0.141 (0.176) |
| profitabil. poor | -0.006*** (0.001) | -0.020*** (0.006) | -0.005*** (0.002) | -0.014** (0.006) |
| corporate firm | 0.000 (0.010) | | 0.018 (0.013) | |
| other legal form | -0.019 (0.012) | | 0.000 (0.014) | |
| local unemp. rate | -0.045 (0.141) | -0.318 (0.604) | -0.039 (0.171) | 0.629 (0.663) |
| community population | 0.042 (0.067) | -0.261 (0.293) | 0.036 (0.082) | -0.677*** (0.245) |
| log expenses | -0.004 (0.005) | 0.039 (0.031) | -0.006 (0.006) | 0.040 (0.028) |
| log revenues | -0.006 (0.005) | 0.037 (0.041) | -0.004 (0.006) | -0.076* (0.043) |
| local property tax rate | 0.039 (0.043) | 0.064 (0.084) | 0.053 (0.045) | 0.198*** (0.062) |
| Adjusted R^2 | 0.186 | 0.179 | 0.221 | 0.179 |
| Observations | 1204223 | 75433 | 1002764 | 70513 |
| Groups | 523629 | 47653 | 435960 | 43809 |
| Clusters | 400 | 107 | 386 | 81 |

Note: All specifications include person, firm, municipal and year fixed effects as well as: skill-year, occupation-year, firm size-year, CBA type-year, state-year fixed effects. Standard errors (in parentheses) clustered at district level. Significance levels are 0.1 (*), 0.05 (**), and 0.01 (***).

5.4 Timing and qualification

Next, we test for heterogeneous skill effects. When interacting the log collection rate with skill dummies, shows that the overall effect is driven by the medium-skilled workers (see Table 7). In fact, we neither find a significant negative effect for the high nor for low-skilled workers. Nevertheless, the point estimate for the high-skilled is very similar to the one of the medium-skilled. One of the reasons for the insignificant coefficient for high-skilled workers is the small sample size compared to the medium-skilled. Due to the rigorous choice of dropping all workers that have once had a censored wage during the observation period, we exclude many high-skilled worker and maybe even keep only a negatively selected group of the highly qualified (see below for a sensitivity check). The share of high-skilled workers in the baseline only is 5%, while without the exclusion it would be 15%.

As stated above the collection rate in year t is known between one and three months before January of year t . Wages are measured as of June 30 of year t . So when regressing the collection rate in t on wages in t there is already a lag of 7 to 9 months. Nevertheless, it might be the case that firms are not able adjust wages in that period of time. Moreover, it is possible that there are different adjustment speeds for different skill types. We thus estimate a distributed lag model adding the collection rates in $t - 1$ interacted with the skill dummies in specification (2). It turns out that for high-skilled workers the collection rate in $t - 1$ as a negative and significant effect on their wage.

In Table 8 we present long-run wage elasticities and incidence measures.²¹ Intuitively, elasticities and incidence rise in absolute terms when moving from model (1) to model (2). Moreover, the wage elasticity of the high-skilled becomes significant and is actually more negative than the one for medium-skilled (-0.53 vs. -0.45). The effect on low-skilled workers is much smaller and not significantly distinguishable from zero. This suggests that the wage incidence is increasing in skill: the higher the qualification, the stronger the wage decrease following a tax increase. This pattern makes sense in a wage bargaining context, as it is difficult to drive down the wages of the low-skilled whose wage rates are already close to the implicit minimum wage, which is determined by unemployment benefits and social assistance. A tax increase in the bargaining model decreases the overall rents to be distributed between firm and workers. Worker groups that do not get much of the rents prior to the tax

²¹ The long-run effect is calculated by adding the two coefficients for periods t and $t - 1$ for each skill group and then transforming this long-run estimate into an elasticity and an incidence measure.

Table 7: Effects on log wages: baseline results

| Model | (1) | (2) |
|---|----------------------|----------------------|
| log collection rate _t : high skilled | -0.093 (0.075) | -0.065 (0.060) |
| log collection rate _t : medium skilled | -0.091** (0.043) | -0.089** (0.045) |
| log collection rate _t : low skilled | -0.053 (0.055) | -0.101 (0.072) |
| log collection rate _{t-1} : high skilled | | -0.075* (0.042) |
| log collection rate _{t-1} : medium skilled | | -0.027 (0.031) |
| log collection rate _{t-1} : low skilled | | 0.029 (0.056) |
| log value added | 0.004*** (0.002) | 0.004** (0.002) |
| log investment | -0.000 (0.001) | -0.000 (0.001) |
| log employees | 0.034*** (0.009) | 0.034*** (0.009) |
| log full-time hours | 0.038 (0.037) | 0.035 (0.036) |
| work council | 0.006* (0.003) | 0.006* (0.004) |
| share high-skilled employees | -0.003 (0.056) | -0.001 (0.058) |
| share medium-skilled employees | -0.019 (0.045) | -0.021 (0.048) |
| profitabil. poor | -0.009*** (0.002) | -0.008*** (0.002) |
| corporate firm | 0.003 (0.004) | 0.002 (0.004) |
| local unemp. rate | -0.054 (0.141) | 0.016 (0.150) |
| community population | 0.103* (0.059) | 0.128** (0.064) |
| log expenses | -0.013** (0.006) | -0.013** (0.006) |
| log revenues | 0.016** (0.006) | 0.019*** (0.006) |
| local property tax rate | -0.070** (0.034) | -0.078** (0.035) |
| Adjusted R^2 | 0.197 | 0.178 |
| Observations | 3714094 | 3378032 |
| Groups | 1144983 | 1068602 |
| Clusters | 402 | 402 |

Note: All specifications include person, firm, municipal and year fixed effects as well as: skill-year, occupation-year, firm size-year, CBA type-year, state-year fixed effects. Standard errors (in parentheses) clustered at district level. Significance levels are 0.1 (*), 0.05 (**), and 0.01 (***).

increase cannot lose as much. In terms of the incidence, firms reduce the wage bill of the medium-skilled most, which is, of course, a pure size effect, given that 75% of the workers are medium-skilled.

Table 8: Effects on individual wages: results by skill

| Model | (1) | (2) |
|-------------------|----------|----------|
| Lag lengths | 0 | 1 |
| wage elasticities | | |
| overall | -0.34 | -0.42 |
| high-skilled | -0.37 | -0.53* |
| medium-skilled | -0.37** | -0.45** |
| low-skilled | -0.23 | -0.29 |
| euro incidence | | |
| overall | -0.55 | -0.74 |
| high-skilled | -0.11 | -0.17* |
| medium-skilled | -0.39 ** | -0.51 ** |
| low-skilled | -0.05 | -0.07 |

As stated above we dropped all workers whose wages were at least censored once from 1998 to 2008. In the following we provide a sensitivity test of this choice. While specification (1) of Table 9 shows the baseline results, we relax the rigorous treatment of censored wages slowly when moving to the right. The results show that the treatment of censored wages affects skill groups differently: While the coefficients for the medium- and low-skilled become slightly more negative, the coefficient of the high-skilled rises and eventually even becomes positive. In model (2) we only drop the observation in the year where the wages were actually censored from the sample. In specification (3), we do not drop any observations but use the contribution ceiling as the wage when observations are censored. In the last model, we impute censored wages with a standard procedure provided for the LIAB data, which uses a Tobit model. Based on these insights, we argue that our rigorous approach is cleanest. Nevertheless, we might face a negatively selected group of high-skilled workers. If it is correct that worker groups that have higher rents prior to the tax change, it is likely that the wage elasticity of the high-skilled is even more negative.

Table 9: Effects on log wages: Robustness w.r.t wage censoring

| Model | (1) | (2) | (3) | (4) |
|-------------------------------------|-----------------------|----------------------|----------------------|----------------------|
| Wage treatment | person never censored | not censored in t | censored | imputed |
| log collection rate: high skilled | -0.093 (0.075) | -0.042 (0.076) | 0.023 (0.050) | -0.018 (0.057) |
| log collection rate: medium skilled | -0.091** (0.043) | -0.099** (0.044) | -0.100*** (0.038) | -0.117*** (0.042) |
| log collection rate: low skilled | -0.053 (0.055) | -0.061 (0.055) | -0.063 (0.048) | -0.082 (0.057) |
| log value added | 0.004*** (0.002) | 0.004*** (0.002) | 0.004*** (0.001) | 0.003** (0.002) |
| log investment | -0.000 (0.001) | -0.000 (0.001) | -0.001 (0.001) | -0.000 (0.001) |
| log employees | 0.034*** (0.009) | 0.034*** (0.009) | 0.025*** (0.008) | 0.027*** (0.009) |
| log full-time hours | 0.038 (0.037) | 0.036 (0.038) | 0.035 (0.035) | 0.030 (0.038) |
| work council | 0.006* (0.003) | 0.005* (0.003) | 0.004 (0.003) | 0.004 (0.003) |
| share high-skilled employees | -0.003 (0.056) | 0.007 (0.054) | 0.012 (0.042) | 0.020 (0.047) |
| share medium-skilled employees | -0.019 (0.045) | -0.024 (0.044) | -0.026 (0.038) | -0.038 (0.042) |
| profitabil. poor | -0.009*** (0.002) | -0.009*** (0.002) | -0.008*** (0.002) | -0.008*** (0.002) |
| corporate firm | 0.003 (0.004) | 0.003 (0.004) | 0.003 (0.003) | 0.003 (0.004) |
| local unemp. rate | -0.054 (0.141) | -0.033 (0.141) | -0.068 (0.123) | -0.020 (0.136) |
| community population | 0.103* (0.059) | 0.101* (0.059) | 0.073 (0.051) | 0.118** (0.056) |
| log expenses | -0.013** (0.006) | -0.013** (0.006) | -0.013** (0.006) | -0.015** (0.006) |
| log revenues | 0.016** (0.006) | 0.016** (0.006) | 0.014** (0.006) | 0.019*** (0.006) |
| local property tax rate | -0.070** (0.034) | -0.073** (0.034) | -0.063** (0.029) | -0.074** (0.032) |
| Adjusted R^2 | 0.197 | 0.207 | 0.220 | 0.141 |
| Observations | 3714094 | 4031477 | 4829620 | 4829620 |
| Groups | 1144983 | 1259709 | 1442152 | 1442152 |
| Clusters | 402 | 402 | 402 | 402 |

Note: All specifications include person, firm, municipal and year fixed effects as well as skill-year, occupation-year, firm size-year, CBA type-year, state-year fixed effects. Standard errors (in parentheses) clustered at district level. Significance levels are 0.1 (*), 0.05 (**), and 0.01 (***).

5.5 Worker and firm heterogeneity

Next, we turn to test for other heterogeneous worker effects (see Table 10). As done for qualification we interact the log collection rate with various worker type dummy variables.²² Specification (1) and (2) shows that there are neither significant differences for different levels of firm specific tenure nor for different age groups. Interestingly, we find the effect seems to be higher for women, although the interaction term is not statistically significant (specification (3)). There is no difference in terms of the wage incidence between blue and white-collar workers. Last in model (5), we differentiate between workers who switch firms and workers who stay in the same work during our period of observation. The later group is less mobile and might therefore share an additional burden. In fact, as Table 10 suggests, job stayers bear a much higher share of the corporate tax burden, whereas more mobile workers who change firm do not seem to be affected at all by the burden shifting of firms (the point estimate for job switchers is positive but not statistically significantly so).

²² The baseline effects of the dummy variables are included but not shown in the table.

Table 10: Heterogenous firm effects on log wages (interactions)

| Model Group | (1) firm tenure | (2) age | (3) gender | (4) collar type | (5) mobility |
|--------------------------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
| log collection rate | -0.083* (0.046) | -0.085* (0.045) | -0.129*** (0.049) | -0.083* (0.044) | -0.095** (0.044) |
| log collection rate * medium | -0.006 (0.016) | | | | |
| log collection rate * high | 0.005 (0.022) | | | | |
| log collection rate * medium | | -0.000 (0.009) | | | |
| log collection rate * old | | -0.001 (0.019) | | | |
| log collection rate * male | | | 0.055 (0.047) | | |
| log collection rate * white collar | | | | -0.024 (0.024) | |
| log collection rate * mobile workers | | | | | 0.202*** (0.070) |
| log value added | 0.004*** (0.002) | 0.004*** (0.002) | 0.004*** (0.002) | 0.004*** (0.002) | 0.004*** (0.002) |
| log investment | -0.000 (0.001) | -0.000 (0.001) | -0.000 (0.001) | -0.000 (0.001) | -0.000 (0.001) |
| log employees | 0.034*** (0.009) | 0.034*** (0.009) | 0.034*** (0.009) | 0.034*** (0.009) | 0.034*** (0.009) |
| log full-time hours | 0.038 (0.037) | 0.038 (0.037) | 0.038 (0.037) | 0.038 (0.037) | 0.038 (0.037) |
| work council | 0.006* (0.003) | 0.006* (0.003) | 0.006* (0.003) | 0.006* (0.003) | 0.005* (0.003) |
| share high-skilled employees | -0.004 (0.056) | -0.002 (0.056) | -0.002 (0.056) | -0.002 (0.056) | -0.003 (0.056) |
| share medium-skilled employees | -0.018 (0.045) | -0.019 (0.045) | -0.019 (0.045) | -0.019 (0.045) | -0.019 (0.045) |
| profitabil. poor | -0.009*** (0.002) | -0.009*** (0.002) | -0.009*** (0.002) | -0.009*** (0.002) | -0.009*** (0.002) |
| corporate firm | 0.003 (0.004) | 0.003 (0.004) | 0.003 (0.004) | 0.003 (0.004) | 0.003 (0.004) |
| local unemp. rate | -0.053 (0.140) | -0.054 (0.141) | -0.056 (0.140) | -0.054 (0.140) | -0.052 (0.140) |
| community population | 0.097 (0.059) | 0.102* (0.059) | 0.103* (0.059) | 0.103* (0.059) | 0.101* (0.059) |
| log expenses | -0.013** (0.006) | -0.013** (0.006) | -0.013** (0.006) | -0.013** (0.006) | -0.013** (0.006) |
| log revenues | 0.016** (0.007) | 0.016** (0.006) | 0.016** (0.006) | 0.016** (0.006) | 0.016** (0.006) |
| local property tax rate | -0.069** (0.034) | -0.070** (0.034) | -0.070** (0.034) | -0.069** (0.034) | -0.068** (0.034) |
| Adjusted R^2 | 0.198 | 0.198 | 0.197 | 0.197 | 0.197 |
| Observations | 3714094 | 3714094 | 3714094 | 3714094 | 3714094 |
| Groups | 1144983 | 1144983 | 1144983 | 1144983 | 1144983 |
| Clusters | 402 | 402 | 402 | 402 | 402 |

Note: All specifications include person, firm, municipal and year fixed effects as well as: skill-year, occupation-year, firm size-year, CBA type-year, state-year fixed effects. Standard errors (in parentheses) clustered at district level. Significance levels are 0.1 (*), 0.05 (**), and 0.01 (***).

In terms of heterogeneous firm effects, we start off by splitting the sample into corporate and non-corporate firms. Recall from Section 2 that the business tax treatment of the two legal types is quite different. Moreover, firm characteristics differ strongly, notably in terms of size. We, therefore, split the sample and estimate the baseline model separately for non-corporate and corporate firms. Despite the stark differences, Table 11 shows that the point estimate and therefore wage elasticities are quite similar between corporate and non-corporate firms. Statistical significance for non-corporate firms (p-value of 0.11) is likely to be not achieved due to the relatively small sample size in combination with demanding econometric model. Note that the wage incidence of non-corporate firms is only 30 cents as compared to 53 cents for corporate firms.

Next, we run several interaction models to test for further firm heterogeneity. Table 12 shows the results. In specification (1) we replicate the result shown in Table 11: while neither the effect for non-corporate firms nor the difference between corporate and non-corporate firms is statistically significant, the combined effect for corporate is statistically significant. In model (2) we test whether there are differences between single and multi-establishment firms following the theoretical analysis of Section 3. The interaction term is insignificant suggesting that the wage incidence does not differ between single and multi-establishment firms.

In the third and fourth specification, we check for different size effects. In model (3) we define the dummy variable “locally influential firm”, which is equal to one if the firm’s number of employees is more than one percent of the municipalities population. These type of firms should have it easier to influence the local governments and prevent any unwanted tax increases. If this kind of endogeneity matters we would thus expect zero effects for these influential firms. Reassuringly, we find, however, that wage incidence effect is only significant for these influential firms. In fact, looking at the effects by firm size in specification (4), we find an interesting pattern: there are strong negative effects on wages for very small firms with less than 50 employees and for large firms with more than 500 workers. Medium-sized firms with a workforce of 50-250 do not seem to cut wages after increases of the local business tax.

Specification (5) and (6) show that there are no differences in terms of the firm’s profitability or between firms with and without a work council. Last, we use a survey question of the LIAB asking “whether local taxation was important for the initial location decision of the firm”. We find only significantly negative tax effects for firms for which local taxation mattered.

Table 11: Heterogenous firm effects on log wages

| Model | (1) | (2) |
|--------------------------------|---------------------|----------------------|
| | noncorporate | corporate |
| log collection rate | -0.102 (0.064) | -0.093** (0.045) |
| log value added | 0.007*** (0.002) | 0.004** (0.002) |
| log investment | -0.003* (0.002) | -0.000 (0.001) |
| log employees | 0.049*** (0.010) | 0.032*** (0.009) |
| log full-time hours | 0.064 (0.051) | 0.033 (0.040) |
| work council | 0.009 (0.010) | 0.006** (0.003) |
| share high-skilled employees | -0.076 (0.090) | 0.002 (0.058) |
| share medium-skilled employees | -0.056 (0.035) | -0.020 (0.048) |
| profitabil. poor | -0.004* (0.002) | -0.009*** (0.002) |
| non-durables | 0.123*** (0.022) | |
| local unemp. rate | 0.004 (0.257) | -0.026 (0.145) |
| community population | -0.026 (0.092) | 0.106* (0.062) |
| log expenses | 0.001 (0.008) | -0.013** (0.007) |
| log revenues | 0.009 (0.008) | 0.017** (0.007) |
| local property tax rate | 0.008 (0.038) | -0.079** (0.037) |
| Adjusted R^2 | 0.203 | 0.198 |
| Observations | 201603 | 3512491 |
| Groups | 92557 | 1085873 |
| Clusters | 316 | 395 |
| Elasticity | -0.39 | -0.38 |
| Incidence | -0.30 | -0.53 |

Note: All specifications include person, firm, municipal and year fixed effects as well as: skill-year, occupation-year, firm size-year, CBA type-year, state-year fixed effects. Standard errors (in parentheses) clustered at district level. Significance levels are 0.1 (*), 0.05 (**), and 0.01 (***).

Table 12: Heterogenous firm effects on log wages

| Model | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|--|----------------------|----------------------|----------------------|----------------------|---------------------|----------------------|----------------------|
| Group | legal form | establishment type | rel. firm size | firm size | profitability | work council | tax salience |
| log collection rate | -0.057 (0.051) | -0.109** (0.053) | -0.058 (0.054) | -0.130** (0.062) | -0.091** (0.046) | -0.079* (0.048) | -0.081 (0.073) |
| log collection rate * corporate | -0.032 (0.029) | | | | | | |
| log collection rate * stand alone | | 0.026 (0.029) | | | | | |
| log collection rate * locally influential firm | | | -0.037 (0.037) | | | | |
| log collection rate * 50-250 workers | | | | 0.109** (0.050) | | | |
| log collection rate * 250-1000 workers | | | | 0.027 (0.059) | | | |
| log collection rate * >1000 workers | | | | 0.036 (0.071) | | | |
| log collection rate * poor | | | | | 0.014 (0.014) | | |
| log collection rate * work council | | | | | | -0.007 (0.024) | |
| log collection rate * local tax relevant. | | | | | | | -0.028 (0.087) |
| log value added | 0.004*** (0.002) | 0.004*** (0.002) | 0.004*** (0.002) | 0.004*** (0.002) | 0.004*** (0.002) | 0.004*** (0.002) | 0.004** (0.002) |
| log investment | -0.000 (0.001) | -0.000 (0.001) | -0.000 (0.001) | -0.000 (0.001) | -0.000 (0.001) | -0.000 (0.001) | 0.001 (0.001) |
| log employees | 0.034*** (0.009) | 0.033*** (0.009) | 0.037*** (0.009) | 0.034*** (0.009) | 0.034*** (0.009) | 0.034*** (0.009) | 0.037*** (0.010) |
| log full-time hours | 0.039 (0.037) | 0.040 (0.037) | 0.039 (0.037) | 0.039 (0.037) | 0.041 (0.037) | 0.038 (0.037) | 0.028 (0.037) |
| work council | 0.006* (0.003) | 0.006** (0.003) | 0.006** (0.003) | 0.006* (0.003) | 0.006* (0.003) | 0.016 (0.033) | 0.002 (0.005) |
| share high-skilled employees | -0.002 (0.056) | -0.004 (0.055) | -0.001 (0.056) | -0.001 (0.056) | -0.004 (0.056) | -0.002 (0.056) | 0.044 (0.063) |
| share medium-skilled employees | -0.020 (0.045) | -0.019 (0.045) | -0.020 (0.045) | -0.019 (0.045) | -0.022 (0.045) | -0.019 (0.045) | 0.002 (0.050) |
| profitabil. poor | -0.009*** (0.002) | -0.009*** (0.002) | -0.009*** (0.002) | -0.009*** (0.002) | -0.027 (0.019) | -0.009*** (0.002) | -0.008*** (0.002) |
| corporate firm | 0.045 (0.037) | 0.004 (0.004) | 0.003 (0.004) | 0.003 (0.004) | 0.004 (0.004) | 0.003 (0.004) | 0.006 (0.005) |
| local unemp. rate | -0.051 (0.141) | -0.053 (0.141) | -0.051 (0.140) | -0.054 (0.140) | -0.051 (0.140) | -0.054 (0.141) | -0.160 (0.135) |
| community population | 0.102* (0.059) | 0.110* (0.060) | 0.100* (0.059) | 0.104* (0.059) | 0.102* (0.059) | 0.102* (0.059) | 0.102 (0.064) |
| log expenses | -0.013** (0.006) | -0.012* (0.006) | -0.013** (0.006) | -0.013** (0.006) | -0.014** (0.006) | -0.013** (0.006) | -0.010* (0.006) |
| log revenues | 0.016** (0.006) | 0.017*** (0.006) | 0.016** (0.006) | 0.016** (0.006) | 0.016** (0.006) | 0.016** (0.006) | 0.018** (0.008) |
| local property tax rate | -0.069** (0.034) | -0.063* (0.036) | -0.073** (0.035) | -0.069** (0.034) | -0.071** (0.034) | -0.069** (0.034) | -0.034 (0.032) |
| Adjusted R^2 | 0.197 | 0.198 | 0.197 | 0.197 | 0.197 | 0.197 | 0.211 |
| Observations | 3714094 | 3696836 | 3714094 | 3714094 | 3714094 | 3714094 | 2667926 |
| Groups | 1144983 | 1139646 | 1144983 | 1144983 | 1144983 | 1144983 | 668473 |
| Clusters | 402 | 402 | 402 | 402 | 402 | 402 | 381 |

Note: All specifications include person, firm, municipal and year fixed effects as well as: skill-year, occupation-year, firm size-year, CBA type-year, state-year fixed effects. Standard errors (in parentheses) clustered at district level. Significance levels are 0.1 (*), 0.05 (**), and 0.01 (***).

5.6 Sensitivity

Table 1 in the Appendix shows that results are similar when using the collection rate in levels instead of logs. Moreover, Table 2 in the Appendix shows that omitting person fixed effects renders the tax effect coefficient insignificant. The importance of the (person) fixed effects estimation is also demonstrated by Table 3 in the Appendix, which shows that estimating the model with Ordinary Least Squares even yields a significantly positive coefficient of the local tax variable.

6 Conclusions

How much of the corporate tax burden is borne by workers? While this question has been heavily discussed in economics ever since Harberger (1962)’s seminal work, compelling empirical evidence is scarce due to tough requirements that have to be fulfilled in order to identify the true wage effect. In this paper, we use the German corporate tax legislation that provides a nearly ideal laboratory to answer this question. In Germany, the 11,100 municipalities which can change corporate tax rates annually, and on average 8% do so each year. We link administrative information on the universe of the German municipalities from 1998 to 2008 to high-quality administrative linked employer-employee data to estimate the effect of corporate taxation on individual wages as recorded in the social security accounts. Moreover, the local corporate tax legislation allows us to treat the German municipalities as many small open economies and thereby gauge the full incidence of corporate taxation on wages, including the often neglected general equilibrium effects.

We find that a 1% increase in the effective marginal corporate tax rate leads to a 0.3% decrease in the wages. This implies that for every additional tax euro a firm has to pay, the wage bill is decreased by 50 cents. In line with our theoretical model, we find that this direct effect, which arises in a wage bargaining context, is only found in firms with a collective bargaining agreement in place. We also find that the negative direct wage incidence is increasing in skill. High-skilled workers who are likely to extract the highest rents in a wage bargaining context, experience the highest relative wage decreases if corporate taxes rise. Moreover, we are able to show that the indirect effect, that is the general equilibrium effect on wages, is negligible in the context of the German business. In line with Siegloch (2013) we provide evidence that this effect is probably due to higher mobility of labor (relative to capital) within local labor markets.

References

- Alda, H., S. Bender, and H. Gartner (2005). European Data Watch: The Linked Employer-Employee Dataset Created from the IAB Establishment Panel and the Process-Produced data of the IAB (LIAB). *Schmollers Jahrbuch: Journal of Applied Social Science Studies* 125(2), 327–336.
- Arulampalam, W., M. P. Devereux, and G. Maffini (2012). The Direct Incidence of Corporate Income Tax on Wages. *European Economic Review* 56(6), 1038–1054.
- Auerbach, A. J. (2005). Who Bears the Corporate Tax? A Review of What We Know. NBER Working Paper No. 11686.
- Barth, E. and J. Zweimüller (1995). Relative Wages under Decentralized and Corporatist Bargaining Systems. *Scandinavian Journal of Economics* 97(3), 369–384.
- Bauer, T. K., T. Kasten, and L. Siemers (2012). Business taxation and wages: Evidence from individual panel data. IZA Discussion Paper No. 6717.
- Bender, S., A. Haas, and C. Klose (2000). The IAB Employment Subsample 1975–1995. *Schmollers Jahrbuch: Journal of Applied Social Science Studies* 120(4), 649–662.
- Bradford, D. F. (1978). Factor prices may be constant but factor returns are not. *Economics Letters* 1(3), 199–203.
- Büttner, T. (1999). Determinants of Tax Rates in Local Capital Income Taxation: A Theoretical Model and Evidence from Germany. CESifo Working Paper No. 194.
- Büttner, T. (2001). Local Business Taxation and Competition for Capital: The Choice of the Tax Rate. CESifo Working Paper No. 440.
- Büttner, T. (2003). Tax Base Effects and Fiscal Externalities of Local Capital Taxation: Evidence from a Panel of German Jurisdictions. *Journal of Urban Economics* 54(1), 110–128.
- Chetty, R., J. N. Friedman, T. Olsen, and L. Pistaferri (2009). Adjustment Costs, Firm Responses, and Micro vs. Macro Labor Supply Elasticities: Evidence from Danish Tax Records. *The Quarterly Journal of Economics* 126(2), 749–804.

- Chetty, R. and E. Saez (2013). Teaching the Tax Code: Earnings Responses to an Experiment with EITC Recipients. *American Economic Journal: Applied Economics* 5(1), 1–31.
- Desai, M. A., C. F. Foley, and J. R. Hines (2007). Labor and Capital Shares of the Corporate Tax Burden: International Evidence. mimeo, presented at the International Tax Policy Forum and Urban-Brookings Tax Policy Center conference on Who Pays the Corporate Tax in an Open Economy?, 18 December, 2007.
- Diamond, P. A. and J. Mirrlees (1971). Optimal Taxation and Public Production. *American Economic Review* 61, 8–27 and 261–278.
- Dwenger, N., P. Rattenhuber, and V. Steiner (2011). Sharing the burden: Empirical evidence of corporate tax incidence. mimeo.
- Ellguth, P., H.-D. Gerner, and J. Stegmaier (2012). Wage Bargaining in Germany – the Role of Works Councils and Opening Clauses. IAB Discussion Paper 05/2012.
- Felix, R. A. (2007). Passing the Burden: Corporate Tax Incidence in Open Economies. Federal Reserve Bank of Kansas City Regional Research Working Paper 07-01.
- Felix, R. A. and J. R. Hines Jr. (2009). Corporate Taxes and Union Wages in the United States. NBER Working Paper No. 15263.
- Fuest, C., A. Peichl, and S. Siegloch (2011). Do Employees Bear the Burden of Corporate Taxation? A Micro Level Approach Using Linked Employer-Employee Data. Presented at the 67th Annual Congress of the International Institute of Public Finance in Ann Arbor.
- Gravelle, J. C. (2010). Corporate Tax Incidence: Review of General Equilibrium Estimates and Analysis. Congressional Budget Office Working Paper No. 2010-03.
- Harberger, A. C. (1962). The incidence of the corporation income tax. *Journal of Political Economy* 70, 215–240.
- Harberger, A. 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*, pp. 51–73. Washington: ACCF Center for Policy Research.

- Harberger, A. C. (2006). Corporate Tax Incidence: Reflections on What Is Known, Unknown and Unknowable. In J. W. Diamond and G. R. Zodrow (Eds.), *Fundamental Tax Reforms: Issues, Choices, and Implications*, pp. 283–308. Cambridge, MA: MIT Press.
- Hassett, K. A. and A. Mahur (2006). Taxes and Wages. AEI Working Paper No. 128.
- Kleven, H. and M. Waseem (2013). Using Notches to Uncover Optimization Frictions and Structural Elasticities: Theory and Evidence from Pakistan. *The Quarterly Journal of Economics* forthcoming.
- Kölling, A. (2000). The IAB-Establishment Panel. *Schmollers Jahrbuch: Journal of Applied Social Science Studies* 120(2), 291–300.
- Kotlikoff, L. J. and L. H. Summers (1987). Tax Incidence. In A. J. Auerbach and M. Feldstein (Eds.), *Handbook of Public Economics*, Volume 2, pp. 1043–1092. Amsterdam: Elsevier.
- Liu, L. and R. Altshuler (2011). Measuring the burden of the corporate income tax under imperfect competition. mimeo.
- Oswald, A. J. (1993). Efficient contracts are on the labour demand curve: Theory and facts. *Labour Economics* 1(1), 85–113.
- Ratti, Ronald A. & Shome, P. (1977). On a General Equilibrium Model of the Incidence of the Corporation Tax under Uncertainty. *Journal of Public Economics* 8(2), 233–238.
- Shoven, J. B. (1976). The Incidence and Efficiency Effects of Taxes on Income from Capital. *Journal of Political Economy* 84(6), 1261–1283.
- Siegloch, S. (2013). Employment Effects of Corporate Taxation. IZA Discussion Paper.

A Appendix

In this appendix we discuss some additional aspects of profit tax incidence on wages implied by the wage bargaining model developed in section 2. Firstly, consider the indirect effects of tax changes on wages, which are defined as the effects due to the adjustment of input factors. Here, equation (3) implies

$$\begin{aligned}\frac{\partial w_i^{k**}}{\partial K_i} &= 0; \\ \frac{\partial w_i^{k**}}{\partial L_i^k} &= -\frac{(1-\beta^k)}{(1-\beta^k\beta^j)} \frac{w_i^{k**}}{L_i^k} < 0 \\ \frac{\partial w_i^{k**}}{\partial L_i^{j \neq k}} &= \frac{(1-\beta^j)\beta^k}{L_i^k(1-\beta^k\beta^j)} w_i^j > 0\end{aligned}$$

A marginal change in investment does not affect the wage rates because investment is always at its profit maximizing level, so that a change in investment does not affect the rent available for bargaining. An increase in the quantity of labor of skill type k leads to lower wages because profit per worker declines. If the labor input of other skill groups increases, w_i^{k*} increases. This happens because the workers of the skill group that expands its supply of workers only capture part of the additional surplus generated.

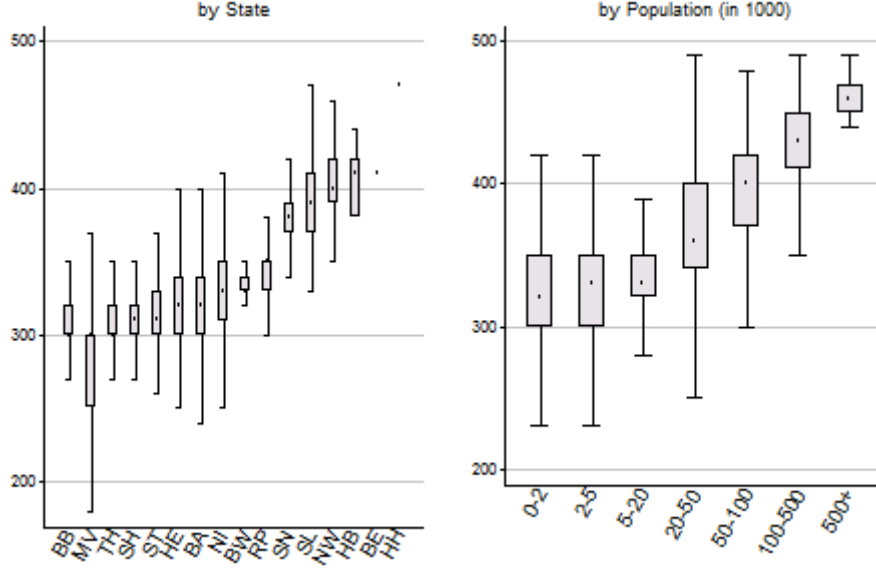
Next to this it is interesting to consider the factors determining the magnitude of the direct effect. Firstly, high bargaining power is self-defeating when it comes to the shifting of corporate tax:

$$\begin{aligned}\frac{\partial w_i^{k**}}{\partial \tau_i \partial \beta^k} &= -r \frac{(1-\beta^j)}{(1-\beta^k\beta^j)^2} \frac{(1-\alpha)}{(1-\tau_i)^2} \frac{K_i}{L_i^k} < 0, \\ \frac{\partial w_i^{k**}}{\partial \tau_i \partial \beta^j} &= r \frac{(1-\beta^k)\beta^k}{(1-\beta^k\beta^j)^2} \frac{(1-\alpha)}{(1-\tau_i)^2} \frac{K_i}{L_i^k} > 0\end{aligned}$$

The reason is the following: a skill group with high relative bargaining power captures a large part of the rent created by the company. If higher corporate taxes diminish this rent, those who get the largest share suffer most. Secondly and unsurprisingly, we find that the direct effect is increasing in the size of the skill group and decreasing in the size of the capital stock:

$$\begin{aligned}\frac{\partial w_i^{k**}}{\partial \tau_i \partial L_i^k} &= r \frac{(1-\beta^j)\beta^k}{(1-\beta^k\beta^j)} \frac{(1-\alpha)}{(1-\tau_i)^2} \frac{K_i}{(L_i^k)^2} > 0 \\ \frac{\partial w_i^{k**}}{\partial \tau_i \partial K_i} &= -r \frac{(1-\beta^j)\beta^k}{(1-\beta^k\beta^j)} \frac{(1-\alpha)}{(1-\tau_i)^2} \frac{1}{L_i^k} < 0\end{aligned}$$

Figure 1: Cross-Sectional variation in collection rates



Finally, note that the effect of a change in the interest rate is

$$\frac{\partial w_i^{k**}}{\partial r} = -r \frac{(1 - \beta^j) \beta^k (1 - \alpha \tau_i)}{(1 - \beta^k \beta^j) (1 - \tau_i)} \frac{K_i}{L_i^k} < 0$$

An increase in the interest rate also reduces the wage rate. The interest rate effect could be relevant in the case of a change in the national corporate income tax T because a nationwide tax change could have significant general equilibrium effects including a change in the interest rate. Our analysis focuses on changes in local tax rates, where these effects can be neglected.

Table 1: Robustness: effects on wages in levels

| Model | (1) |
|--------------------------------|----------------------|
| collection rate | -0.026** (0.013) |
| log value added | 0.004*** (0.002) |
| log investment | -0.000 (0.001) |
| log employees | 0.034*** (0.009) |
| log full-time hours | 0.038 (0.037) |
| work council | 0.006* (0.003) |
| share high-skilled employees | -0.003 (0.056) |
| share medium-skilled employees | -0.019 (0.045) |
| profitabil. poor | -0.009*** (0.002) |
| corporate firm | 0.003 (0.004) |
| local unemp. rate | -0.055 (0.140) |
| community population | 0.101* (0.059) |
| log expenses | -0.013** (0.006) |
| log revenues | 0.016** (0.006) |
| local property tax rate | -0.066* (0.034) |
| Adjusted R^2 | 0.197 |
| Observations | 3714094 |
| Groups | 1144983 |
| Clusters | 402 |
| Elasticity | -0.42 |
| Incidence | -0.57 |

Note: All specifications include person, firm, municipal and year fixed effects as well as: skill-year, occupation-year, firm size-year, CBA type-year, state-year fixed effects. Standard errors (in parentheses) clustered at district level. Significance levels are 0.1 (*), 0.05 (**), and 0.01 (***).

Table 2: Robustness: Effects on log wages - different fixed effects

| Model | (1) | (2) | (3) |
|--------------------------------|----------------------|----------------------|----------------------|
| Fixed Effects | Worker | Firm | Municipal |
| log collection rate | -0.089** (0.045) | -0.052 (0.049) | 0.014 (0.066) |
| log value added | 0.004*** (0.002) | 0.005*** (0.002) | 0.013*** (0.003) |
| log investment | -0.000 (0.001) | -0.001 (0.001) | 0.004** (0.001) |
| log employees | 0.033*** (0.009) | 0.022** (0.008) | -0.001 (0.007) |
| log full-time hours | 0.042 (0.037) | 0.027 (0.042) | -0.256*** (0.069) |
| work council | 0.006* (0.003) | 0.003 (0.004) | 0.100*** (0.012) |
| share high-skilled employees | -0.003 (0.057) | 0.036 (0.053) | 0.087* (0.047) |
| share medium-skilled employees | -0.021 (0.046) | -0.034 (0.039) | 0.078** (0.037) |
| profitabil. poor | -0.009*** (0.002) | -0.009*** (0.002) | -0.011*** (0.003) |
| corporate firm | 0.003 (0.004) | 0.001 (0.005) | 0.026*** (0.008) |
| local unemp. rate | -0.045 (0.143) | -0.082 (0.139) | -0.297* (0.178) |
| community population | 0.098* (0.059) | 0.090 (0.063) | -0.003 (0.087) |
| log expenses | -0.011* (0.006) | -0.010 (0.007) | -0.005 (0.007) |
| log revenues | 0.016** (0.007) | 0.018*** (0.007) | 0.016** (0.008) |
| local property tax rate | -0.070** (0.035) | -0.042 (0.039) | -0.069 (0.044) |
| Adjusted R^2 | 0.199 | 0.214 | 0.243 |
| Observations | 3492251 | 3492251 | 3492251 |
| Groups | 1035507 | 3645 | 1708 |
| Clusters | 402 | 402 | 402 |
| Elasticity | -0.36 | -0.21 | 0.06 |
| Incidence | -0.49 | -0.29 | 0.08 |

Note: Dependent variable: log monthly wage. All specifications include year fixed effects as well as year-industry fixed effects. Clustered standard errors in parentheses. Significance levels are 0.1 (*), 0.05 (**), and 0.01(***).

Table 3: Robustness: Effects on log wages - by estimator

| Model | (1) | (2) | (3) |
|--------------------------------|----------------------|----------------------|----------------------|
| Estimator | OLS | RE | FE |
| log collection rate | 0.090* (0.052) | 0.018 (0.036) | -0.086* (0.044) |
| log value added | 0.024*** (0.004) | 0.007*** (0.002) | 0.004*** (0.002) |
| log investment | 0.009*** (0.002) | 0.001 (0.001) | -0.000 (0.001) |
| log employees | -0.007 (0.005) | 0.020*** (0.003) | 0.034*** (0.009) |
| log full-time hours | -0.262*** (0.064) | -0.037 (0.035) | 0.038 (0.037) |
| work council | 0.113*** (0.011) | 0.051*** (0.009) | 0.006* (0.003) |
| share high-skilled employees | 0.223*** (0.039) | 0.228*** (0.034) | -0.002 (0.056) |
| share medium-skilled employees | 0.069*** (0.024) | 0.074*** (0.023) | -0.019 (0.045) |
| profitabil. poor | -0.011** (0.005) | -0.010*** (0.002) | -0.009*** (0.002) |
| corporate firm | 0.031*** (0.008) | 0.012*** (0.004) | 0.003 (0.004) |
| local unemp. rate | -0.384** (0.159) | -0.106 (0.108) | -0.054 (0.140) |
| community population | 0.009** (0.004) | 0.017*** (0.003) | 0.102* (0.059) |
| log expenses | 0.012 (0.013) | -0.007 (0.005) | -0.013** (0.006) |
| log revenues | 0.018 (0.015) | 0.021*** (0.006) | 0.016** (0.006) |
| local property tax rate | -0.019 (0.032) | -0.047* (0.025) | -0.069** (0.034) |
| Adjusted R^2 | 0.482 | . | 0.197 |
| Observations | 3714094 | 3714094 | 3714094 |
| Groups | . | 1144983 | 1144983 |
| Clusters | 402 | 402 | 402 |
| Elasticity | 0.37 | 0.08 | -0.35 |
| Incidence | 0.50 | 0.10 | -0.48 |

Note: Dependent variable: log monthly wage. All specifications include year fixed effects as well as year-industry fixed effects. Clustered standard errors in parentheses. Significance levels are 0.1 (*), 0.05 (**), and 0.01 (***).