Taxation of Multinational Corporations and Union Wage Bargaining*

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Abstract: We investigate a symmetric model with multinational enterprises (MNEs) and union wage bargaining. Distinguishing between taxation based on separate accounting (SA) and formula apportionment (FA), we find that corporate tax rates have a positive impact on the wage level under SA, while under FA a negative effect prevails. The main insight emerging from a tax competition analysis is the derivation of ambiguous fiscal externalities established by the endogenous wage level under SA. In contrast, under FA we find a wage income externality which is unambiguously positive. In an empirical part, we investigate the effect of corporate taxation on the wage level under FA. Using US state data from 1995-2004 we find that a 10% increase in the local corporate tax rate induces a 5% drop in local workers' wages. With respect to fiscal externalities we find that a 10% rise in the average tax rate of neighboring states increases local workers' wages on average by 7%.

JEL classification: H7, H73

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1 Introduction

With increasing economic integration the importance of multinational enterprises has profoundly grown in the last decades. In the OECD, nearly 75 percent of all traded goods arrive their destination through intra-firm channels. This new situation imposes challenges to corporate taxation. Several empirical studies have shown that MNEs engage in substantial profit shifting activities between their affiliates in order to reduce the overall tax burden (e.g. Clausing, 2003). Currently a separate accounting (SA) system for the taxation of multinational corporations is employed at the international level according to which profits are taxed in the country where they accrue. This legislation gives rise to the described profit shifting activities and justifies a race-to-the bottom in corporate tax rates. At the national level, an alternative taxation system is employed in the US, Canada and Germany, which is based on profit consolidation and apportionment by a factor formula measuring the affiliates' relative activity. Due to the profit consolidation the formula apportionment (FA) system abolishes shifting incentives and therefore has gained increasing attention from policy makers and researchers in the last few years.

Nevertheless, the discussion about the appropriate corporate tax system has abstracted from labor market imperfections so far, although labor markets in many OECD countries are characterized by wage rigidities and union wage bargaining. Our paper investigates the wage bargaining process in an open economy with multinational corporations in a symmetric setting. A main focus lies on the derivation of fiscal externalities in the described setting.

Our paper compares the effects of corporate taxation on labor market outcomes under SA and FA. In the theoretical part of the work, we develop a model with two symmetric countries. Each country hosts one affiliate of a representative multinational enterprise. The MNE produces a homogenous good using labor as input factor. Under FA, consolidated profits are assumed to be allocated based on the relative payroll share. The MNEs are supposed to maximize their overall after-tax profits.

We model a three stage game in which labor demand, wage rates, transfer prices and tax rates are endogenously determined. The structure of the game is as follows: On the first stage, the goverments of country 1 and country 2 simultaneously choose their corporate tax rates ignoring the effect of their decisions on the tax base of the

other country. On the second stage, the representative MNE and local unions bargain over the wage level in a standard right-to-manage setting. Finally on the third stage, the MNE decides about the labor demand and sets the intra-firm transfer price for the good traded.

One insight emerging from the third stage is that under SA the labor demand does not depend on corporate tax rates, while under FA, a negative correlation between a country's corporate tax rate and its affiliate's labor demand may be established. As the tax base is allocated by the relative payroll share, the MNE has an incentive to employ an overproportional number of workers at the low tax location, as this increases its tax base in the low tax country and therefore reduces the MNE's overall tax payment.

On the second stage we analyse a wage bargaining process applying a standard right-to-manage model. Under SA the corporate tax rate exerts a positive effect on local wages, because profit sensitivity to wage changes is reduced in absolute terms by a rise of the corporate tax rate. The intuition is that payroll cost are assumed to be deductible from the corporate tax base and therefore a rise in the wage level translates in a rise in payroll cost which reduces the corporate tax base. The tax base reduction induces a decline of the MNE's tax burden which is the higher the higher the corporate tax rate. Therefore an increase in the corporate tax rate tends to increase the bargained wage level. This profit sensitivity effect is shown to exceed the adverse effect of corporate taxation on the MNE's profits, which tends to reduce the bargained wages. In contrast, the effect of a corporate tax increase on the foreign wage rate is shown to be negative, as changes in the local corporate tax rate do not alter the profit sensitivitiy with respect to *foreign* wage rate. Therefore, in the foreign country a lower wage rate is bargained due to the reduction in the overall profit level. Under FA, we cannot derive a clear-cut effect of the corporate tax rate on the bargained wages due to complex second order effects. Nevertheless, assuming a symmetric equilibrium in the tax competition game, we can show that the corporate tax rate exerts a negative (positive) influence on local (foreign) wages. To be completed...

On the first stage of our analysis we consider a tax competition game, in which each country maximizes its social welfare function containing tax revenues as well as residents' wage and profit income. Under SA we obtain the well-known positive profit shifting externality, as governments have an incentive to reduce their corporate tax

rates, thereby attracting profit from abroad and improving the national tax base. The negative effect on the tax bases of other countries is ignored implying that the governments engage in a race-to-the-bottom with inefficiently low tax rates on corporate income (e.g. Mintz, 1999). In addition, we derive an ambiguous wage externality, which might work in the opposite direction. A rise in the local corporate tax rate reduces the workers' wages in the foreign country. The reduction in wages reduces payroll cost and increases the foreign affiliate's profit and thereby the foreign corporate tax base. On the other hand a reduction in wages induces a reduction in wage income which translates in a reduced utility levels. Last, our model contains the established profit income externality stating that an increase in the corporate tax rate reduces profits and imposes a negative externality on foreign residents to the degree to which they own the MNE.

The transition from SA to FA removes the profit shifting externality but at the same time introduces two other distortions. First, a rise in the tax rate of one FA country induces the MNE to shift labor demand to the other country since it might thereby lower its weighted average tax rate. Moreover a rise in the corporate tax rate is shown to increase the bargained wage level in the foreign country and to lower the bargained wage level in the home country. Both effects raise wage income in the foreign country, while lowering wage income in the home country. As we assume the consolidated tax base under FA to be apportioned according to the relative payroll share, this implies a higher share to be apportioned to the foreign country thereby imposing a positive ecteratliy which may be called formula externality. Second, a rise in the corporate tax rate biases labor demand towards the foreign country and tends to increase the foreign wage level. This directly rises wage income in the foreign country and therefore establishes a positive wage income externality. Both effects motivate a race-to-the bottom in corporate tax rates under FA. Third, for obvious reasons the negative profit income externality carries over to FA systems.

The empirical part of our analysis contains a test of the causal effect of corporate taxation on workers' wage levels under FA. We use US state data for the years 1995-2004 provided by the US Bureau of Labor Statistics. US states are fiscal jurisdictions and autonomously set corporate tax rates. FA is applied to determine the state corporate tax base. Our data set contains average monthly wages distinguishing between US

states, industries and firm size. We estimate the effect of the local corporate tax rate on the local average wage level and find that in line with our theoretical predictions a 10 percent rise in the corporate tax rate reduces the wage level by 5 percent. With respect to fiscal externalities we find that a 10 percent rise in the corporate tax rate of neighboring states increases the local wages by 7 percent.

The economic literature provides several studies investigating the effects of FA under a short run perspective, for example, McLure (1980), Weiner (1994), Mintz (1999) and Gordon and Wilson (1986). Nevertheless none of these papers is especially concerned about labor market effects, their investigations are rather centered around MNEs' capital investment and labor demand decisions. Our theoretical model modifies the literature with respect to two assumptions. First, we assume wages to be flexible and endogenously determined in a bargaining process between employees (unions) and corporations. Second, in an extension to our model we will suppose labor not to be a homogenous, but a heterogenous production factor, i.e. we differentiate between high skilled and low skilled labor. Under FA, this directly leads to the above described higher labor demand sensitivity with respect to corporate tax rates for high skilled workers. In addition, we test the theoretical FA results on macro data for US states and micro data from the German SOEP. The empirical analysis confirms the theoretically derived hypotheses. Therefore to our best knowledge the paper is the first to provide evidence on the impact of corporate tax rates on workers' remuneration under FA. A negative effect of the payroll factor on labor demand was tested by Goolsbee and Maydew (2000). Moreover, the economic literature provides several articles which consider (long-run) tax competition under FA and SA, for example Gordon and Wilson (1986), Pethig and Wagener (2003), Eggert and Schjelderup (2003), Kind et al. (2005) and Riedel and Runkel (2005). While these studies in line with our analysis derive a positive 'formula externality' under FA, they do not specifically regard effects of corporate taxation on the other country's personal income tax base. Moreover to our best knowledge the paper is the first to derive ambiguous fiscal externalities under SA, which may lead to governments setting inefficiently high or inefficiently low corporate tax rates. Therefore the paper contributes to the debate on why corporate tax rates of OECD countries have not fallen to zero given proceeding economic integration in the last decades.

The remainder of the paper is structured as follows: in section 2 we develop the

theoretical model. In section 3 and 4 we analyse our theoretical model for taxation systems based on SA and FA respectively. The results of our empirical estimations are presented in section 5. Sections 6 discusses policy implications and concludes.

2 Theoretical Model

We consider a simple model with two symmetric countries i, labeled 1 and 2, which have the same size, production technology and labor supply. Each country hosts one affiliate of a representative MNE jointly owned by a citizen of a third country. Subscripts denote the country of location. The MNE produces a good using homogenous labor L_i. Workers' remuneration in country i is symbolized by w_i. In section (8) we will relax the homogeneity assumption and investigate the model for workers with heterogenous skill levels. Local labor supply is assumed to be fixed as workers are immobile between the two countries.

The MNE earns an overall profit

$$\Pi = \sum_i \widetilde{\Pi_i} - \sum_i T_i - \theta(p-1) \tag{1}$$

with $\widetilde{\Pi_i}$ and T_i describing pre-tax profits and tax payments in country i. Formally the affiliates' pre-tax profits calculate

$$\widetilde{\Pi_i} = F(L_i) - w_i L_i + (p-1) \tag{2}$$

$$\widetilde{\Pi_j} = F(L_i) - w_i L_i - p + 1 \tag{3}$$

The MNE's output is given by the production function $F(L_i)$ which is identical across countries and has the usual properties $F'(L_i) > 0$ and $F''(L_i) < 0$. The MNE's workers at location i receive a remuneration $w_i L_i$. Moreover we assume the affiliate in country i to deliver one good or service to the affiliate in country j, which is assumed to increase affiliate j's profits by 1 for simplicity reasons. The true price of the good is set to 1 for simplicity reasons. One might therefore think of an internally traded good sold to the affiliate in country j at transfer price p and then to be resold at the market at the true price 1. As the true price is not observable to tax authorities, the

MNE might attach a transfer price which deviates from the true price to shift profits between its affiliates. To derive an inner solution we assume transfer pricing to incur convex concealment cost with the following properties

$$\begin{aligned} &\theta\,(p=1)=0 \\ &sign(\theta')=sign\,(p-1) \\ &\theta''\,(p-1)>0 \end{aligned} \tag{4}$$

Note that the concealment cost are not deductible from the corporate tax base. This corresponds to a perception of these cost as penalty fees, which an MNE has to pay, if the tax authority detects profit shifting activities. In contrast if the MNE spends effort to refrain the tax authority from observing its profit shifting acitivities, it might declare these expenditure (e.g. lawyer fees) as administration cost and may deduct them from the corporate tax base. There is no unique modelling in the economic literature with respect to that issue, for a discussion of the approaches see Haufler and Schjelderup (2000). Nevertheless our results would not qualitatively change if we assumed concealment cost to be tax deductible.

In the theoretical part of our paper, we investigate a three stage game in which labor demand, wage rates, transfer prices and tax rates are endogenously determined. The structure of the game is as follows: On the first stage, the goverments of country 1 and country 2 simultaneously choose their corporate tax rates ignoring the effect of their decisions on the tax base of the other country. On the second stage, the representative MNE and the local unions (which are assumed to be organized at affiliate level) bargain over the wage level in a standard right-to-manage setting. Finally on the third stage, the MNE decides about the labor demand and sets the intra-firm transfer price for the good traded. The model will be solved by backward induction.

3 Separate Accounting

The theoretical analysis discriminates for different corporate tax systems. First we investigate the MNE's employment and transfer pricing decision under FA and SA.

3.1 Labor Demand and Transfer Prices

Under SA profit is taxed in the country where it is earned. Therefore the tax payments of the representative MNE in country i are

$$T_i = t_i \widetilde{\Pi_i} \tag{5}$$

The MNE maximizes its overall profits by choosing the optimal values for L_i and p. The following FOC are derived

$$(t_j - t_i) = \theta'(p-1) \tag{6}$$

$$F'(L_i) = w_i \tag{7}$$

The MNE's optimal transfer pricing decision is determined by equation (6). If $t_j > t_i$ the marginal concealment cost θ' are positive and therefore the MNE overstates its transfer price $p > 1$ to shift profits from the subsidairy in country j to the headquarter in country i. If $t_i > t_j$ the transfer price is understated and profits are shifted to the affiliate in country j. Moreover, we modelled the corporate tax as pure profit tax, and therefore labor demand is not distorted by corporate taxation under SA (equation (7)). Nevertheless variations in the labor tax rate change the corporation's wage cost and labor demand.

3.2 Wage Bargaining

In the following we investigate the effects of corporate taxation on wage bargaining between a MNE and a local union in a standard right-to-manage bargaining model. Workers are assumed to be organized in unions on the affiliate level. As we do not observe unions to be organized worldwide on MNE level, it is a reasonable assumption to restrict union organization to affiliate or national level. MNE and union maximize the following objective function by choosing the optimal wage level

$$max[\Pi(w_i, w_j)]^{1-\delta}[(w_i - \overline{w})L_i]^{\delta} \tag{8}$$

subject to

$$L_i(w_i, w_j) < N, \quad w_i > \overline{w} \tag{9}$$

whereas $\Pi(w_i, w_j)$ represents the corporation's profit, $v(w_i)$ symbolizes the utility unions receive from the remuneration level[1], $\overline{w}$ is the reservation wage and δ the union's bargaining power, both assumed to be equal across countries. Last, $L_i(w_i)$ defines the MNE's labor demand function.

As motivated above, workers do not receive utility from the wage and employment level in the foreign affiliate. In contrast, the MNE is assumed to be led by a central management and act as unity in the bargaining process. As the affiliates are not presumed to have any decision-making authority this assumption is completely stringent. Moreover empirical evidence shows that workers' wages do not only respond to their affiliate's profitability, but to the MNE's overall profitability (Budd et al. 2005).

Taking logs and differentiating equation (8) with respect to w_i gives

$$\Phi_i = \frac{\delta}{L_i(w_i)}\frac{\partial L_i}{\partial w_i} + \frac{\delta v'(w_i)}{v(w_i) - v(\overline{w})} + \frac{1-\delta}{\Pi(w_i)}\frac{\partial \Pi}{\partial w_i} = 0 \tag{10}$$

To derive the corporate tax rate effect on the bargained wage level, we apply the implicit function theorem

$$\frac{\partial w_i}{\partial t_l} = -\frac{\frac{\partial \Phi_i}{\partial t_l}}{\frac{\partial \Phi_i}{\partial w_l}} \quad l \in (i, j) \tag{11}$$

As for the objective function (8) to be concave the second derivative of the objective function with respect to the wage rate must be negative ($\frac{\partial \Phi_i}{\partial w_i} < 0$), it holds that

$$sign\left(\frac{\partial w_i}{\partial t_l}\right) = sign\left(\frac{\partial \Phi_i}{\partial t_l}\right) \quad l \in (i, j) \tag{12}$$

with

$$\frac{\partial \Phi_i}{\partial t_l} = \frac{\delta}{L_i}\frac{\partial L_i}{\partial w_i \partial t_l} - \frac{\delta}{L^2}\frac{\partial L_i}{\partial w_i}\frac{\partial L_i}{\partial t_l} + \frac{(1-\delta)}{\Pi(w_i)}\frac{\partial \Pi}{\partial w_i \partial t_l} - \frac{1-\delta}{\Pi^2}\frac{\partial \Pi}{\partial w_i}\frac{\partial \Pi}{\partial t_l} \quad l \in (i, j) \tag{13}$$

Under SA the labor demand and profit reaction to wage rate changes can be described by first differentiating equations (5) and (7)

[1]The assumption of a linear objective function is for analytical and expository convenience. Our results do not change, if we assumed the union's utility to be a concave function of the wage level w_i.

$$\frac{\partial L_i}{\partial w_i} = \frac{1}{F''(w_i)} \tag{14}$$

$$\frac{\partial L_i}{\partial w_j} = 0 \tag{15}$$

$$\frac{\partial \Pi}{\partial w_i} = -(1-t_i)L_i \tag{16}$$

This directly leads to the conditions

$$\frac{\partial L_i}{\partial t_i} = \frac{\partial L_i}{\partial t_j} = \frac{\partial L_i}{\partial w_i \partial t_i} = \frac{\partial L_i}{\partial w_i \partial t_j} = 0 \tag{17}$$

$$\frac{\partial \Pi}{\partial w_i \partial t_i} = L_i \tag{18}$$

$$\frac{\partial \Pi}{\partial w_i \partial t_j} = 0 \tag{19}$$

As we modelled the corporation tax to be a tax on pure profits only, the sensitivity of labor demand with respect to wage rate changes is independent of the coporate tax rate. Equation (19) shows that the MNE's profit sensitivity with respect to the local wage rate changes increases with the local corporate tax rate. In contrast, the effect of the foreign corporate tax rate on profit sensitivity with respect to changes in the local wage level is shown to be zero. As, under SA, the local workers' payroll cost are deductible from the local corporate tax base only, an increase in the corporate tax rate increases the tax savings due to payroll cost reduction and thereby reduces the sensitivity of overall profits with respect to the local workers' wage rate. As local payroll cost are not deductible from the foreign tax base no cross effect of the foreign corporate tax rate on profit sensitivity with respect to local wage changes is observed.

The following proposition is derived

Proposition 1. *Under SA the local corporate tax rate has a positive (negative) effect on the MNE's local (foreign) workers' remuneration.*

Proof: As stated in equations (16) the corporate tax rate does neither affect labor demand nor the sensitivity of labor demand with respect to the wage level. Therefore the first two terms on the right hand side of equation (13) are zero.

Since payroll cost are assumed to be deductible from the corporate tax base and therefore a rise in the wage level translates in a rise in payroll cost which reduces

the corporate tax base. The tax base reduction induces in decline of the MNE's tax burden, which is higher the higher the corporate tax rate. Therefore an increase in the corporate tax rate tends to increase the bargained wage level. This profit sensitivity effect is shown to exceed the adverse effect of corporate taxation on the MNE's profits, which tends to reduce the bargained wages. It follows that

$$\frac{\partial \Phi_i}{\partial t_i} = \frac{(1-\delta)L_i(1-t_j)\widetilde{\Pi_j}}{\Pi^2} > 0 \tag{20}$$

$$\frac{\partial \Phi_i}{\partial t_j} = -\frac{(1-\delta)L_i(1-t_i)\widetilde{\Pi_j}}{\Pi^2} < 0 \tag{21}$$

■

The wage level in country i is shown to rise with the corporate tax rate i, while it falls with the corporate tax rate in country j. A rise in country i's corporate tax rate exerts two effects. First, it lowers the profit sensitivity to local wage rate changes as local payroll costs are deductible from the corporate tax base. The gains from tax base reduction increase with the corporate tax rate. This effect tends to raise the bargained wage level. Second, a rise in the corporate tax rate directly lowers the MNE's overall profit and therefore tends to reduce the bargained wage level. It can be shown that the former effect prevails and therefore a tax increase raises the wage level of local workers (see equation (20)). In contrast a rise in the corporate tax rate reduces the wage level of foreign workers, as the rise in the corporate tax rate does not exhibit any effect on the profit sensitivity with respect to *their* wages and they only perceive the reduction in overall profits which reduces their bargained wage level.

This result contrasts the existing literature on wage bargaining in open economies. Schöb and Koskela (2002), for example, investigate wage bargaining in an open economy with national corporations, which implies that the corporate tax rates do not exhibit any effect on the wage level of local and foreign workers. Fuest and Huber (XY)????)

3.3 Tax Competition

The third stage of the game relaxes the assumption of fixed corporate tax rates. In the following we model a tax game between the two countries' governments, which levy a corporate income tax on the MNE's profits. Each gevernment maximizes a social

welfare function containing tax revenues weighted by the marginal cost of public funds (ρ), the residents' wage earnings and their share in the MNE's profits denoted by s_i. As under SA, all profits earned in country i are subject to corporate taxation in country i the social welfare function may be written[2]

$$SW_i = \rho t_i \widetilde{\Pi_i} + (w_i - \overline{w})L_i + \overline{w}N_i + s_i\Pi \tag{22}$$

We investigate the Nash equilibrium for equal tax rates $t_i = t_j$. As both countries maximize their tax revenue, it holds

$$\frac{\partial SW_i(t_i, t_j)}{\partial t_i} = 0 \tag{23}$$

The countries are assumed to be identical, therefore it is reasonable to focus on the symmetric Nash equilibrium of the tax competition game. Let $\widetilde{t} = \widetilde{t_i} = \widetilde{t_j}$ be the equilibrium tax rate. Equilibrium tax revenue in country i can be written as

$$SW_i(\tilde{t}, \tilde{t}) =: W(\tilde{t}) \tag{24}$$

Again our analysis investigates whether the countries choose inefficiently high or low tax rates in equilibrium. Therefore we determine the impact of a coordinated increase in the common tax rate $\tilde{t}$ on the tax revenue of the countries. Differentiating (24) yields

$$\begin{aligned}\frac{\partial SW_i}{\partial t_j} = \rho t_i \left\{ \frac{\partial \Pi_i}{\partial p}\frac{\partial p}{\partial t_j} + \frac{\partial \Pi_i}{\partial L_i}\left(\frac{\partial L_i}{\partial t_j} + \frac{\partial L_i}{\partial w_i}\frac{\partial w_i}{\partial t_j}\right) + \frac{\partial \Pi_i}{\partial w_i}\frac{\partial w_i}{\partial t_j}\right\} + L_i\frac{\partial w_i}{\partial t_j} \\ +(w_i - \overline{w})\left(\frac{\partial L_i}{\partial t_j} + \frac{\partial L_i}{\partial w_i}\frac{\partial w_i}{\partial t_j}\right) + s_i\frac{\partial \Pi}{\partial t_j}\end{aligned} \tag{25}$$

It follows directly from equations (6) and (7)

$$\frac{\partial L_i}{\partial t_j} = \frac{\partial \Pi_i}{\partial t_j} = 0 \tag{26}$$

$$\frac{\partial p}{\partial t_j} = \frac{1}{\theta''(p-1)} > 0 \tag{27}$$

$$\frac{\partial \Pi}{\partial t_j} = -\Pi_j < 0 \tag{28}$$

[2]As we normalised the price of the MNE's output to 1, we do not consider consumer surplus in the social welfare function.

Consequently, equation (25) can be simplified

$$\frac{\partial SW_i}{\partial t_j} = \rho t_i \frac{1}{\theta''(p-1)} + \{-\rho t_i L_i + (1+\epsilon)L_i\} \frac{\partial w_i}{\partial t_j} - s_i \Pi_j \tag{29}$$

with ϵ being the labor demand elasticity with respect to the wage rent earned by the MNE's workers

$$\epsilon = \frac{(w_i - \overline{w})}{L_i} \frac{\partial L_i}{\partial w_i} = \frac{w_i}{L_i} \frac{\partial L_i}{\partial w_i} - \frac{\overline{w}}{L_i} \frac{\partial L_i}{\partial w_i} \tag{30}$$

This leads to the following proposition

Proposition 2. *Suppose the tax competition game under SA attains a symmetric equilibrium $t_i = t_j = \widetilde{t}$; then the governments may either set too high or too low corporate tax rates.*

Proof: It follows from equations (4), (20) and (21)

$$\frac{1}{\theta''(p-1)} < 0 \tag{31}$$

$$L_i \frac{\partial w_i}{\partial t_j} < 0 \tag{32}$$

The sign of $(1+\epsilon)L_i \frac{\partial w_i}{\partial t_j}$ is determined by the sign of ϵ. For standard konvex labor demand functions $\frac{w_i}{L_i} \frac{\partial L_i}{\partial w_i} > -1$ and therefore it follows that $\epsilon > 0$ and $(1+\epsilon)L_i \frac{\partial w_i}{\partial t_j} < 0$. q.e.d. ■

We derive an ambiguous fiscal externalities under SA. Therefore governments might set too high or too low corporate tax rates, depending on the relative size of the derived effects. The first term on the right hand side of equation (29) describes the well known profit shifting externality derived under SA in many economic papers. The fiscal externality is established, as governments do not take into account that a rise in their tax rate increases the amount of profits shifted to the other country and thereby rises the other country's tax revenue. In addition a negative profit income externality is derived (symbolized by the last term on the right hand side of equation (29)). An increase in the corporate rate of one country reduces the MNE's profits which induces a negative externality on the other country's welfare to the degree to

which the corporation is owned by residents of the foreign country (s_i).[3] Both effects are well known in the literature on corporate tax competition.

Our model's contribution is the derivation of wage income externalities. In the previous section, we derived a negative effect of country j's corporate tax rate on the wage level in country i. First, the endogenous wage level induces a positive fiscal externality as a reduction in country i's wage rate raises the pre-tax-profits earned by the local affiliate and thereby the corporate tax base. Second, the reduction in workers' remuneration leads to a fall in workers' utility from wage income. The increase in the local corporate tax rate thus 'redistributes' wage income within the MNE from the foreign to the home country. The drop in the wage rate increases the MNE's labor demand and thereby the social welfare from wage income, but as for standard convex labor demand functions labor demand elasticity is smaller than one in absolute terms ($\epsilon > -1$) the overall effect of a corporate tax rate increase on foreign workers' utility from wage income is negative. The sign of the overall wage externality depends on the relative size of the payroll reduction effect versus the wage income utility effect. The externality tends to be negative, if the marginal cost of public funds and labor demand elasticity were low, while the outside option $\overline{w}$ is large.

4 Formula Apportionment

Under a FA tax system the MNE's profits are consolidated at an international level and apportioned to the MNE's affiliates according to a formula based on relative capital investment, payroll or sales. In our model we assume profits to be allocated by relative payroll share. Then the MNE's tax burden in country i calculates

$$T_i \quad = \quad t_i \beta_i \sum_i \widetilde{\Pi_i} \tag{33}$$

with β_i being the fraction of the consolidated tax base apportioned to country i

[3]Note that the corporate tax rate increase has only a direct effect on the MNE's overall profits as the tax burden increases in the corporate tax rate. It directly follows from equations 20 and 21, that the induced increase in the local wage rate is exactly compensated by a reduction in the foreign wage rate and profits are unchanged.

$$\beta_i = \frac{w_i L_i}{W} \tag{34}$$

and W representing the MNE's total wage cost at both locations

$$W = \sum_i w_i L_i \tag{35}$$

Wage payments are assumed to be fully deductible from the tax base and therefore the corporate tax is modelled as pure profit tax. As is commonly known, under a FA system the MNE does not have any incentive to shift profits due to tax base consolidation, therefore the transfer price is set equal to the true price $p = 1$.
The MNE's overall demand for labor is determined by the following FOC

$$F'(L_i) \quad = \quad w_i + \frac{(t_i - t_j)}{(1 - \bar{t})} \frac{\beta_j w_i}{W} \sum_i \widetilde{\Pi_i} \tag{36}$$

with $\bar{t}$ being defined as the MNE's average tax rate

$$\bar{t} = t_i \beta_i + t_j \beta_j \tag{37}$$

The MNE's labor demand is determined by equation (36). The first term on the right hand side reflects labor demand to be the higher the lower workers' remuneration. As wage levels might differ between the countries, the term may induce diverging labor demands. The second term on the right-hand-side describes the MNE's labor demand under FA to be biased towards the low tax country. This FA effect may be explained by the MNE's incentive to increase its payroll cost in the tax haven and thereby its corporate tax base share apportioned to the low tax country. This reduces the MNE's overall tax burden. Therefore if $t_j > t_i$ the second term is negative and motivates an increased labor demand and vice versa. Note that the size of this FA term depends on the size of the wage level w_i. A rise in w_i increases the summand in absolute terms. This implies that considering the FA effect only, a wage increase enlargens the MNE's labor demand in the low tax country, but simultaneously reduces labor demand in the

high tax country.[4] In the former (latter) case the marginal cost of employing an additional worker is reduced (increased) and an augmented share of profits is apportioned to the low (high) tax country. A detailled analysis of wage effects on labor demand will be given within the scope of the wage bargaining model.

4.1 Wage Bargaining

As we focus on symmetric Nash equilibria at the tax competition game on the first stage we will derive the marginal effects of corporate and labor tax rates on the wages bargained for symmetric tax rates only, as complicated second order effects otherwise make the results ambiguous and hard to track. Taking into account the ambiguity of the result for the general case, we additionally test the below derived hypotheses using FA data on US states in section XY. With the symmetry assumption it holds

$$t_i = t_j = \hat{t} \quad \tau_i = \tau_j = \hat{\tau} \quad L_i = L_j = \hat{L} \quad w_i = w_j = \hat{w} \quad \Pi_{Ti} = \Pi_{Tj} = \hat{\Pi}_T \tag{38}$$

Analogously to the analysis under SA, the sign of the marginal corporate tax rate increase on workers' wages is determined by

$$sign\left(\frac{\partial w_i}{\partial t_l}\right) = sign\left(\frac{\partial \Phi_i}{\partial t_l}\right) \quad l \in (i,j) \tag{39}$$

whereas equations (10) to (13) apply. By differentiating equation (36) and afterwards applying the symmetry assumption can derive the following second order conditions

$$\frac{\partial L_i}{\partial w_i} = \frac{1}{F''(\hat{L})} < 0 \tag{40}$$

$$\frac{\partial L_i}{\partial w_i \partial t_i} = -\frac{\partial L_i}{\partial w_i \partial t_j} = -\frac{[F''(\hat{L})\hat{L}^2 + 2\hat{\Pi}_T]}{4(1-\hat{t})F''(\hat{L})^2\hat{L}^2} < 0 \tag{41}$$

$$\frac{\partial L_i}{\partial w_j} = \frac{\partial L_i}{\partial w_j \partial t_j} = 0 \tag{42}$$

$$\frac{\partial L_i}{\partial t_i} = -\frac{\partial L_i}{\partial t_j} = \frac{\hat{\Pi}_T}{2(1-\hat{t})F''(\hat{L})\hat{L}} < 0 \tag{43}$$

[4] We will refer to the second term on the right hand side of equation (36) as FA term throughout the rest of the analysis.

With the symmetry assumption labor demand falls with the wage rate (equation (41)). The effect of the corporate tax rate on labor demand sensitivity with respect to wage rate changes cannot generally be signed. Nevertheless for a Cobb Douglas production function it is proved that $F''(\hat{L})\hat{L}^2 + 2\hat{\Pi}_T > 0$ in the appendix and therefore we can show that the labor demand sensitivity falls (rises) with increases in the local (foreign) corporate tax rate. As the corporate tax is modelled to be a pure profit tax, labor demand in country i depends on the wage rate in country i solely and therefore there are no cross effects of the foreign wage level or corporate tax rate on labor demand (equation (42)). Moreover, the effect of the local (foreign) corporate tax rate on the MNE's local labor demand is shown to be negative (positive). A rise in the local (foreign) corporate tax rate increases (decreases) the FA term in equation (36) thereby inducing the MNE to demand less (more) local workers.

$$\frac{\partial \Pi}{\partial w_i} = -(1-\hat{t})\hat{L} < 0 \tag{44}$$

$$\frac{\partial \Pi}{\partial w_i \partial t_i} = \frac{1}{2}\left[\hat{L} - \frac{\hat{\Pi}_T}{\hat{w}}\right] < 0 \tag{45}$$

$$\frac{\partial \Pi}{\partial w_i \partial t_j} = \frac{1}{2}\left[\hat{L} + \frac{\hat{\Pi}_T}{\hat{w}}\right] > 0 \tag{46}$$

$$\frac{\partial \Pi}{\partial t_i} = \frac{\partial \Pi}{\partial t_j} = -\hat{\Pi}_T < 0 \tag{47}$$

According to equation (44) the MNE's profits fall with workers' wages as thereby the MNE's payroll cost are increased. The effect of the local corporate tax rate on this profit sensitivity is twofold. First, payroll cost are deductible from the corporate tax base and a higher corporate tax rate reduces profit sensitivity to wage rate changes. Second, a corporate tax increase in country i makes it more costly to raise the wage level as the payroll sum increase induces a higher share of profits to be apportioned to country i which is then taxed at an enlarged corporate tax rate. The latter effect can be shown to outweigh the former one in absolute terms for any positive profit earned by the MNE. Thus the sensitivity of profits with respect to wage rate changes is shown to fall (rise) in the local (foreign) corporate tax rate. Last, after applying the envelope theorem we can shown that the MNE's overall profit falls with the corporate tax rate in both countries, according to equation (47). Plugging in the second order effects (41)

to (47) in equation (13) gives rise to the following proposition

Proposition 3. *Under FA the local corporate tax rate exerts a negative (positive) effect on local (foreign) workers' remuneration.*

Proof: It holds that

$$\frac{\delta}{L_i}\frac{\partial L_i}{\partial w_i \partial t_j} - \frac{\delta}{L^2}\frac{\partial L_i}{\partial w_i}\frac{\partial L_i}{\partial t_j} = 0 \tag{48}$$

$$\frac{(1-\delta)}{\Pi(w_i)}\frac{\partial \Pi}{\partial w_i \partial t_j} - \frac{1-\delta}{\Pi^2}\frac{\partial \Pi}{\partial w_i}\frac{\partial \Pi}{\partial t_j} = \frac{1-\delta}{4(1-\hat{t})\hat{w}} > 0 \tag{49}$$

Therefore $\frac{\partial \Phi_i}{\partial t_j} > 0$ and it follows that $\frac{\partial w_i}{\partial t_j} > 0$. Analogously we show that

$$\frac{\delta}{L_i}\frac{\partial L_i}{\partial w_i \partial t_i} - \frac{\delta}{L^2}\frac{\partial L_i}{\partial w_i}\frac{\partial L_i}{\partial t_i} = -\frac{\delta[F''(\hat{L})\hat{L}^2 + 4\hat{\Pi}_T]}{4(1-\hat{t})F''(\hat{L})^2\hat{L}^3} < 0 \tag{50}$$

$$\frac{(1-\delta)}{\Pi(w_i)}\frac{\partial \Pi}{\partial w_i \partial t_i} - \frac{1-\delta}{\Pi^2}\frac{\partial \Pi}{\partial w_i}\frac{\partial \Pi}{\partial t_i} = -\frac{1-\delta}{4(1-\hat{t})\hat{w}} < 0 \tag{51}$$

Therefore it is straight forward to show that $\frac{\partial \Phi_i}{\partial t_i} < 0$ and thus $\frac{\partial w_i}{\partial t_i} < 0$. q.e.d.
The intuition behind the results can be best understood referring to equations (10), (13), (49) to (51). A rise in the local corporate tax rate tends to decrease local labor demand as well as the sensitivity of this labor demand with respect to the local wage level. Both effects reduce the bargained wage level in the home country. Additionally, an increase in the corporate tax rate reduces the MNE's total profits, but exerts an ambiguous effect on the sensitivity of profits with respect to the wage level. First, raising the corporate tax rate reduces the sensitivity of profits with respect to the wage level in absolute terms as payroll cost are deductible from the corporate tax rate. Second, an increase in the local corporate tax rate raises the profit sensitivity in absolute terms as a higher wage level induces an enlarged amount of the consolidated tax base to be apportioned to the home country and then to be taxed at the increased corporate tax rate. The latter effect prevails, if the MNE's total profits were positive. Therefore, the corporate tax rate is shown to exert a negative effect on the MNE's total amount of profits and the profit sensitivity with respect to wage rate changes, both tending to reduce the bargained wage level. Therefore the effect of the local corporate tax rate on the local workers' wage level is shown to be negative.
In contrast, an increase in the local corporate tax rate raises the foreign wage level.

As the local corporate tax has no effect on foreign labor demand and foreign labor demand elasticity, the local corporate tax rate impacts on the wage bargaining process only through its effect on the MNE's profits. While an increase in the local corporate tax rate reduces the MNE's overall profits, it reduces the profit sensitivity to changes of the *foreign* level in absolute terms, as payroll cost are deductible from the corporate tax base and higher foreign wages induce a higher share of the consolidated tax base to be apportioned and taxed in the foreign country at the corporate tax rate t_j which is reduced in relative terms though the increase in the home country tax rate.
Therefore assuming a symmetric equilibrium in the tax competition game, the local corporate tax rate is shown to exert a negative marginal effect on workers' remuneration, while the foreign corporate tax rate exerts a positive effect. In section 5 we will test the theoretical implications of proposition 3 using US state data. The analysis will confirm our theoretical result. As one might assume modern economies not to be in the modelled long-run tax competition equilibrium, the empirical results suggest the derived effects to prevail in more general settings.

4.2 Tax Competition

Under FA, the social welfare is defined

$$SW_i = \rho\beta_i \sum_i \widetilde{\Pi_i} + (w_i - \overline{w})L_i + \overline{w}N_i + s_i\Pi \tag{52}$$

The definition is analogous to the SA system. Social welfare is derived from corporate tax revenues as well as the residents' wage and corporate income. The corporate tax base under FA is determined by the relative payroll share of country i β_i, which determines the fraction of the consolidated profits apportioned to country i. As both countries maximize their social welfare, it holds

$$\frac{\partial SW_i(t_i, t_j)}{\partial t_i} = 0 \tag{53}$$

The countries are assumed to be identical, therefore it is reasonable to focus on the symmetric Nash equilibrium of the tax competition game. Let $\widetilde{t} = \widetilde{t_i} = \widetilde{t_j}$ be the equilibrium tax rate. Equilibrium tax revenue in country i can then be written as

$$SW_i(\tilde{t},\tilde{t}) =: R(\tilde{t}) \tag{54}$$

To investigate whether the countries choose inefficiently high or low tax rates in equilibrium, we have to determine the impact of a coordinated increase in the common tax rate $\tilde{t}$ on the tax revenue of the countries. Differentiating equation (54) yields

$$\frac{dSW(\tilde{t})}{d\tilde{t}} = \sum_i \frac{\partial R_i(t_i,t_j)}{\partial t_l}\Big|_{t_i=t_j} \tag{55}$$

where we used $\partial SW_i(\cdot)/\partial t_i = 0$ according to equation (53). The cross effect $\partial SW_i(\cdot)/\partial t_l$ reflects the fiscal externalities. It describes how the tax revenue of country i is influenced by the tax policy of the other country. Taking into account that the MNE has no incentive to shift profits under FA the following fiscal externalities can be derived

$$\begin{aligned}\frac{\partial SW_i(t_i,t_j)}{\partial t_l} = t_i \sum_i \widetilde{\Pi}_i \frac{\partial \beta_i}{\partial t_l} + t_i\beta_i \sum_i \frac{\partial \sum_i \widetilde{\Pi}_i}{\partial w_i}\frac{\partial w_i}{\partial t_l} + t_i\beta_i \sum_i \frac{\partial \sum_i \widetilde{\Pi}_i}{\partial L_i}\frac{\partial L_i}{\partial t_l} + \\ + \left[1 + \frac{\partial L_i}{\partial w_i}\frac{w_i - \overline{w}}{L_i}\right] L_i \frac{\partial w_i}{\partial t_l} + [w_i - \overline{w}]\frac{\partial L_i}{\partial t_j} + s_i \frac{\partial \Pi}{\partial t_l}\end{aligned} \tag{56}$$

Proposition 4. *Suppose the tax competition game under FA attains a symmetric equilibrium $t_i = t_j = \widetilde{t}$; then countries might set inefficiently high or small corporate tax rates due to a positive FA externality and a positive wage income tax externality and a negative profit income externality.*

Proof: The FA externality is explicitly derived

$$\begin{aligned}\frac{\partial \beta_i}{\partial t_l} &= \left[\frac{\partial \beta_i}{\partial w_i} + \frac{\partial \beta_i}{\partial L_i}\frac{\partial L_i}{\partial w_i}\right]\frac{\partial w_i}{\partial t_l} + \left[\frac{\partial \beta_i}{\partial w_j} + \frac{\partial \beta_i}{\partial L_j}\frac{\partial L_j}{\partial w_j}\right]\frac{\partial w_j}{\partial t_l} \\ &= \frac{1}{4\hat{w}}\left[1 + \frac{\partial L_i}{\partial w_i}\frac{\hat{w}}{\hat{L}}\right]\frac{\partial w_i}{\partial t_l} - \frac{1}{4\hat{w}}\left[1 + \frac{\partial L_j}{\partial w_j}\frac{\hat{w}}{\hat{L}}\right]\frac{\partial w_j}{\partial t_l} > 0\end{aligned} \tag{57}$$

As for standard convex labor demand functions the elasticity of labor demand with respect to the wage rate is smaller than 1 in absolute terms, it follows that equation (57) is unambiguously positive. Note that under the symmetry assumption cross effects of the foreign wage rate on the local labor demand are zero. The change in the local corporate tax rate does not exhibit any effect on the MNE's corporate tax base, as

under symmetry $\frac{\partial w_j}{\partial t_i} = -\frac{\partial w_i}{\partial t_i}$. Additionally employing equation (36) for the symmetry case delivers

$$t_i\beta_i \sum_i \frac{\partial \sum_i \widetilde{\Pi_i}}{\partial w_i}\frac{\partial w_i}{\partial t_l} + t_i\beta_i \sum_i \frac{\partial \sum_i \widetilde{\Pi_i}}{\partial L_i}\frac{\partial L_i}{\partial t_l} = 0 \tag{58}$$

According to equation (43) and our result in proposition 3 we can show that the wage income effect is unambiguously positive for covnvex labor demand functions

$$\left[1 + \frac{\partial L_i}{\partial w_i}\frac{w_i - \overline{w}}{L_i}\right] L_i \frac{\partial w_i}{\partial t_l} + [w_i - \overline{w}]\frac{\partial L_i}{\partial t_j} > 0 \tag{59}$$

Moreover,

$$s_i \frac{\partial \Pi}{\partial t_l} = -s_i \hat{\Pi}_T < 0 \tag{60}$$

q.e.d. ■

Therefore three fiscal externalities are derived under FA. First, FA induces an externality as a rise in the corporate tax rate of country i induces the MNE to shift workers to country j to reduce the payroll cost and thereby the tax base in country i. The shift enlargens the share of the consolidated corporate tax base to be apportioned to country j and thus establishes a positive fiscal externality which may be called FA externality. Simultaneously the wage effects lead to labor demand changes in the opposite direction. Nevertheless for convex labor demand functions the labor demand changes are outweighed by the wage changes, therefore the overall sign of the externality is positive. Second, we observe a positive wage income tax externality. Raising the corporate tax rate leads to an increased in the bargained wages of the foreign affiliate and thereby utlity of wage income in the foreign country is increased, establishing a positive fiscal externality. Additionally, this externality is enforced, as a marginal rise in country i's corporate tax rate induces the MNE to employ more workers in country j, an effect which additionally raises the wage income utility. Third, we find the well known negative profit income externality.

5 Empirical Results

In the following section we estimate the impact of the corporate tax rate on the wage level under a FA system. Our theoretical model could establish an unambiguous wage

effect for symmetric tax competition equilibria only and therefore we further investigate the connection between the corporate tax rate and workers' wages in an empirical analysis. The hypotheses are tested on macro data for US states.

Our data is provided by the US Bureau of Labor Statistics. We retrieved macrodata on workers' average monthly wages dicriminating for US states, industries and firm size for the years 1997 to 2004. The US states are fiscal jurisdictions and autonomously set corporate tax rates. To determine the state level tax base of multi-state corporations a FA is applied. Therefore the tax base of multi-state corporations is consolidated on national level[5] and apportioned to the states on the basis of a formula based on property, payroll and/or sales. Note that these formulas are heterogenous between US states as state governments have the authority to set the apportionment formula. In our analysis we control for state effects like population density, importance of agricultural production, GSP. We estimate a fixed effects model of the following form

$$lnW_{it} = \alpha_i + \beta_1 Tax_{it} + \beta_2 \overline{Tax_{jt}} + \beta_3 X_{it} + \epsilon_{it} \tag{61}$$

where W_{it} indicates the average monthly wage level, Tax_{it} the corporate tax rate in state i at time t[6]; $\overline{Tax_{jt}}$ is the average corporate tax rate of neighboring states. In line with the empirical literature on fiscal externalities, we weighted the tax rates of neighboring states with the population size to derive the average tax rate of neighboring states (see e.g. Büttner, 2003); X_{it} contains state level controls as well as specific time trends.

Table 1 in the appendix shows the estimation results. Controlling for state specific effects and time trends, we derive a statistically significant effect of the corporate tax rate on the average wage level in the US states. In specification (1) we include the state gross social product as well as the state employment level and the gross social product per state and per industry as explanatory variable. As these variables might be afflicted by endogeneity, we reestimate the equation under specification (2) without these explanatory variables. Nevertheless the estimation results do not qualitatively

[5] A minority of US states employs a concept of worldwide profit consolidation under the FA system.

[6] If corporate tax rate were progressive we used the highest marginal corporate tax rate. As multiregional corporations are usually large corporations it is reasonable to assume that their profits are sufficiently high that the top marginal corporate tax rate applies. The specification is in line with the literature on taxation effects on investment and labor demand.

change. We find that a 1 percent rise in the corporate state tax leads to a fall in the local average tax rate by around 0.5 percent. Moreover a rise in the average corporate tax rate of neighboring states (weighted by the relative population) by 1 percent raises the local workers' remuneration by 0.7 to 0.9 percent on average. Note, that because the states have very different sizes, we correct for heteroscedasticity in all our regressions using White standard errors. Therefore we find a significantly negative causal effect of the corporate tax rate on local wage level and a positive effect on foreign wages.

6 Discussion and Conclusion

To be completed.

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8 Appendix

For a Cobb Douglas production function it holds that $F''(\hat{L})\hat{L}^2 + 2\hat{\Pi}_T > 0$.

$$F(L_i) = L_i^{\alpha} G_i^{1-\alpha} \quad \alpha \in [0,1] \tag{62}$$

with G being a fixed production factor, e.g. land. The optimal labor demand decision is determined by (36), therefore it follows

$$\hat{L} = \left(\frac{\alpha \hat{G}^{1-\alpha}}{\hat{w}} \right)^{\frac{1}{1-\alpha}} \tag{63}$$

The above condition can be modified

$$\alpha(\alpha-1)\hat{L}^{\alpha}\hat{G}^{1-\alpha} + 2\left[\hat{L}^{\alpha}\hat{G}^{1-\alpha} - \hat{w}\hat{L}\right] > 0 \tag{64}$$

$$\alpha(\alpha-1) + 2\left[1 - \hat{w}\frac{\hat{L}^{1-\alpha}}{\hat{G}^{1-\alpha}}\right] > 0 \tag{65}$$

$$2 - \alpha > 0 \quad q.e.d. \tag{66}$$

Endogenous Variable: Log Average Wage		
Variable	Specification (1)	Specification (2)
Adjacent Tax	0.5142^{***}	0.6262^{***}
	(0.0713)	(0.0721)
Tax Rate	-0.7204^{***}	-0.6419^{***}
	(0.0494)	(0.0504)
Pop. Density	0.2268^{***}	0.3341^{***}
	(0.0107)	(0.0101)
Agrishare	-3.4951^{***}	-4.7500^{***}
	(0.0978)	(0.0952)
Est.No. $\times 10^{-6}$	-1.17^{***}	-0.677^{***}
	(0.108)	(0.0826)
GSPtot $\times 10^{-6}$	0.262^{***}	
	(0.0091)	
Region	$\surd$	$\surd$
Period	$\surd$	$\surd$
Industry	$\surd$	$\surd$
Firm Size	$\surd$	$\surd$
Number of Observations	37005	37005
R^2	0.6752	0.6603

*** significant at 1% level

** significant at 5% level

* significant at 10% level

Table 1: Effect of the Corporate Tax Rate on Wages