Do Countries Compensate Firms for International Wage Differentials?

Ferdinand Mittermaier*
University of Munich

Johannes Rincke**
University of Erlangen-Nuremberg

Final Version, March 2013

Accepted for publication in the

Journal of Public Economics

Abstract

We address the role of labor cost differentials for national tax policies. Modeling a tax competition race between two countries competing for a population of mobile firms, we show that in equilibrium, the high-wage country charges a lower tax than the low-wage country. Moreover, under tax competition the high-wage country attracts more firms than in a setting without taxation. Exploiting exogenous variation in labor cost differentials induced by the breakdown of communism in eastern Europe, we find that tax policies are in line with the model prediction. Our most conservative estimates suggest that a one dollar increase in the compensation cost differential (in prices as of 2000) triggers a cut of the statutory corporate income tax rate by about one percentage point.

Keywords: Foreign direct investment, corporate taxation, labor costs

JEL Classification: H25, H73, F23

* University of Munich, Seminar for Economic Policy, Akademiestrasse 1, 80799 Munich, ferdinand.mittermaier@lrz.uni-muenchen.de. Currently working as investment manager at Allianz Investment Management SE

** University of Erlangen-Nuremberg, Department of Economics, Lange Gasse 20, 90403 Nuremberg, johannes.rincke@wiso.uni-erlangen.de

1 Introduction

High industrial wages are commonplace in developed economies and are perceived as a characteristic of their standard of living and level of development, but it is increasingly understood that they pose a serious threat to those countries' industrial bases. Competition from low-wage countries is thus fueling fears of the loss of manufacturing jobs as well as of too much dependence on jobs in service industries. In case of the old industrial cores of western Europe, concerns regarding the eastward relocation of firms and employment are driven by the fact that more than 20 years after the lifting of the Iron Curtain, eastern European countries can still market themselves as low-cost locations.

However, at least for western Europe, recent research suggests that job losses because of the relocation of employment to eastern Europe are actually quite limited (Konings and Murphy, 2006). The apparent stability of the industrial core in countries facing low-wage competition from locations within a highly integrated market is certainly surprising. Because of factors such as downward stickiness of wages, union power, and political constraints to abolish minimum wages and other labor market rigidities, it is very hard for high-wage countries to regain competitiveness via direct labor cost reductions. We argue that to understand the performance of western Europe's core industries over the past two decades, the role of national tax policies is crucial. While prices and wages tend to be sticky, the tax system is politically determined. As taxes can affect the international competitiveness of businesses, it seems natural to study whether governments can compensate firms for the disadvantage of relatively high labor costs.

At least two recent observations from Europe support the notion that governments make use of tax policies to keep domestic firms competitive. First, comparing the group of 'border' countries located at the eastern edge of western Europe (Austria, Denmark, Finland, Germany, Greece, Italy, and Sweden) to the rest of western Europe, we find that after the regime change in eastern Europe in 1989, the former cut their corporate income tax rates much more aggressively. Between 1990 and 1994, the border countries reduced their statutory tax rates by 12.5 percentage points on average, while other countries in western Europe cut their rates by an average of just two percentage points. This striking difference in average tax changes of more than 10 percentage points suggests that countries directly exposed to the new low-wage competition from eastern Europe have tried to restore their competitiveness by lowering the tax burden on businesses.

A second observation relates to the allocation of direct subsidies to firms. In a recent article, Haufler and Mittermaier (2011) point out that a disproportionate share of state aid in

Europe flows to heavily unionized regions, characterized by (in relative terms) high wages and low productivity. They cite a number of recent cases where national governments paid significant subsidies to firms investing in regions with below-average productivity and strong union power, like southern Italy and east Germany.[1] The authors then show that unionization triggers investment incentives, because by attracting foreign direct investment (FDI), governments can induce a more moderate wage bargaining behavior by unions. In effect, governments face incentives to compensate firms for disadvantageous labor market conditions.

Guided by these considerations, we analyze the role of labor cost differentials in international competition for FDI. Our contribution is twofold. First, we study optimal tax policies in the presence of wage differentials when countries compete for FDI. Our theoretical analysis reveals that in equilibrium, the high-wage country is willing to offer a more favorable tax regime. Attracting firms not only adds to the tax base, but also increases local production and the industrial sector wage bill. Since the 'extra' income earned by workers is partially paid by the low-wage country's consumers via higher prices, the high-wage country is willing to offer internationally mobile firms a more favorable tax regime.

From the theoretical analysis emerges the prediction that high-wage countries will compensate firms by setting lower corporate tax rates compared to low-wage countries. In the second part of the paper, we empirically test this prediction, focusing on the statutory corporate income tax rate as the key parameter of international tax competition. As union behavior is potentially responsive to tax policies in strategic settings, and because tax incidence effects may lead to a shifting of part of the corporate tax burden onto labor in the form of lower wages, we need an identification strategy that takes account of the simultaneity between labor cost differentials and tax policies. As a source of exogenous variation in international labor cost differentials, we exploit the breakdown of the communist regimes in eastern Europe. The regime change in 1989/90 and the following rapid integration between eastern and western Europe induced an unprecedented degree of variation in labor cost differentials in western Europe, both across countries and across time.

The logic of using the regime change in eastern Europe as a natural experiment is straightforward and rests on two simple facts: First, because of eastern Europe's opening up to international mobility of produced goods and factors of production, western Europe was

[1]Compare Table 1 in Haufler and Mittermaier (2011) for a selective overview of some recent cases fitting this pattern.

affected by an integration shock that can plausibly be assumed to be exogenous to national tax policies. Second, it is plausible to assume that some countries in western Europe were more strongly affected by the integration shock than others, depending largely on their geographical position relative to eastern Europe. In principle, our identification rests on the assumption that for the competitiveness of the different locations in western Europe, the importance of wages paid in eastern Europe decreases with distance to this region. We therefore define the labor cost differential as the difference between a country's labor cost and the average cost of all other locations, whereby the weights used to compute the average cost of neighbors are country-specific and depend negatively on physical distance. We then derive the effect of labor cost differentials on corporate tax rates from instrumental variables estimations, where the instrument is constructed such that it captures the differential impact of the integration shock on the locations' relative wage costs.

Across various specifications, our estimations provide strong evidence that countries indeed compensate firms for international wage differentials. Moreover, the estimated effects are economically significant. If the compensation cost differential increases by one dollar (in prices as of 2000), firms are, on average, compensated by a one percentage point cut in the corporate income tax rate. Accounting for differences in labor productivity, we find that a one standard deviation increase in the unit labor cost differential decreases the statutory tax rate by about seven percentage points.

On the theoretical side, our model builds on two major strands of literature, one examining the role of distorted labor markets in firms' location decisions, the other looking at governments competing for mobile capital in tax competition. As an important example in the first strand, Leahy and Montagna (2000) show that governments may not find it desirable to encourage inward FDI, depending on the centralization level of wage bargaining (which has a bearing on the incentive of a multinational enterprise to locate in a certain jurisdiction). Lommerud et al. (2003) demonstrate that unionization can, at the same time, induce inward foreign direct investment and cause job losses in the unionized country.

As to the second strand of literature mentioned above, we build on models analyzing the location choices of mobile firms under tax competition. A sizable body of work deals with countries competing for a discrete number of firms by setting lump-sum location taxes (or subsidies). Most closely related to our model are Haufler and Wooton (1999) and Bjorvatn and Eckel (2006), who model competition for a single firm, and Haufler and Wooton (2010), extending the analysis to many firms. This literature examines the role of country size, trade costs and industry structure in tax competition, but largely ignores labor market frictions.

A recent contribution making an effort to combine those strands of the literature by looking into the interplay of tax and wage policies is the abovementioned work by Haufler and Mittermaier (2011). Apart from this, we are aware of two recent related contributions. Egger and Seidel (2011) study the link between trade liberalization and imperfect labor markets for tax competition in an agglomeration model with monopolistic competition and fair wage preferences as labor market rigidity. They perform a numerical analysis to find, inter alia, that labor market imperfections depress tax rates, especially so for high levels of trade costs. In a recent contribution, Exbrayat et al. (2012) show that capital may be partially agglomerated in a unionized country when it competes with a country with a competitive labor market. However, in their model, wages do not influence the marginal cost of production, which is a major distortion arising from high wage costs.

On the empirical side, we add to the literature on the determinants of corporate tax rates which has, somewhat surprisingly, so far largely ignored the role of labor costs. Apart from Devereux et al. (2008), strategic tax competition among countries has been analyzed by Overesch and Rincke (2011) and Davies and Voget (2008).

The remainder of the paper is organized as follows. Section 2 presents the theoretical model. After providing a preliminary look at the data in Section 3, we discuss the estimation approach in Section 4. Estimation results are presented in Section 5, and Section 6 concludes.

2 Competition for firms: The role of wage differentials

Consider two countries, A and B, and a fixed number of mobile firms in an oligopolistic industry producing a good x. A and B have the same population size with each country's number of identical households normalized to 1.[2] A numéraire good, y, is produced by perfectly competitive firms in both countries, with labor being the only input. Labor costs are the only variable costs in both sectors. In the numéraire sector, $1/\bar{w}$ units of labor are needed to produce one unit of good y. Trade is free in y, which equalizes its price

[2] We focus on symmetric country sizes for two reasons. First, the phenomenon of a market size advantage (which can make up for a country's drawbacks in other areas) is well understood from existing work. Second, in the asymmetric case terms get hard to interpret and clutter up the analysis. However, our results also hold in a scenario with asymmetric countries. The calculations are provided by the authors upon request.

at unity and the competitive wage rate at $\bar{w}$. In the x-sector, one unit of capital, m, is needed for each firm to produce any output, and one unit of labor is needed to generate one unit of x.

2.1 Demand

Household preferences are of the quasi-linear and quadratic form

$$u_i = ax_i - \frac{1}{2}bx_i^2 + y_i,\ i \in \{A, B\}, \tag{1}$$

yielding linear demand functions for x (with a, b being parameters). Each household inelastically supplies one unit of labor. Labor is mobile across sectors but immobile across countries. Denoting country-specific wages in the x-sector by w_A and w_B, we assume $w_A \geq w_B = \bar{w}$, so country A will play the role of the high-wage country. Hence, while the x-sector wage in B is competitive, x-sector production will be more expensive in A than local y-sector production and production of both goods in B. This can be interpreted as the outcome of a situation with asymmetries in union power or a sector-specific minimum wage in A.[3]

Depending on how many firms will settle in A and on production per firm, a varying share of A's workforce will be employed in the x-sector. The rest will be employed in the y-sector and earn the competitive wage $\bar{w}$. As workers are identical, we only consider average income and can ignore the allocation of individual workers to industries in A. Any tax proceeds, T_i, from business taxes on the mobile firms are redistributed to domestic worker-consumers in equal per capita shares,[4] leading us to workers' average per-capita budget constraints in the two countries of $sw_A + (1-s)\bar{w} + T_A = p_A x_A + y_A$ and $\bar{w} + T_B = p_B x_B + y_B$, with p_i denoting the price of x in market i and s standing for the (endogenously determined) share of A workers employed in the x industry.

Maximizing u_i subject to households' budget constraints and aggregating over consumers, we obtain $X_i = (a - p_i)/b$ as aggregate demands for x. Welfare in each country is derived from the individual utility functions (1). Solving the consumers' optimization problem

[3] The exogeneity of the wage cost differential has been chosen for three reasons: It keeps the model analytically tractable and fits our estimation strategy where the cost differential is also quasi-exogenous after the fall of the 'Iron Curtain'. Besides that, w_A is a parametrization for the wage that, for instance, a trade union would choose given a standard objective function such as $(w_u - \bar{w})^{\alpha} E^{1-\alpha}$, with E denoting employment. In such an approach, wage levels covered by w_A in our model would be chosen, depending on the level of α. Our approach, however, also covers other cases of labor market rigidities such as sector-specific minimum wages.

[4] A subsidy to firms would be financed via a lump-sum tax on households.

and substituting for y_i using the budget constraint yields the following national welfare measures:

$$U_A = (a - p_A)\frac{X_A}{2} + s(w_A - \bar{w}) + \bar{w} + T_A, \quad U_B = (a - p_B)\frac{X_B}{2} + \bar{w} + T_B. \tag{2}$$

2.2 Production

We assume there is a fixed number of identical firms, M, each disposing of one unit of capital (which could be thought of as a specific resource or technology, but also as knowledge capital such as a patent, a certain technology or a suitable managing team). The setup of each plant requires one unit of capital. We further assume that capital is owned by residents outside the region considered.[5] We will let m_A (m_B) denote the number of firms settling in A (B). At most M firms can enter the production stage; we will concentrate on cases where demand is such that the market is large enough for all M firms to operate profitably. Location has a bearing on firms' wage costs. Moreover, trade in x is not free, but causes per-unit transport costs τ. We assume firms to act as Cournot competitors. Their profits amount to

$$\pi_A = (p_A - w_A)x_{AA} + (p_B - w_A - \tau)x_{BA}, \quad \pi_B = (p_B - \bar{w} - \tau)x_{AB} + (p_B - \bar{w})x_{BB}, \tag{3}$$

with x_{ij} denoting the quantity of x sold in i but produced in j, and π_i denoting profits of a firm residing in country i.[6] Maximizing these, and using aggregate demand , we obtain

$$\begin{aligned} x_{AA} &= \frac{a - w_A + m_B(\bar{w} - w_A + \tau)}{b(M+1)}, \; x_{BA} = \frac{a - w_A - m_B(w_A - \bar{w}) - m_B\tau - \tau}{b(M+1)}, \\ x_{AB} &= \frac{a - \bar{w} - m_A(\bar{w} - w_A) - m_A\tau - \tau}{b(M+1)}, \; x_{BB} = \frac{a - \bar{w} + m_A(w_A - \bar{w} + \tau)}{b(M+1)}. \end{aligned} \tag{4}$$

In what follows, the total quantity sold in a market will be denoted by $X_i = m_i x_{ii} + m_j x_{ij}$, whereas the total quantity produced will be referred to as $Pr_i = m_i(x_{ii} + x_{ji})$.[7]

[5] This is a common assumption in the related literature, as competition for mobile firms targets multinationals whose capital owners are typically very dispersed across countries.

[6] We make the standard assumption that the resource constraints $M_A(x_{AA}+x_{BA}) < n$ and $M_B(x_{BB}+x_{AB}) < 1$ are fulfilled so that there is enough labor to produce goods x and y in both countries.

[7] It is easy to see that the most 'expensive' production is the one for exports to B, x_{BA}. We focus on cases where two-way trade occurs in equilibrium, i.e. $x_{BA} > 0$ (and $x_{AB} > 0$). This means trade costs are below the prohibitive level $\tau^{proh} \equiv (a - w_A - m_B(w_A - \bar{w}))/(1 + m_B)$.

Prices will be

$$p_A = \frac{a + m_A w_A + m_B \bar{w} + m_B \tau}{M+1}, \qquad p_B = \frac{a + m_A w_A + m_B \bar{w} + m_A \tau}{M+1}, \tag{5}$$

which illustrates the standard finding that more local producers lead to tougher competition in the product markets with trade barriers, lowering prices accordingly.[8] Inserting prices and quantities into (3), we obtain firms' profits as

$$\begin{aligned} \pi_A &= \frac{(a - w_A + m_B(\bar{w} - w_A + \tau))^2}{b(M+1)^2} + \frac{(a - w_A - m_B(w_A - \bar{w}) - m_B\tau - \tau)^2}{b(M+1)^2}, \\ \pi_B &= \frac{(a - \bar{w} - m_A(\bar{w} - w_A) - m_A\tau - \tau)^2}{b(M+1)^2} + \frac{(a - \bar{w} + m_A(w_A - \bar{w} + \tau))^2}{b(M+1)^2}. \end{aligned} \tag{6}$$

From here on, let us denote the wage differential $w_A - \bar{w}$ by Ω. It is positive whenever industrial wages in A are higher than the (competitive) level in B (or the y-industry, for that matter). Upon entry, each firm will have to pay a lump-sum tax. This keeps the model analytically tractable while maintaining the main distortion we are analyzing, namely the one of the location decision.[9]

The equilibrium firm allocation will be such that after-tax profits are equalized, i.e. $\pi_A - t_A = \pi_B - t_B$.[10] Solving this equation for m_A, dividing by M and denoting the tax differential $(t_A - t_B)$ by Θ leads to the share μ_A of firms that will settle in A:

$$\mu_A = \frac{1}{2} - \frac{b(M+1)\Theta + 2\Omega(2a - 2w_A - \tau + \Omega)}{4M(\tau^2 + \Omega^2)}, \tag{7}$$

which depends on the tax differential in an intuitive way: A higher Θ lowers μ_A.[11] With $\Theta = \Omega = 0$, we have $\mu_A|_{w_A=\bar{w}, t_A=t_B} = 1/2$, which means in a fully symmetric case profits are equalized in a perfectly dispersed equilibrium. We will further analyze μ_A once we have come up with the equilibrium tax differential.

[8] It can also be seen that more firms in A make prices higher in both countries.

[9] A profit tax would lead to a similar distortion and hence qualitatively similar results, but considerably complicate the analysis.

[10] Capital has a participation constraint, namely that after-tax profits are positive. We only consider such cases here, making production by all M firms viable (this is without loss of generality: If after-tax profits were negative, fewer firms would enter the market until profits would turn nonnegative. As M is exogenous in our model, this figure would be replaced by a number $K < M$, not changing our results). After-tax profits also constitute an upper bound for any potential fixed costs associated with making production operative (for instance, for the relocation and installation of real capital, or for the adaptation of knowledge capital to local needs in the region constituted by countries A, B).

[11] $\frac{\partial \mu_A}{\partial \Theta} = -\frac{b(M+1)}{4M(\tau^2+\Omega^2)} < 0$.

2.3 Governments

Each government maximizes welfare within its jurisdiction. National welfare consists of consumer surplus, wage income and business tax income, as can be seen from (2) when using the household budget constraint and the equilibrium prices from (5). Note that tax proceeds equal the business tax times the number of firms: $T_A = m_A t_A$, $T_B = m_B t_B$. With a higher industrial wage in A, there is an extra wage income to be earned in the x-sector, whereby the corresponding total wage bill depends on $Pr_A = m_A(x_{AA} + x_{AB})$, the total quantity of x actually produced there.[12] This leads to government objectives of

$$U_A = CS_A + (w_A - \bar{w})Pr_A + T_A + \bar{w}, \quad U_B = CS_B + T_B + \bar{w}. \tag{8}$$

Consumer surplus is the net utility from x-consumption. Using X_A, X_B and prices from (5), we find

$$\begin{aligned} CS_A &= \frac{(aM - M(\bar{w} + \tau) - m_A(w_A - \bar{w} - \tau))^2}{2b(M+1)^2}, \\ CS_B &= \frac{(aM - M\bar{w} - m_A(w_A - \bar{w} + \tau))^2}{2b(M+1)^2}. \end{aligned} \tag{9}$$

There are several forces in our model that will drive equilibrium taxes and therefore the allocation. First, the stronger is market separation by trade costs, the more firms will benefit from locating in different markets due to a reduction of competitive pressure, driving up the governments' ability to tax them, ceteris paribus. We call this the 'local market power' effect. Second, countries benefit from firms producing within their area as consumers benefit from local production in the presence of trade costs. This is the standard motive in the 'bidding for firms' literature and will give countries an incentive to support inward FDI via lower taxes or subsidies. We dub this the 'local production benefit' effect. Third, there is an extra rent in country A, the 'wage bill' effect. For country A, it adds another trade-off to the model as employment in its x-sector will generate income there while at the same time raising the price of the goods produced. This harms consumers, including those residing in A. Given this nontrivial interplay of the forces involved, even in this standard model set-up, it is not ex ante clear what the equilibrium tax differential across countries and hence the allocation will look like.

Governments maximize (8) with respect to t_A and t_B, respectively. The corresponding

[12] Note that this quantity equals s from (2) since one unit of labor is needed for one unit of output.

Nash equilibrium in tax rates displays a differential of

$$\Theta^* = \frac{2\Omega[4\tau^3 - (8a - 8w_A + 3\Omega)\tau^2 + 2\Omega^2\tau - \Omega^2(4a - 4w_A + \Omega)]}{b(5 + 6M)\tau^2 + b(3 + 4M)\Omega^2}. \quad (10)$$

With this, we are in a position to analyze how industrial wage differentials affect tax policies and industry allocation.

2.4 Main results

From (10), we see that the tax differential is zero if there is no industrial wage differential across countries ($\Omega = 0$). This just means that symmetric regions will set taxes at the same level. Observe, however, that $\Theta^* < 0$ whenever Ω is positive:

Proposition 1 *In a tax competition game between two countries that have the same population, but differ with respect to industrial wage costs, the high-wage country sets a lower tax than the low-wage country at the Nash equilibrium:* $\Theta^*|_{\Omega>0} < 0$.

Proof: See Appendix.

Being at a wage cost disadvantage when it comes to hosting mobile foreign capital, country A offsets some of it by offering a more favorable tax regime. Local consumption as well as local production earning its citizens high wages induce the government to give up some of the proceeds of business taxation. It should be stressed that this result holds independently of the specific size of the real trade costs $\tau > 0$ and the 'extra wage' $\Omega > 0$: For all parameter constellations, the high-wage country A will optimally charge a lower tax than country B.

Given this result, the question arises what the allocation of firms across countries will be. Plugging Θ^* from (10) into (7) provides us with

$$\mu_A^* = \frac{1}{2} - \frac{\Omega[2a(2M + 1) - 2\bar{w} - \tau - M(w_A + 3\bar{w} + 2\tau)]}{M[2(4M + 3)\Omega^2 + 2(6M + 5)\tau^2]}. \quad (11)$$

Under standard restrictions on parameters it can be shown that $\mu_A^* < 1/2$, i.e., the equilibrium tax policy will never be such that it can 'override' the higher wage in A:

Proposition 2 *The lower tax in high-wage country A still leaves it with a smaller fraction of firms than the low-wage country B,* $\mu_A^* < \frac{1}{2}$.

Proof: See Appendix.

This result shows that even with a lump-sum tax instrument at its disposal, country A will not override the wage effect to attract a majority of mobile real capital to its jurisdiction. Observe again that the proof holds independently of the levels of $\tau, \Omega > 0$. The distortion in the labor market harms consumers (with higher prices) and firms (with higher costs, rendering it more 'expensive' for A to attract them), making the additional wage bill and tax base costly.

From the results obtained so far, it follows that μ_A^* is larger than the equilibrium share of firms A would host in the absence of taxes:

$$\mu_A^{notax} = \mu_A^* + \frac{b(M+1)\Theta^*}{4M\left(\tau^2 + \Omega^2\right)}, \tag{12}$$

where the factor added is negative since $\Theta^* < 0$ from Proposition 1. This leads us to our last main result:

Proposition 3 *Tax competition leads to a larger fraction of firms locating in the region with high labor costs than would otherwise be the case,* $\mu_A^* > \mu_A^{notax}$.

This can also be seen by inspection of (7): Any negative Θ diminishes the numerator of the term which is subtracted from 1/2. In particular, this holds true for $\Theta^* < 0$, rendering μ_A^* larger than μ_A^{notax}.

To sum up, our model predicts that a high wage country competing for mobile capital will find it optimal to offer a comparatively favorable tax regime so as to make up for (part of) the disadvantage of higher labor costs. In our model, this is driven by the motives of consumer surplus and wage bill maximization, but also by tax revenue motives.[13]

3 Labor market institutions, labor costs, and tax policies

Before turning to more elaborate empirical tests of the model's key implication, we first discuss some descriptive evidence providing for a closer link between the stylized theo-

[13] While many other motives to attract foreign investment are conceivable, such as technological or knowledge spillovers or political rents from firm attraction, such benefits can in most cases be expected to hit competing countries symmetrically. We therefore believe that modeling any of these additional benefits would not overturn our results.

retical model and the data. In most of what follows, we make use of data for European countries for the period from 1982 to 2000. As a first step in linking the theoretical model to the data, we study the association between unionization and labor costs. While our model builds on an exogenous wage differential between countries, differences in unionization rates across countries are a prime candidate for the ultimate source of international labor cost differentials. Figure 1 shows that in our data, there is indeed a strong positive link between unionization, measured by union density (union membership divided by employment), and the wage level, measured by the hourly compensation cost in manufacturing (in U.S. dollars as of 2000).[14]

Figure 1 about here.

As the next step in our descriptive analysis, we want to see if the link between relative wage levels and key parameters of the tax system implied by our theoretical model is actually present in the raw data. This raises the question what to choose as the best available measure to proxy the tax parameter from the model. As the model makes use of a lump-sum tax (or subsidy), it would be desirable to use the level of direct subsidies offered to firms when making international location decisions. However, this is difficult to accomplish, as one would need information not only on subsidies actually paid, but also on incentive packages for multinational firms in bidding races that the respective government lost (and therefore did not pay out any subsidy). For this reason, the data on state aid to firms compiled by Eurostat are of no particular use for our purpose.

Given the difficulties to characterize national tax policies on the subsidy side, we employ the statutory corporate tax rate as our key parameter. This may actually be seen as an advantage over using subsidies because the tax rate is a fairly broad measure for the attractiveness of locations for private investment. In particular, the corporate income tax rate is relevant even for smaller firms that often do not have the bargaining power to obtain sizable subsidies. We also expect the statutory tax rate to be less affected by the business cycle and other temporary country-specific effects that are difficult to control for in an empirical analysis.[15]

As the theoretical model highlights the role of wages relative to a competing location for investment, we need to specify a wage-level variable of competing locations. Following

[14] One might be tempted to exploit labor market institutions as a source of exogenous variation in wage differentials. However, the variation over time in such institutions is typically not sufficient for identification.

[15] Of course, this choice is not without alternatives. For a discussion, we refer the reader to Devereux et al. (2008) and Overesch and Rincke (2011). Both studies find that countries compete over statutory rates, but less so over effective rates.

the method employed by the tax competition literature to derive the average tax rate of neighbors (Devereux et al., 2008; Overesch and Rincke, 2011), we make use of a simple weighted average of all other countries' compensation costs, where the weights w_{ij} are chosen such that they inflate a given neighbor's impact on the average according to country size, measured by population (*pop*), and deflate it according to geographical distance between capitals (d). Specifically, the weights of neighbors j of a given country i are set as[16]

$$w_{ij} = \begin{cases} \frac{\ln(pop_j)/d_{ij}^2}{\sum_{k \neq i} \ln(pop_k)/d_{ik}^2} & \text{if} \quad j \neq i \\ 0 & \text{if} \quad j = i. \end{cases} \tag{13}$$

Using the squared inverse distance is motivated by the notion that geography matters for the investment decisions of multinational firms. In particular, we refer to the evidence on a negative effect of distance on FDI flows (Carr et al., 2001). Similarly, geographical distance drives transportation costs for produced goods but also information costs (Portes and Rey, 2005). Inflating the weights by population (in logs) reflects the fact that competing locations with larger markets (all other things equal) should be more relevant in determining the relative position of a given country than competitors with small markets.[17] Note that the weights are normalized such that $\sum_j w_{ij} = 1 \; \forall i$. This normalization is necessary, because otherwise the compensation cost of a given country could not be meaningfully compared to that of competing countries.

Figure 2 shows how the corporate income tax is related to hourly compensation costs in the raw data for up to 27 European countries between 1982 and 2000 (unbalanced panel). The left panel depicts the association between the statutory tax rate and compensation costs, LC, after netting out country-specific effects and neighbors's compensation costs. We note that, holding wages in competing locations constant, the corporate income tax is strongly negatively related to a country's wage level.[18]

Figure 2 about here.

Having said this, it is remarkable that if we plot the business tax rate against *neigh-*

[16]We offer robustness checks for the definition of weights in Section 5.

[17]By using population in logs to inflate weights, we respond to the rather extreme variation in country size in Europe (think of Luxembourg vs. Germany). Taking logs makes sure that averages are not dominated by a few large countries.

[18]One should note that the association between both variables could also be driven by other factors. For instance, if corporate taxes are following a secular downward trend over time, a positive trend in productivity (and, thus, increasing compensation costs) could be responsible for the observed pattern.

bors' compensation costs (while netting out country-specific effects and own compensation costs), we find a positive association (right panel of Figure 2). Hence, holding own wages constant, the less competitive a given country's neighbors in terms of their labor costs, the less favorable is the tax policy towards firms. Again, the observed partial correlation is consistent with our theoretical model.

We next turn to a distinctive feature of our data: It covers a rather drastic change in the relative competitiveness in terms of labor costs for some western European countries. As discussed in the introduction, this change was brought about by the breakdown of the communist regimes in eastern Europe in 1989/90 and suddenly exposed western Europe to a number of new low-wage competitors for FDI. Defining the compensation cost differential as the difference between a given country's own compensation costs and the average compensation cost of its neighbors, we can easily compare the evolution of relative compensation costs over time across countries. Figure 3 depicts the compensation cost differential for selected western European countries for the period from 1975 to 2000. Up to 1989, countries in eastern Europe did not function as competitors for FDI. Consequently, only western European countries are used to derive relative compensation costs for these years. For the period 1990 – 1992, no reliable data on internationally comparable labor costs are available for eastern Europe. Because these countries were already functioning as alternative locations for FDI, we code the relative compensation costs of western European countries for the transition period as missing. From 1993 onwards, we include data for the Czech Republic, Hungary, and Poland when deriving the relative labor costs of western European economies. Starting from 1997, we also phase in labor costs in other eastern European countries.[19]

Figure 3 about here.

For the period up to 1989, the variation in compensation cost differentials is actually modest. This holds in particular for the years after 1982 for which data on corporate income tax rates is available. Were we to test the implications of our theory using only this part of the data, we would most certainly face the problem of insufficient variation in compensation cost differentials. For the period 1993 – 2000, however, the graph shows a huge variation in compensation cost differentials. The cross-country variation in this part of the data is due to the fact that with distance-based weights used to construct neighbors' compensation costs, differences in geographical location relative to eastern Europe translate into differences in relative compensation costs. The role of geographic

[19]Phasing-in according to data availability: Bulgaria from 1998; Estonia, Latvia, Lithuania, Slovak Republic, and Slovenia from 1997; Romania in 2000.

distance to eastern Europe as a force mitigating the degree of exposure to the integration shock is thus reflecting the fact that some economies, like, for instance, Austria and Germany, were directly exposed to the new competitors by sharing a border with formerly communist countries, while economies at the western periphery of Europe (like Spain, for instance) were much more insulated against the shock. The compensation cost differential for Germany, a country located at the eastern edge of western Europe, thus jumps from a value close to zero in 1989 to about 11.5 dollars in 1993. Given a level of compensation costs of 25.0 dollars in 1993, this means that, under the assumed weighting scheme, the integration shock put Germany at a labor cost disadvantage of about 45% relative to its neighbors.[20] In contrast, relative labor costs in Spain were virtually unaffected by the shock. The estimation approach to be discussed below is tailored to exploiting the differences in how countries were affected by the integration shock.

As our theory predicts a tax policy response to changes in relative labor costs, it seems useful to contrast the evolution of corporate income taxes in Western Europe with the different degree to which countries in western Europe were exposed to the integration shock. Figure 4 displays the average statutory corporate income tax rates for three groups of countries for the period 1982 – 2000. The solid line depicts the (unweighted) average rate in the group of countries located geographically at the border to formerly communist eastern Europe (Austria, Denmark, Finland, Germany, Greece, Italy, and Sweden). The dashed line shows the average tax rate of all remaining western European countries in our data. Apart from the well-known secular downward trend in the rate of the corporate income tax in western Europe, it is striking to see that the average tax difference between the group of border countries and the remaining western European countries stands at 13.1 percentage points in 1989 and then melts down to 3.0 percentage points within a period of just five years, before staying more or less constant until the end of the period covered by our data. Figure 3 and Figure 4 together suggest to consider the integration shock of 1989/90 as the ultimate driving force behind the relative tax rate reductions in the border countries in the post-integration phase.

Figure 4 about here.

Evidently, the impact of the integration shock on the compensation cost differential of western European countries is driven by the component capturing neighbors' labor costs.

[20] Shortly after their integration into the world economy, the new competitors stood (relative to German labor costs) at 8% (Czech Republic, 2.0 dollars), 11.6% (Poland, 2.9 dollars), and 12% (Hungary, 3.0 dollars), respectively (all figures for the year 1993). Using alternative weighting schemes to derive the differentials yields very similar results. For instance, using just the inverse distance to compute the weights, i.e. setting $w_{ij} = \frac{1/d_{ij}}{\sum_{k\neq i} 1/d_{ik}}$, we obtain a compensation cost differential for Germany of 8.5 for the year 1993, implying a labor cost disadvantage relative to neighbors of about 34%.

This suggests that a tax response of governments to the change in their country's relative competitiveness would be driven mostly by changes in their neighbors' wage levels rather than changes in the wage level of their own country. Figure 5 shows that this view is indeed consistent with our data. In order to highlight the potential impact of the integration shock, Figure 5 displays the association between the corporate income tax and compensation costs after netting out country-specific effects and productivity (GDP per hour worked). Both panels of the graph make use of just two observations for each of 12 western European countries. The first observation for each country is from 1988, while the second one is from 1994. The graph thus plots the data for a short panel of countries covering the occurrence of the regime change in eastern Europe. The left panel reveals that, holding productivity constant, changes in the business tax rate are not systematically related to changes in compensation costs. Once we turn to the link between taxes and *neighbors'* compensation costs (right panel), however, the pattern looks remarkably different. The regression line exhibits a positive slope (equivalent to the coefficient of neighbors' compensation costs in a fixed-effects regression with own compensation costs as control), suggesting that tax rates set by western European governments between 1988 and 1994 were responsive to the integration shock, in particular to changes in competitors' labor costs, in a way that is consistent with our theoretical model. For instance, the graph nicely shows that the integration shock and the resulting severe reduction in neighbors' average labor costs for Germany and Austria between 1988 and 1994 has coincided with significant tax reductions in these countries. Figure 5 also highlights the potential of the integration shock to be used for identification purposes.

Figure 5 about here.

Since wages are sticky in the highly regulated labor markets in most western European countries, we certainly do not expect the integration shock to exhibit a short-term effect on labor costs in these countries. It is revealing, however, to study the long-term consequences of the regime change in eastern Europe on labor costs in western Europe. Figure 6 displays the association between the overall growth of hourly compensation costs in 16 western European countries and the distance to eastern Europe (measured by the distance to the nearest eastern European capital). The left panel displays the relationship for the period 1975–1989. Apparently, there is no systematic link between the two. Compared to this, the right panel reveals a striking correlation between labor cost growth and distance to eastern Europe in the period after the integration shock (1990–2007). Among the six countries with the lowest growth in compensation costs, we find Germany, Finland, Italy, and Sweden, all geographically close to eastern Europe. Figure 6 carries the straightforward implication that when estimating the impact of relative labor costs on tax policies, we need to take into account that, at least in the long run, taxation and labor costs might well respond jointly to changes in the competitive environment. One possible explanation is that under the intense pressure from low-wage competition for FDI in eastern Europe, unions in those western European countries directly exposed to the newly competing locations responded by moderating their behavior when bargaining over wage rates.

Figure 6 about here.

4 Empirical approach

4.1 Estimation

In the following, we focus on tax policy responses to the integration shock experienced by European economies around 1989/90. We do not believe that tax policies were fundamentally different in that period. Rather, by analyzing the response to the integration shock, we hope to present estimates derived from a credibly exogenous source of variation.

As discussed above, our dependent variable will be the statutory corporate income tax rate. In order to test the hypothesis about compensating tax policies, we set up a simple empirical model relating the corporate income tax rate to the labor cost differential plus controls. With LC denoting labor costs, we define the labor cost differential as

$$\Delta LC_{it} = LC_{it} - \sum_{j \neq i}^{N} w_{ij} LC_{jt}. \tag{14}$$

Assuming a linear relation between taxes and relative labor costs, our estimation equation then reads

$$TAX_{it} = \alpha \Delta LC_{it} + X_{it}\beta + \gamma_t + c_i + \epsilon_{it}, \quad i = 1 \ldots, N, \quad t = 1982, \ldots, 2000, \tag{15}$$

where TAX_{it} represents the corporate income tax rate, X_{it} is a vector of controls, c_i denotes country-specific and γ_t period-specific effects. From the theoretical model and the preliminary analysis of our data, we expect α to be negative.

As regards the choice of an estimator for model (15), we have already argued that it will be difficult to control all factors that could affect both the corporate income tax as well as the (relative) wage level. Moreover, there are at least two reasons why causality could run not only from wages to the tax rate, but also from the tax rate to the wage level.

First, corporate income taxes affect investment. Consequently, labor market conditions must be assumed to depend on a country's attractiveness for private investment and, therefore, tax policies. Second, a recent literature on the incidence of corporate taxes finds a sizeable shifting of taxes onto labor.[21] For these reasons, we need to design an identification strategy that takes into account the likely endogeneity of the labor cost differential in equ. (15).[22]

Our approach to dealing with the endogeneity of ΔLC is to employ an instrumental variable (IV) capturing the effect the breakdown of the communist regimes in eastern Europe had on relative labor costs in western Europe. More specifically, we construct and use as an IV a variable measuring the exposure (in geographical terms) of western European countries to the fall of the Iron Curtain and the implied integration shock. The design of the IV follows the spirit of the interaction term in difference-in-difference applications, but deviates from this example in two respects. First, the interaction involves the inverse distance to eastern Europe instead of an indicator for 'treated' units. This accounts for the fact that the integration shock carries the potential to affect all countries in western Europe, but to a different degree, plausibly depending on the physical distance to the origin of the shock. Second, the interaction involves a negative time trend instead of a dummy variable for post-shock periods. This is meant to reflect that the characteristics of the shock were such that its potential impact on western Europe was large at the beginning, but then gradually reduced by the process of economic integration itself (leading to rising wages in eastern Europe, etc.). Hence, using a negative time trend in the interaction is consistent with labor cost convergence after the occurrence of the shock. Note that Figure 3 suggests this sort of convergence has affected labor cost differentials of Austria and Germany after 1995, for instance.

To sum up, we define the instrumental variable as

$$IV_{it} = \begin{cases} (1/D_i)(2001 - t) & \text{if } t \geq 1990 \\ 0 & \text{if } t < 1990 \end{cases}, \tag{16}$$

[21]Arulampalam et al. (2012) and Dwenger et al. (2011) assume that an increase in the business tax reduces the excess return that capital and labor can bargain over. A higher tax thus transmits into lower wages. Felix and Hines (2009) also look at the rent sharing aspect of corporate tax incidence, but focus on the distribution of rents among unionized and non-unionized workers.

[22]While unobserved changes in a country's competitiveness as a location for FDI would tend to induce a positive correlation between taxes and wages, both arguments in favor of reversed causality (from the corporate tax to wages) imply a negative relation between the tax rate and the wage level. We therefore have no strong prior about the direction of the bias when estimating α from OLS regressions.

where $t = 1982, \ldots, 2000$ and D_i is the distance of country i's capital to the geographically closest capital in eastern Europe. By construction, we expect the instrument to be positively correlated with the labor cost differential, an assumption that will be confirmed in the first-stage regressions reported below. Note that the flavor of the IV relates our work to a number of studies in related contexts that have exploited integration shocks for the purpose of identification using similar techniques (e.g., Besley et al., 2010; Redding and Sturm, 2008).

While it would, in general, be possible to include in the estimation equation own and neighbors' labor costs separately, we prefer the specification containing just the differential. The reason is that, while the integration shock provides us with a well-motivated and statistically powerful instrument for the differential, we lack a credible and strong instrumental variable for the level of labor costs alone.

To ensure the validity of the IV, we need to account for a potential direct effect of the 1989/90 regime change on tax policies in western Europe. The most likely form such an effect could plausibly take is that of a change in the tax price of western European countries relative to their neighbors', i.e. increased direct tax competition for mobile capital. A recent empirical literature argues that this sort of competition has significantly contributed to the decline in statutory corporate income tax rates in Europe since the beginning of the 1980s (Devereux et al, 2008; Overesch and Rincke, 2011; Davies and Voget, 2008). We follow this strand of literature and model a potential direct tax competition effect by including a weighted average of neighbors' tax rates among the control variables, where the weights are the same as those used to derive neighbors' compensation costs. The tax competition variable thus takes the form

$$TAX_{-it} = \sum_{j \neq i}^{N} w_{ij} TAX_{jt}. \tag{17}$$

As discussed by Overesch and Rincke (2011), using lagged average tax rates of neighbors to account for tax competition is much simpler (and perhaps more realistic) than incorporating contemporaneous values, but gives very similar results, irrespective of whether the lagged tax of neighbors is instrumented or not. As we want to focus on the role of labor cost differentials for international tax policies, we therefore include $TAX_{-i,t-1}$ as an ordinary regressor.

The identification strategy suggested above implies that only western European countries can be used for estimation. With just 16 countries with sufficient data on all variables at our disposal, we face a lack of degrees of freedom for certain robustness checks. In particular, we cannot allow for country clusters when computing standard errors for the coefficients in equ. (15). We therefore complement the analysis for western Europe by estimations for a total of 27 countries, including eastern Europe. Naturally, these countries can enter the analysis only with observations from the year 1993 onwards.

While it is straightforward to run simple OLS regressions on the extended sample, 2SLS regressions require an alternative specification of the IV. Adopting the logic of the IV for estimations from the baseline sample, we presume that the labor cost differential induced by the integration shock in eastern European countries after 1993 was driven by the degree of remoteness, measured by the distance to western Europe. As for western Europe, we interact the shock with a time trend, but now the trend is *positive*. The specification thus captures the idea that the geographic position of a country like the Czech Republic (with two immediate neighbors in western Europe) would let us predict a larger labor cost differential (in absolute terms) relative to its neighbors than a more remote country like Lithuania. Using an indicator $EAST_i$ for eastern European countries and denoting by $\tilde{D}_i$ the distance of country i's capital to the geographically closest capital in western Europe, we thus specify the IV for the extended sample as

$$IV'_{it} = \begin{cases} (1/D_i)(2001-t) & \text{if } t \geq 1990 \text{ and } EAST_i = 0 \\ -(1/\tilde{D}_i)(2001-t) & \text{if } t \geq 1990 \text{ and } EAST_i = 1 \\ 0 & \text{if } \quad t < 1990 \end{cases}, \tag{18}$$

where $t = 1982, \ldots, 2000$. Note that for countries contributing observations only from post-shock periods, the specification of the IV is similar in spirit to instrumenting the labor cost differential by a series of country-specific trends.

As regards the other control variables, we follow the literature on the determinants of corporate tax rates and include country size (GDP in logs), and a measure for openness (share of the sum of exports and imports in GDP). We also control for preferences for public expenditures (percentage of population below 15 and above 65 years). Furthermore, we follow Slemrod (2004) and check the robustness of our findings by including the top personal income tax. Without a convincing instrument for this variable in sight, we treat it as an ordinary regressor. Finally, as long as we measure labor costs by real compensation costs (as opposed to unit labor costs), we account for productivity differences by including among the controls the real GDP per hour worked.

4.2 Data

As regards the tax data, Overesch and Rincke (2011) provide for a detailed description of sources. Labor cost differentials are constructed from two variables. The first one is a pure measure of real compensation costs, comprising hourly direct pay, employer social insurance expenditures, and other labor taxes. Most of the data come from the U.S. Bureau of Labor Statistics (BLS; International Comparisons of Hourly Compensation Costs in Manufacturing, 1975-2009). Because the BLS data does not cover all European countries, we complement the data by compensation costs provided by Eurostat. We use prevailing commercial market exchange rates to convert Eurostat compensation costs from national currencies to U.S. dollars. As a second measure for real compensation costs, we use unit labor costs in manufacturing, representing the current cost of labor per 'real quantity unit' of output produced. The data is taken from the ILO's 'Key Indicators of the Labor Market' database. The unit labor cost indicator is particularly useful for our study as it explicitly accounts for productivity differences in generating output, and it is specifically designed as an indicator of countries' cost competitiveness.

Data for real GDP per hour worked is from the Conference Board's Total Economy Database. Data sources for the remaining control variables are Eurostat and the World Development Indicators of the World Bank.

Table 1 presents descriptive statistics for the data used in the baseline panel estimations.[23] While more recent data are available for all variables used in estimations, we prefer to include only years up to 2000. With this restriction imposed, our data is symmetric in the sense that it covers eight years before the integration shock (1982 – 1989) and eight after the shock (1993 – 2000).[24]

Table 1 about here.

Descriptive statistics for the extended panel data set are displayed in Table 2.[25]

Table 2 about here.

[23]The countries contributing to the data set are Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, and UK.

[24]Recall that we have to exclude years 1990 – 1992 for missing data on compensation costs in eastern Europe.

[25]This data adds to the baseline data set observations from Bulgaria, Czech Republic, Cyprus, Estonia, Hungary, Latvia, Lithuania, Poland, Slovak Republic, Slovenia, and Switzerland. Cyprus and Switzerland are not covered in the baseline data due to missing information on unit labor costs.

5 Empirical results

5.1 Western Europe

Findings from our baseline estimations using only western European countries are assembled in Table 3. All regressions account for a full series of country fixed effects and a full series of period effects. Standard errors are robust to heteroscedasticity. We report results with the usual form of clustered standard errors in Subsection 5.2, using an extended sample with sufficient degrees of freedom.

Table 3 about here.

Our key explanatory variable is the real hourly compensation cost differential. Column (1) reports a simple OLS regression with country size, openness, the population share of young and the share of elderly people as a basic set of controls. The coefficient of the compensation cost differential is not statistically different from zero.

We next turn to 2SLS estimates exploiting the variation in the compensation cost differential induced by the integration shock. Column (2) shows the first-stage regression with the same set of controls as in column (1). As expected, we find a strong positive partial correlation between the IV and the differential. The main regression, reported in column (3), suggests a strong negative impact of the compensation cost differential on the statutory tax rate. This finding corroborates the results obtained from the theoretical analysis. The estimate indicates that a one-dollar increase in the compensation cost differential would trigger a compensating cut in the corporate income tax rate of about one percentage point.

Columns (4) to (7) show that our results are only marginally affected if we add our additional controls. It is worth noting that the signs of the corresponding coefficients are all in line with previous work on the determinants of corporate income tax rates. Direct tax competition seems to be present in western Europe, but accounting for this does not affect our main finding. Note that including the lagged tax of neighbors reduces the number of observations to 212. With all covariates included, we estimate a one-standard deviation increase in the compensation cost cost differential to decrease the statutory tax rate by 5.5 percentage points.

Column (8) reports the first stage from the 2SLS in column (7). Even with the additional controls, the IV is still highly significant. As our main regression accounts for the labor cost differential, but not for own and neighbors' labor costs separately, it is instructive to see how the IV correlates with the components of the labor cost differential. From the descriptive analysis, we expect the positive partial correlation between the differential and the IV to stem mainly from a negative correlation between the IV and neighbors' compensation costs. For the correlation between the IV and own compensation costs, we expect a (weaker) positive correlation (recall the discussion of Figure 6). The expectations are confirmed in columns (9) and (10). Three quarters of the identifying partial correlation can be attributed to neighbors' compensation costs, one quarter to own compensation costs.

While regressions with GDP per hour worked control for locations' own productivity, a more comprehensive approach of testing the hypothesis of compensating tax policies involves using unit labor costs to derive the cost differential. This way, our estimations account for labor cost differences between locations net of productivity differences. Table 4 assembles the corresponding estimation results. We find all the previously obtained key results confirmed. With all controls included, the coefficient of the differential is -0.467, implying that a one-standard deviation increase in the unit labor cost differential decreases the statutory tax rate by 7.0 percentage points. It is reassuring to see that this estimate is higher than the corresponding impact of 5.5 percentage points for a one-standard deviation increase in the compensation cost differential, for cross-country wage differences should partly reflect differences in labor productivity.

Table 3 about here.

Splitting up the impact of the IV on the unit labor cost differential, we find that about 63 percent of the partial correlation between the two variables is explained by the correlation between the IV and neighbors' unit labor costs, while own unit labor costs contribute a share of 37 percent.

5.2 Extended sample and further robustness tests

This subsection presents estimations using an extended sample including some eastern European countries. Recall that we do not observe labor costs for these countries before 1989. For eastern European countries the IV therefore takes the form of a trend with country-specific slope, where the slope is determined by remoteness, i.e. distance from western Europe. Because internationally comparable unit labor costs are unavailable for some countries in the extended sample, we report only estimations using the real compensation cost differential.

Table 5 displays the results. The inference is now based on standard errors which are robust to heteroscedasticity and clustering by country. Once we employ the IV to account for the endogeneity of labor costs, we obtain an estimate of -0.012 for the compensation cost differential, a value only slightly higher than the one derived before. The coefficient of the IV in the first stage is almost identical to the one from Table 3, column (2), suggesting that our IV is of similar power in the extended sample as compared to the baseline. Moreover, the coefficient of the compensation cost differential is robust to including our additional controls.

Table 5 about here.

We conclude that extending the analysis to eastern Europe leaves our main result unchanged: In prices as of 2000, an increase in compensation costs by one dollar would, all other things equal, trigger a cut of the corporate income tax by 1.2 percentage points. Although the clustered standard errors are much higher than those from Table 3, our point estimates are still significantly different from zero at least at the five percent level.[26]

It is worth noting that the effect of direct tax competition is highly significant as long as our regressions do not account for the compensation cost differential (results not shown). Once we consider direct tax competition and competition working through labor costs as two alternative forces shaping national tax policies in Europe, we find that the compensation cost differential is always significant, while the direct tax competition effect is not statistically different from zero.[27]

We now turn to tests of the robustness of the specification of the IV.[28] Recall from Equ. (18) that for $t \geq 1990$, $IV'_{it} - IV'_{i,t-1} = -1/D_i$ if $EAST_i = 0$, and $IV'_{it} - IV'_{i,t-1} = 1/\tilde{D}_i$ if $EAST_i = 1$. In other words, we impose linearity on the part of the decay of the shock over time that is captured by the IV and, therefore, can be used for identification. In order to check if the linearity assumption affects the power of the IV, we use two alternative

[26] Without accounting for country clusters, the standard errors are almost identical to those reported in Table 3.

[27] Note, however, that the tax competition effect is present in the regressions using the smaller sample and standard errors not accounting for country clusters (see Table 4).

[28] We use the extended sample for all remaining robustness tests. The results are similar in all cases if we run the estimations on the baseline sample.

non-linear specifications. First, we impose a decay of the shock over time following

$$IV''_{it} = \begin{cases} \frac{1}{D_i}\frac{2000-t}{2001-t} & \text{if } t \geq 1990 \text{ and } EAST_i = 0 \\ -\frac{1}{\tilde{D}_i}\frac{2000-t}{2001-t} & \text{if } t \geq 1990 \text{ and } EAST_i = 1 \\ 0 & \text{if } \quad t < 1990 \end{cases}, \tag{19}$$

where $t = 1982, \ldots, 2000$. Hence, the decay of the shock captured by IV''_{it}, measured by $IV''_{it} - IV''_{i,t-1}$, is growing (in absolute value) over time. Alternatively, consider

$$IV'''_{it} = \begin{cases} \frac{1}{D_i}\frac{1}{t-1992} & \text{if } t \geq 1990 \text{ and } EAST_i = 0 \\ -\frac{1}{\tilde{D}_i}\frac{1}{t-1992} & \text{if } t \geq 1993 \text{ and } EAST_i = 1 \\ 0 & \text{if } \quad t < 1990 \end{cases}, \tag{20}$$

where $t = 1982, \ldots, 1989, 1993, 1994 \ldots, 2000$. This specification implies that the decay of the shock is falling (in absolute value) over time. Loosely speaking, IV''_{it} would fit better compared to the baseline IV_{it} if the speed of convergence of labor costs after the shock had increased over time. In contrast, IV'''_{it} would make for a better fit compared to the baseline if the speed of labor cost convergence had been high immediately after the shock and then fallen over time.

Estimations using the alternative specifications for the IV are reported in Table 6, columns (1) and (2). Specification IV'' gives results that are even stronger than those from Table 5, column (7), both in terms of statistical significance of the estimated coefficient as well as the power of the instrument, measured by the corresponding F-statistic. Using this estimate, we are back to our original prediction that an increase in compensation costs by one dollar would be compensated by a cut of the corporate income tax by one percentage point.

Table 6 about here.

If we employ specification IV''', however, the power of the instrument is greatly reduced (the F-statistic is 2.7), resulting in a very imprecise estimate of the coefficient of the compensation cost differential. We conclude that we identify the effect of labor cost differentials as long as the specification of the instrument accounts for a sufficient degree of persistence of labor cost differentials after 1989/90. This finding nicely fits the pattern of compensation cost differentials over time for western European countries like Austria and Germany, for instance (see Figure 3).

The remaining columns in Table 6 report robustness checks with respect to the weight matrix imposed to derive labor cost differentials. Across a number of alternative weighting schemes, we find that i) our finding of a negative partial correlation between labor costs and corporate income taxes is robust, and ii) our previous estimates are conservative as regards the absolute value of the coefficient of the compensation cost differential. More specifically, we note that imposing a weaker distance decay by deflating weights by $1/d_{ij}$ instead of $1/d_{ij}^2$ gives higher point estimates (in absolute value). In contrast, whether we inflate weights by measures of country size or not, and whether we use population (in logs) or GDP (in logs) in the weight formula leaves our estimates virtually unaffected.

Apart from the reported robustness tests, we checked our main findings in numerous respects. In particular, we checked if our results are driven by influential observations. Although the small number of cross sectional units at our disposal puts limits to such exercises, we found that the evidence is not affected by extreme observations. For instance, there are some small high-wage countries in western Europe that are loaded with FDI (Luxembourg, Netherlands). Excluding such countries from the analysis does not change our findings (results not reported).

6 Discussion

This paper develops a model showing that governments of high-wage countries tend to set tax policies which are more favorable for firms than policies chosen by low-wage countries. The model lends support to the notion that differences in corporate income tax policies can at least partly be explained as government policies devised to compensate firms for international labor cost differentials. Using data for European countries, we estimate a substantial effect of labor cost differentials on corporate tax rates, thereby confirming the model prediction. Our results are in line with preliminary findings discussed by Overesch and Rincke (2009), who analyze the tax response of western European countries to the breakdown of communism in 1989 and come to the conclusion that wage differentials are a more plausible driving force (compared to strategic competition in tax rates) for the significant tax cuts in many western European countries during the 1990s. The evidence presented in this paper suggests that the direct tax competition effect is significantly weakened if one accounts for relative labor costs. It would be interesting to know if this also holds in other settings.

We conclude that if labor market institutions are such that wages are kept above the competitive level, this may not only cause unemployment in the respective industries, but also drive governments to compensate firms by offering a more favorable corporate tax system. Hence, high wages make it more likely that governments initiate tax policies often characterized as favoring the interests of 'capital' over those of 'labor'.

Acknowledgments

We thank the co-editor in charge, Jim Hines, and two anonymous referees for insightful and constructive suggestions. We are also indebted to Andreas Haufler and Dominika Langenmayr for careful readings and helpful remarks and Michael Overesch for generously sharing his tax data with us. The paper benefitted from discussions at seminars in Berlin (DIW), Mannheim (ZEW), Munich, and at the IIPF congress in Uppsala (2010). Ferdinand Mittermaier would like to thank the Bavarian Graduate Program in Economics for financial support.

References

Arulampalam, W., Devereux, M. P., Maffini, G., 2012. The direct incidence of corporate income tax on wages. Eur. Econ. Rev. 56, 1038–1054.

Besley, T., Persson, T., Sturm, D., 2010. Political competition, policy and growth: Theory and evidence from the United States. Rev. Econ. Stud. 77, 1329–1352.

Bjorvatn, K., Eckel, K., 2006. Policy competition for foreign direct investment between asymmetric countries. Eur. Econ. Rev. 50, 1891–1907.

Carr, D. L., Markusen, J. R., Maskus, K. E., 2001. Estimating the knowledge-capital model of the multinational enterprise. Am. Econ. Rev. 91, 693–708.

Davies, R. B., Voget, J., 2008. Tax competition in an expanding European Union. Working Paper 08/30, Oxford University Centre for Business Taxation.

Devereux, M. P., Lockwood, B., Redoano, M., 2008. Do countries compete over corporate tax rates? J. Public Econ. 92, 1210–1235.

Dwenger, N., Rattenhuber, P., Steiner, V., 2011. Sharing the burden: Empirical evidence on corporate tax incidence. Preprint of the Max Planck Institute for Tax Law and Public Finance 2011-14.

Egger, P., Seidel, T., 2011. Tax competition, trade liberalization, and imperfect labour markets. Oxf. Econ. Pap. 63, 722–739.

Exbrayat, N., Gaigne, C., Riou, S., 2012. The effects of labour unions on international capital tax competition. Can. J. Econ. 45, 1480–1503.

Felix, R. A., Hines Jr., J. R., 2009. Corporate taxes and union wages in the United States. NBER Working Paper No. 15263.

Haufler, A., Mittermaier, F., 2011. Unionisation triggers tax incentives to attract foreign direct investment. Econ. J. 121, 793–818.

Haufler, A., Wooton, I., 1999. Country size and tax competition for foreign direct investment. J. Public Econ. 71, 121–139.

Haufler, A., Wooton, I., 2010. Competition for firms in an oligopolistic industry: The impact of economic integration. J. Intern. Econ. 80, 239–248.

Konings, J., Murphy, A. P., 2006. Do multinational enterprises relocate employment to low-wage regions? Evidence from European multinationals. Rev. World Econ. 142, 267–286.

Leahy, D., Montagna, C., 2000. Unionisation and foreign direct investment: Challenging conventional wisdom? Econ. J. 110, 80–92.

Lommerud, K. E., Meland, F., Sorgard, L., 2003. Unionised oligopoly, trade liberalisation and location choice. Econ. J. 113, 782–800.

Overesch, M., Rincke, J., 2009. Competition Competition from low-wage countries and the decline of corporate tax rates - Evidence from European integration. World Econ. 32, 1348–1364.

Overesch, M., Rincke, J., 2011. What drives corporate tax rates down? A reassessment of globalization, tax competition, and dynamic adjustment to shocks. Scand. J. Econ. 113, 579–602.

Portes, R., Rey, H., 2005. The determinants of cross-border equity flows. J. Intern. Econ. 65, 269–296.

Redding, S., Sturm, D., 2008. The costs of remoteness: Evidence from German division and reunification. Am. Econ. Rev. 98, 1766–1797.

Slemrod, J., 2004. Are corporate tax rates, or countries, converging? J. Public Econ. 88, 1169–1186.

Appendix

Proof of proposition 1

In (10), given that the denominator and the factor in front of the square brackets are unambiguously positive for any positive wage differential ($\Omega > 0$), Θ^* is negative if and only if the term in square brackets is negative. It reads

$$-(8a - 8w_A + 3\Omega)\tau^2 + 2\Omega^2\tau - \Omega^2(4a - 4w_A + \Omega) + 4\tau^3, \tag{A.1}$$

which can be rearranged to

$$-4(2a - 2w_A - \tau)\tau^2 - \Omega\left(\Omega(4a - 4w_A + \Omega) + 3\tau^2 - 2\Omega\tau\right). \tag{A.2}$$

Both terms in this latter difference are unambiguously negative with all parameters greater than zero and $a - w_A > \tau$ (whereby the latter inequality puts an upper bound on trade costs which is greater than or equal to τ^{proh}, cf. footnote 7), rendering the overall term negative.

Proof of proposition 2

For μ_A^* from (11) to be greater than 1/2, the term subtracted from 1/2 would have to be negative. Since the denominator of the fraction is trivially nonnegative, as is - by assumption - the first factor in the numerator (Ω), this could only be the case if the term in square brackets in the numerator was negative. It equals

$$2a(2M + 1) - 2\bar{w} - \tau - M(3\bar{w} + w_A + 2\tau), \tag{A.3}$$

which can be rearranged to

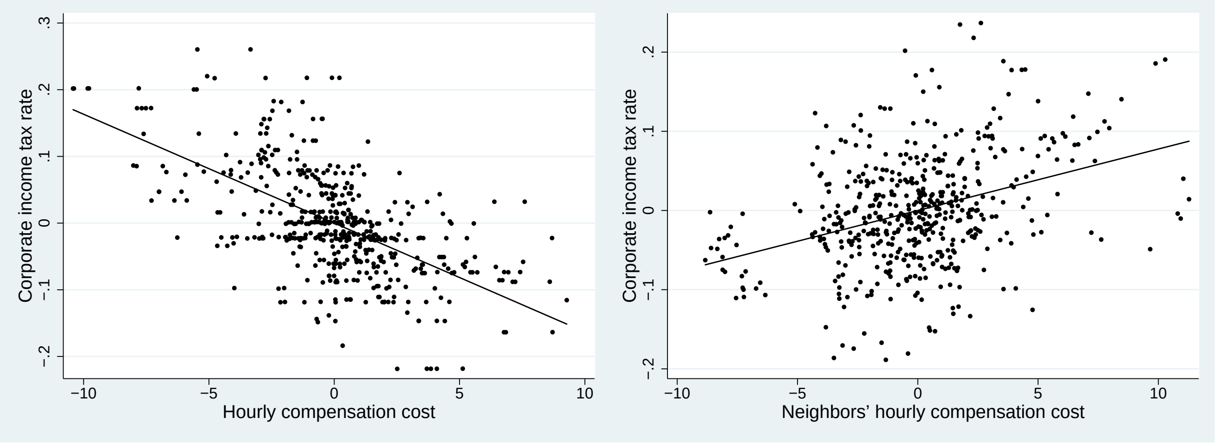
$$2(a - \bar{w}) + M(4a - 3\bar{w} - w_A - 2\tau) - \tau. \tag{A.4}$$

This term is unambiguously positive with all parameters greater than zero, $w_A > \bar{w}$ and $a - w_A > \tau$, rendering the subtracted term positive and μ_A^* smaller than 1/2.

Figure 1: Hourly compensation cost in manufacturing and union density

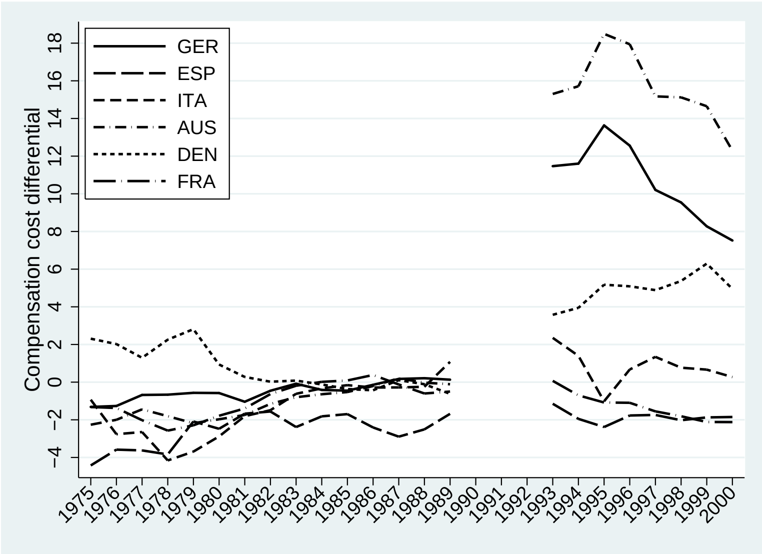
Graph shows association between hourly compensation cost and union density (19 European countries, year 2000) after netting out a constant and GDP per hour worked.

Figure 2: Corporate income tax and hourly compensation costs



Left (right) panel shows association between corporate income tax and hourly compensation cost (neighbors' hourly compensation cost) after netting out country-specific effects and neighbors' compensation cost (own compensation cost) for 27 European countries, 1982–2007.

Figure 3: Compensation cost differentials for selected western European countries



Graph shows differentials between own and neighbors' hourly compensation costs (in year 2000 U.S. dollars). Neighbors' hourly compensation costs computed as weighted average across all other countries. See text for details on the weight formula. Values for 1990 – 1992 omitted due to missing data on compensation costs in eastern Europe.

Figure 4: Average statutory tax rates for different European regions

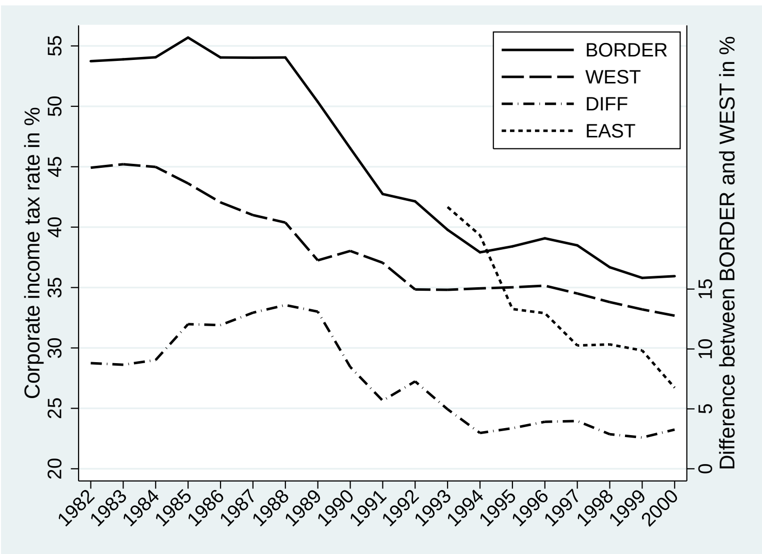
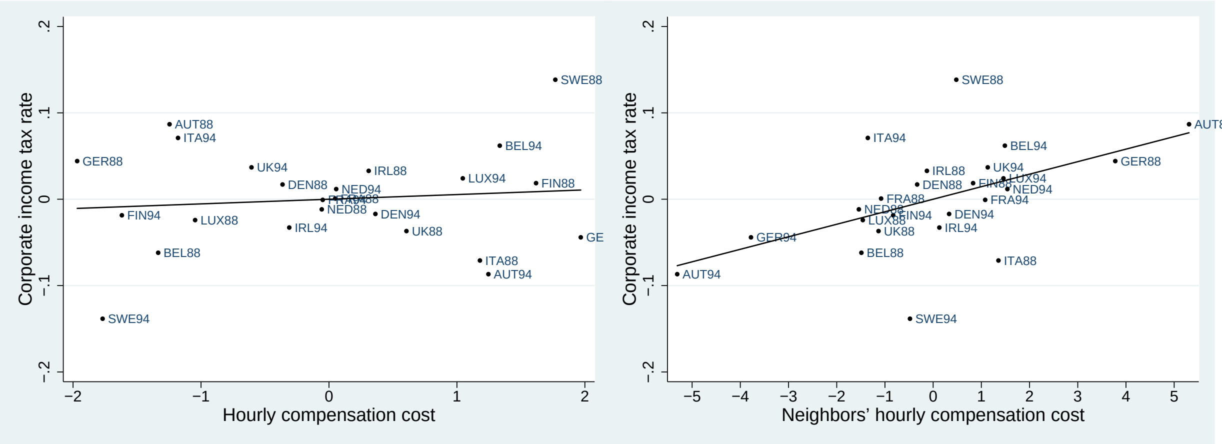
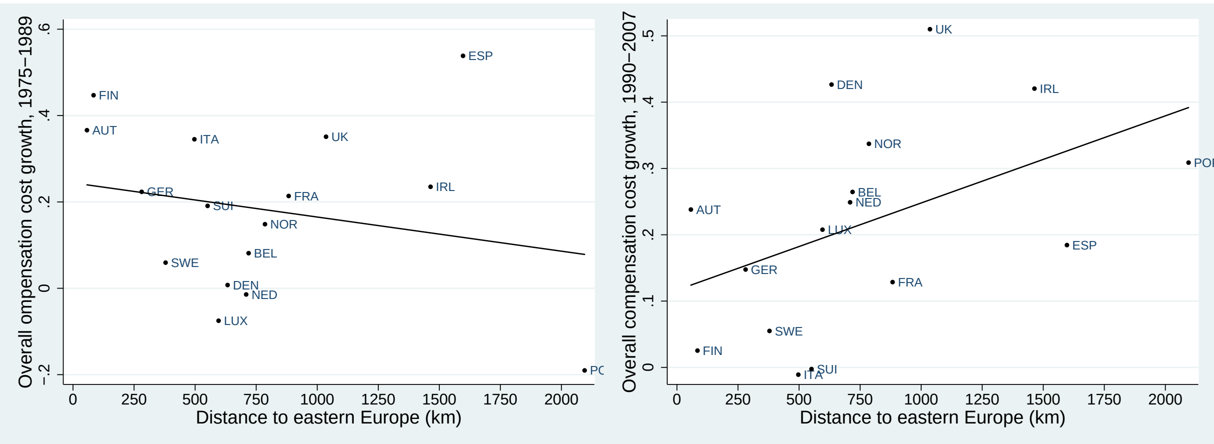


Figure 5: Corporate income tax and hourly compensation costs, 1988 and 1994



Left (right) panel shows association between corporate income tax and hourly compensation cost (neighbors' hourly compensation cost) after netting out country-specific effects and GDP per hour worked for 12 western European countries, 1988 and 1994.

Figure 6: Growth in hourly compensation cost and distance to nearest eastern European capital



Left (right) panel shows association between overall rate of growth in real hourly compensation cost between 1975 and 1989 (1990 and 2007) and distance to nearest eastern European capital.

Table 1: Descriptive statistics

Variable	Mean	Std.Dev.	Min	Max
Statutory corporate income tax rate	0.420	0.101	0.250	0.659
Hourly compensation cost	18.3	5.54	5.01	32.0
Hourly compensation cost differential [a]	1.01	5.02	-10.1	19.3
Unit labor cost	0.683	0.184	0.290	1.12
Unit labor cost differential [a]	0.029	0.151	-0.420	0.542
Log(GDP)	12.1	1.37	8.23	14.4
Log(Population)	9.36	1.40	5.90	11.3
Openness	0.840	0.481	0.366	2.79
% young	0.187	0.027	0.143	0.303
% old	0.146	0.017	0.105	0.182
Top personal income tax rate	0.570	0.104	0.400	0.870
Neighbors' corporate income tax rate [a]	0.422	0.072	0.302	0.591
GDP per hour worked	22.9	4.99	11.2	33.6
IV, derived from integration shock	8.16	19.6	0.000	140

Unbalanced panel (16 countries, years 1982-1989 and 1993-2000, 224 observations).
[a] Competitors' weights based on squared inverse distance and population (in logs).

Table 2: Descriptive statistics, extended sample

Variable	Mean	Std.Dev.	Min	Max
Statutory corporate income tax rate	0.392	0.109	0.187	0.659
Hourly compensation cost	16.2	7.80	1.14	33.3
Hourly compensation cost differential [a]	-0.526	7.50	-21.0	19.9
Log(GDP)	11.9	1.38	8.23	14.4
Log(Population)	9.20	1.36	5.90	11.3
Openness	0.874	0.447	0.366	2.79
% young	0.187	0.026	0.143	0.303
% old	0.144	0.017	0.105	0.182
Top personal income tax rate	0.532	0.121	0.250	0.870
Neighbors' corporate income tax rate [a]	0.402	0.069	0.273	0.585
GDP per hour worked	20.7	6.62	6.79	33.6
IV, derived from integration shock	3.86	20.4	-70.2	140

Unbalanced panel (27 countries, years 1982-1989 and 1993-2000, 286 observations).
[a] Competitors' weights based on squared inverse distance and population (in logs).

Table 3: Compensation cost differentials and tax policies

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Dependent variable	TAX	Comp. cost differential	TAX	TAX	TAX	TAX	TAX	Comp. cost differential	Own comp. cost	Neighbors' comp. cost
Estimator	OLS	OLS	2SLS	2SLS	2SLS	2SLS	2SLS	OLS	OLS	OLS
Compensation cost differential	-0.0017	-	-0.0099***	-0.011***	-0.0095***	-0.0099***	-0.011***	-	-	-
	(0.0014)		(0.0018)	(0.002)	(0.0019)	(0.0018)	(0.002)			
Log(GDP)	0.269***	4.92**	0.283***	0.234***	0.241***	0.289***	0.189***	5.71**	3.65**	-2.06
	(0.038)	(2.30)	(0.045)	(0.043)	(0.047)	(0.045)	(0.045)	(2.65)	(1.40)	(1.72)
Openness	-0.188***	-12.2***	-0.268***	-0.235***	-0.237***	-0.270***	-0.201***	-11.5***	-8.36***	3.11
	(0.050)	(2.56)	(0.060)	(0.065)	(0.054)	(0.058)	(0.057)	(3.12)	(1.54)	(2.10)
% young	-0.434	-17.7	-0.427	-0.624	-0.039	-0.677	-0.190	10.3	8.57	-1.75
	(0.409)	(13.8)	(0.438)	(0.459)	(0.384)	(0.506)	(0.439)	(17.8)	(10.3)	(13.1)
% old	4.23***	-59.4***	3.79***	3.55***	4.21***	3.61***	3.92***	-33.8	-48.2***	-14.4
	(0.698)	(22.5)	(0.740)	(0.710)	(0.707)	(0.714)	(0.661)	(24.3)	(15.6)	(17.3)
Top personal income tax rate	-	-	-	0.475***	-	-	0.476***	9.73***	8.98***	-0.751
				(0.094)			(0.099)	(3.31)	(2.05)	(2.33)
Neighbors' business tax rate (lagged)	-	-	-	-	0.211*	-	0.228*	-19.0**	4.97	24.0***
					(0.125)		(0.137)	(9.05)	(4.38)	(6.19)
GDP per hour worked	-	-	-	-	-	0.006	-0.001	-0.492**	-0.044	0.448***
						(0.005)	(0.004)	(0.120)	(0.116)	(0.137)
IV	-	0.116***	-	-	-	-	-	0.104***	0.025***	-0.079***
		(0.017)						(0.017)	(0.008)	(0.011)
Number of obs.	224	224	224	224	212	224	212	212	212	212
R^2	71.4	-	-	-	-	-	-	-	-	-
F-statistic (IV)	-	46.4	46.4	43.4	45.1	44.0	38.2	38.2		

Unbalanced panel, years 1982-1989 and 1993-2005. Standard errors robust to heteroscedasticity. All regressions include a full series of country and year effects.

Table 4: Unit labor cost differentials and tax policies

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Dependent variable	TAX	Unit labor cost differential	TAX	TAX	TAX	TAX	Unit labor cost differential	Own unit labor cost	Neighbors' unit labor cost
Estimator	OLS	OLS	2SLS	2SLS	2SLS	2SLS	OLS	OLS	OLS
Unit labor cost	0.045	-	-0.478***	-0.560***	-0.404***	-0.467***	-	-	-
differential	(0.047)		(0.115)	(0.143)	(0.084)	(0.089)			
Log(GDP)	0.261***	0.184*	0.323***	0.272***	0.219***	0.160**	0.091	0.028	-0.063
	(0.035)	(0.105)	(0.070)	(0.074)	(0.065)	(0.065)	(0.116)	(0.083)	(0.043)
Openness	-0.144***	-0.633***	-0.450***	-0.444***	-0.354***	-0.333***	-0.559***	-0.501***	0.058
	(0.048)	(0.130)	(0.112)	(0.133)	(0.083)	(0.092)	(0.128)	(0.090)	(0.046)
% young	-0.475	0.514	-0.006	-0.162	0.343	0.195	0.705	0.558	-0.147
	(0.396)	(0.670)	(0.596)	(0.638)	(0.495)	(0.518)	(0.654)	(0.534)	(0.259)
% old	4.35***	-0.573	4.10***	3.88***	4.58***	4.29***	-0.211	-0.751	-0.540
	(0.667)	(1.06)	(0.959)	(0.975)	(0.839)	(0.827)	(1.01)	(0.848)	(0.389)
Top personal	-	-	-	0.551***	-	0.517***	0.272**	0.294***	0.022
income tax rate				(0.120)		(0.112)	(0.124)	(0.094)	(0.051)
Neighbors' business	-	-	-	-	0.567***	0.641***	0.436	1.06***	0.620***
tax rate (lagged)					(0.168)	(0.194)	(0.285)	(0.194)	(0.128)
IV	-	0.0024***	-	-	-	-	0.0024***	0.0009***	-0.0015***
		(0.0004)					(0.0005)	(0.0003)	(0.0002)
Number of obs.	224	224	224	224	212	212	212	212	212
R^2	71.3	-	-	-	-	-	-	-	-
F-statistic (IV)	-	30.9	30.9	25.7	32.5	29.0	29.0		

Unbalanced panel, years 1982-1989 and 1993-2005. Standard errors robust to heteroscedasticity. All regressions include a full series of country and year effects.

Table 5: Compensation cost differentials and tax policies, extended sample

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dependent variable	TAX	Comp. cost. diff.	TAX	TAX	TAX	TAX	TAX
Estimator	OLS	OLS	2SLS	2SLS	2SLS	2SLS	2SLS
Hourly compensation cost differential	-0.0030	-	-0.012***	-0.013**	-0.011***	-0.011***	-0.012**
	(0.0025)		(0.004)	(0.005)	(0.004)	(0.003)	(0.005)
Log(GDP)	0.194*	-1.12	0.153	0.113*	0.134	0.164	0.105
	(0.108)	(3.98)	(0.116)	(0.068)	(0.112)	(0.104)	(0.070)
Openness	-0.177***	-5.97**	-0.204***	-0.168**	-0.186***	-0.208***	-0.143*
	(0.059)	(3.05)	(0.061)	(0.068)	(0.071)	(0.061)	(0.078)
% young	0.012	-0.471	0.018	-0.372	0.305	0.313	0.308
	(0.597)	(29.6)	(0.692)	(0.770)	(0.591)	(0.946)	(0.749)
% old	3.63**	-54.3	3.15*	3.11*	3.52**	3.53**	3.86***
	(1.64)	(53.0)	(1.77)	(1.68)	(1.72)	(1.46)	(1.32)
Top personal income tax rate	-	-	-	0.620***	-	-	0.616***
				(0.233)			(0.209)
Neighbors' business tax rate (lagged)	-	-	-	-	0.131	-	0.069
					(0.317)		(0.271)
GDP per hour worked	-	-	-	-	-	-0.007	-0.009
						(0.011)	(0.007)
IV	-	0.117***	-	-	-	-	-
		(0.027)					
Number of observations	286	286	286	286	263	286	263
R^2	62.9	-	-	-	-	-	-
F-statistic (IV)	-	18.5	18.5	15.0	8.1	18.7	7.22

Unbalanced panel, years 1982-1989 and 1993-2000. Standard errors robust to heteroscedasticity and clustering by country. All regressions include a full series of country and year effects.

Table 6: Compensation cost differentials and tax policies: Robustness of IV and weights

Dependent variable: Statutory tax rate	(1)	(2)	(3)	(4)	(5)	(6)
Estimator	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS
Specification of IV	IV''	IV'''	linear	linear	linear	linear
Specification of weights	$\ln(pop_j)/d_{ij}^2$	$\ln(pop_j)/d_{ij}^2$	$\ln(pop_j)/d_{ij}$	$1/d_{ij}^2$	$1/d_{ij}$	$\ln(gdp_j)/d_{ij}^2$
Hourly compensation cost differential	-0.010***	-0.014	-0.019***	-0.011**	-0.018***	-0.011**
	(0.003)	(0.009)	(0.007)	(0.005)	(0.007)	(0.005)
Log(GDP)	0.102	0.109	0.162**	0.089	0.151**	0.092
	(0.064)	(0.080)	(0.074)	(0.067)	(0.074)	(0.068)
Openness	-0.135**	-0.155	-0.211**	-0.135*	-0.199**	-0.136*
	(0.067)	(0.096)	(0.010)	(0.072)	(0.095)	(0.074)
% young	0.280	0.351	0.310	0.179	0.205	0.204
	(0.699)	(0.844)	(0.849)	(0.730)	(0.826)	(0.734)
% old	3.88***	3.84***	3.43**	3.57***	3.24**	3.65***
	(1.27)	(1.41)	(1.51)	(1.28)	(1.44)	(1.28)
Top personal income tax rate	0.598***	0.644***	0.659***	0.596***	0.651***	0.605***
	(0.202)	(0.230)	(0.223)	(0.207)	(0.227)	(0.209)
Neighbors' business tax rate (lagged)	0.147	-0.053	-0.104	0.134	-0.008	0.124
	(0.210)	(0.429)	(0.648)	(0.271)	(0.564)	(0.282)
GDP per hour worked	-0.009	-0.010	-0.011	-0.008	-0.009	-0.008
	(0.007)	(0.008)	(0.008)	(0.007)	(0.007)	(0.007)
Number of observations	263	263	263	263	263	263
F-statistic (IV)	12.0	2.7	15.0	6.2	11.6	6.1

Unbalanced panel, years 1983-1989 and 1993-2000. Standard errors robust to heteroscedasticity and clustering by country. All regressions include a full series of country and year effects.