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Ferdinand Mittermaier
Johannes Rincke

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Abstract

We address the role of labor cost differentials for national tax policies. Using a simple theoretical framework with two countries competing for a mobile firm, we show that in a bidding race for FDI, it is optimal for governments to compensate firms for international labor cost differentials. Using panel data for western Europe, we then put the model prediction to an empirical test. Exploiting exogenous variation in labor cost differentials induced by the breakdown of communism in eastern Europe, we find strong support for the model prediction that countries with relatively high labor costs tend to set lower tax rates in order to attract mobile capital. Our key result is that an increase in the unit labor cost differential by one standard deviation decreases the statutory tax rate by 7.3 to 7.5 percentage points.

JEL-Code: H25, H73, F23.

Keywords: foreign direct investment, corporate taxation, labor costs.

Ferdinand Mittermaier
University of Munich
Department of Economics
Munich / Germany
ferdinand.mittermaier@lrz.uni-muenchen.de

Johannes Rincke
University of Munich
Department of Economics
Seminar for Economic Policy
Akademiestrasse 1/II
80799 Munich
Germany
johannes.rincke@lrz.uni-muenchen.de

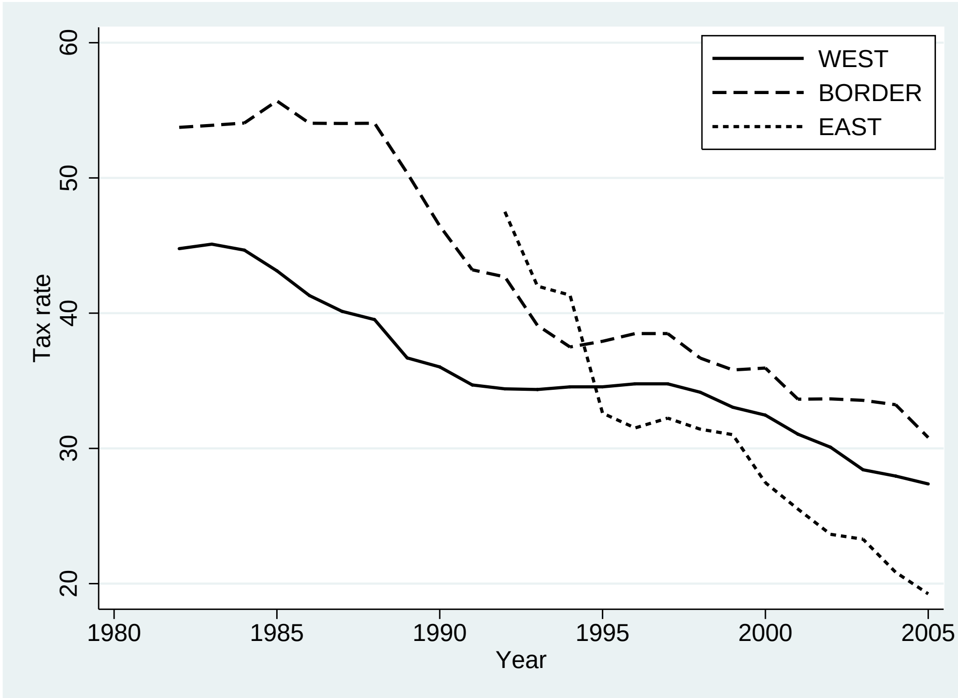
1 Introduction

The last decades have seen an unprecedented level of firm mobility, leaving governments in a situation of intense inter-jurisdictional competition for real capital. It is widely believed that this competition was the main driving force behind the remarkable downward trend in corporate tax rates that has accompanied the process of economic integration between European countries since the 1980s (Devereux et al., 2008; Overesch and Rincke, 2010).

Although the negative trend in corporate income taxes in Europe is a well known phenomenon, there is a noteworthy facet that has so far been largely overlooked. As shown in Figure 1, the average statutory tax rate of those western European countries located geographically at the border to formerly communist eastern Europe (Austria, Denmark, Finland, Germany, Greece, Italy, and Sweden) was substantially higher than the average tax in western countries located farther away from eastern Europe throughout the 1980s. Around 1990, this tax differential began to narrow significantly, until it stabilized at a level of just three to five percentage points after 1994.

Although it seems natural to think of the breakdown of communism in eastern Europe and the following integration of Czechoslovakia, Hungary, Poland and the other transition economies with western Europe as the driving force behind the adjustment of statutory tax rates in those western European countries directly exposed to the integration shock, the ultimate economic factors leading to the tax decline are far from obvious. In particular, as noted by Overesch and Rincke (2009), is does not seem that competition over corporate income tax rates was driving the adjustment process, because the transition countries had tax levels exceeding those in the western countries until 1994. Hence, the downward adjustment of corporate tax levels in the border countries was achieved at a time when the new competitors for FDI had not yet implemented competitive tax policies. This finding suggests to look for other determinants of the relative decrease in tax levels in countries located at the eastern

Figure 1: Average statutory tax rates for different European regions over time



edge of western Europe. Given the characteristics of the transition countries at the beginning of the 1990s, it seems natural to think of the tax adjustment in the border countries as a response to the sudden integration with eastern Europe as a low-wage region.

Guided by the beforementioned example, the paper analyzes the role of labor cost differentials in international competition for FDI. The key point for considering wage differentials is straightforward: In a world of integrated capital markets, labor costs are important determinants of firms' location decisions, and governments competing for FDI should take this into account when designing their tax policies.

The contribution of the study is twofold. First, using a framework similar to that in Haufler and Wooton (1999), we study the role of labor cost differentials in competition for FDI. Our theoretical analysis reveals that if two governments compete for a mobile firm, the high-wage country is willing to offer a more favorable tax regime. From the theoretical analysis emerges the prediction that high-wage countries should compensate firms by setting lower corporate tax rates compared to low-wage countries.

In the second part of the paper, we devise an empirical test of the hypothesis derived from the model, focusing on statutory corporate income tax rates as the key parameters of international tax competition. To solve the evident identification problem when regressing corporate tax rates on wages, we exploit the exogenous variation in labor cost differentials in western Europe induced by the sudden integration with eastern Europe after 1989/90. The idea behind the identification strategy is that, depending largely on the geographical position of countries relative to eastern Europe, some countries in western Europe were more strongly affected than others (in terms of the competitiveness of their wage levels) by the integration of low-wage countries in eastern Europe. As long as we use physical distance to define a composite competitor for each country, a country's labor cost relative to this competitor will therefore be characterized by variation over time that can plausibly be treated as exogenous in a model of corporate tax setting.

The paper adds 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 Davies and Voget (2008) and Overesch and Rincke (2010),[1] while Slemrod (2004) and Winner (2005), e.g., have considered the role of economic openness. Also related is Bénassy-Quéré et al. (2007), who have discussed the role of public infrastructure.

Our data cover a panel of western European countries over the period from 1982 to 2005 and relate statuory corporate income tax rates to two measures of labor costs: the U.S. Bureau of Labor Statistics's index of "Hourly Compensation Costs" in manufacturing, measuring labor costs relative to U.S. levels, and the ILO's measure of unit labor costs. Accounting for the endogeneity of the labor cost differential, a number of controls, the impact of common shocks as well as unobserved heterogeneity

[1]There is a substantial body of empirical literature on tax competition using local data. See, e.g., Besley and Case (1995), Brett and Pinkse (2000), Brueckner and Saavedra (2001), Büttner (2001), and Bordignon et al., 2003.

among countries, the empirical analysis provides strong evidence suggesting that countries with relatively high labor costs tend to set lower corporate income tax rates. The estimated effects are economically significant: If the compensation cost differential increases by one percent of the current compensation cost in the U.S., firms are, on average, compensated by a 0.19 percentage point cut in the tax rate. A one-standard deviation increase in the compensation cost differential thus triggers a 5.1 percentage point cut in taxes. If we take into account differences in labor productivity, we find similar effects: A one-standard deviation increase in the unit labor cost differential is estimated to decrease the statutory tax rate by 7.3 to 7.5 percentage points.

The remainder of the paper is organized as follows. Section 2 presents the theoretical model, Section 3 the evidence, and Section 4 concludes.

2 Bidding for FDI: The role of wage differentials

Our model follows a strand of literature where countries compete for a fixed, discrete number of international firms with a lump-sum location tax/subsidy. Most closely related are Haufler and Wooton (1999) and Bjorvatn and Eckel (2006), who model competition for a single firm, and Haufler and Wooton (2010), who have recently extended the analysis to cover the case of competition for many firms. Other related theoretical work includes Barros and Cabral (2000), who model differing gains from FDI, and Ferrett and Wooton (2010a), who examine the role of the ownership structure. While obviously not mirroring the complex nature of the many features and traits of business taxation, this class of models has the distinctive advantage of displaying the effects at work in inter-jurisdictional competition for capital in the clearest possible way while still maintaining the main trade-offs relevant to our argument.

Consider a mobile foreign entrant firm, f, and two countries, A and B, whose markets are separated by unit transport costs τ. The entrant produces a homogeneous good, x, in what is to become a monopolistic market.[2] There are n identical households in country A and $1-n$ households in country B. A numéraire good, z, is produced by perfectly competitive firms in both countries, with labor being the only input. Trade in z is assumed to be free, equalizing wages in the z-industry to w. In addition, units are scaled such that one unit of labor generates one unit of output, fixing the competitive wage at unity. Household preferences are given by

$$u_i = \alpha x_i - (1/2)\beta x_i^2 + z_i,\ i \in \{A, B\}, \tag{1}$$

yielding linear demand functions for good x. Each household is assumed to inelastically supply one unit of labor. Maximizing u_i subject to the household budget constraint $w = p_i x_i + z_i$ (with p_i denoting the price of x in market i), one obtains

$$X_A = \frac{n(\alpha - p_A)}{\beta}; \qquad X_B = \frac{(1-n)(\alpha - p_B)}{\beta}, \tag{2}$$

as A's and B's aggregate demand for x, respectively. Hence country A is the larger market, as compared to B, if $n > 0.5$.

Following the related literature, we assume that, for the set-up of the new plant, the firm incurs a fixed cost which is sufficiently large to prevent production at both locations. Our set-up thus corresponds to a model of export-platform FDI. Note that serving several countries from one location seems a suitable assumption in the European setting.

Suppose now that there is a sector-specific union in country A, but not in country B, which sets an exogenous wage w_A above the competitive one (which prevails in its z industry), $w_A > w_B = 1$.[3] Let subscripts indicate the country to which terms refer

[2] The absence of incumbent industry implies no loss of generality as long as incumbents would be symmetrically dispersed. For a discussion of the effects of different industry structures, refer to Bjorvatn and Eckel (2006).

[3] Alternatively, we could have used a higher labor input requirement in A (i.e., lower manufacturing productivity) to model a unit labor cost differential. Labor cost differentials have not been analyzed before in this class of models. Barros and Cabral (2000), in an otherwise similar analysis, have considered differing shadow prices of labor (but equal wages) across countries, whereas mobile

and let superscripts denote f's location decision. If f goes to A, then its profits are

$$\pi^A = \frac{n\left(\alpha - w_A\right)^2}{4\beta} + \frac{\left(1-n\right)\left(\alpha - \tau - w_A\right)^2}{4\beta}, \tag{3}$$

with the first term representing market A and the second one market B profits. Since the quantity sent to country B amounts to $(1-n)(\alpha-\tau-w_A)/(2\beta)$, imposing strictly positive exports yields a prohibitive level of trade costs of $\tau^{proh} = (\alpha - w_A)$. Consumer surplus in countries A and B is given by

$$CS_A^A = \frac{n\left(\alpha - w_A\right)^2}{8\beta}; \qquad CS_B^A = \frac{(1-n)(\alpha-\tau-w_A)^2}{8\beta}. \tag{4}$$

Analogous expressions for profits and consumer surplus hold if f goes to B.

For country A, besides increased consumer surplus because of lower prices, attracting the outside firm has the advantage of a higher manufacturing wage income which is partially borne by foreign consumers. Assuming that f's after-tax profits are fully repatriated,[4] and that tax receipts are redistributed to residents, welfare W_A is composed of consumer surplus, tax receipts and the 'extra wage' earned in the x industry.[5] With f choosing the location where after-tax profits are highest, welfare-maximizing governments will engage in a bidding race for the outside firm. A's gross gain, before taxes or subsidies, from attracting f is the welfare difference between the outcome with f located in A and the one with f located in B,

$$\Delta_A = W_A^A - W_A^B = CS_A^A - CS_A^B + (w_A - 1)\frac{\alpha - w_A - (1-n)\tau}{2\beta}. \tag{5}$$

Observe that a country's welfare gain equals its willingness to pay for the investment: If $W_i^i > W_i^j$, country i will be prepared to offer a subsidy. Comparing Δ_A and Δ_B

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capital faces a labor cost differential in our case. Apart from that, in their paper, production (rather than entry) is subsidized.

[4]This assumption is not critical for our results. We refer the interested reader to Ferrett and Wooton (2010b) who show that the equilibrium tax/subsidy offers are independent of the international distribution of the mobile firm's ownership.

[5]The latter could alternatively be interpreted as the employment gain in a country with unemployment where the shadow price of labor is lower than the nominal wage.

at the benchmark case of size symmetry yields

$$\Delta_A - \Delta_B = \frac{(2\alpha - 3w_A - \tau + 1)(w_A - 1)}{8\beta}, \tag{6}$$

which is positive at $1 < w_A < (2\alpha - \tau + 1)/3$. This reveals that, as long as w_A is not 'too large', A will have the stronger incentive to attract f, translating into a lower minimum tax (higher maximum subsidy) it will be prepared to offer.[6] In what follows, we focus on the situation where the high-wage country is willing to offer a lower tax, i.e. when the distortion resulting from production taking place in the high-wage location is not too pronounced.

Having discussed a country's willingness to pay for the investment, we next have to determine what it will actually have to offer in equilibrium in order to win the investment. It is straightforward to determine those 'minimum winning bids'. Each country anticipates the maximum offer of the other country which it must outbid, i.e. it has to bid the rival's gross gain. On top of that, so as to (just) win the race, country i has to offer f the profit differential of what it would earn locating in j, net of what it can earn in i. The minimum winning bid for A is thus

$$O_A = \pi^B - \pi^A + W_B^B - W_B^A = \frac{(2\alpha - \tau - w_A - 1)((3-n)w_A + n - (5n-3)\tau - 3)}{8\beta}. \tag{7}$$

This expression is increasing in w_A, implying a higher subsidy if the wage differential gets larger. It also has the intuitive property of falling in n, reflecting the fact that with positive trade costs, it will be the more costly for A to attract the firm the smaller is its market. It is immediately obvious that due to its cost disadvantage, A will not be able to attract the mobile firm if it has the additional drawback of offering the smaller market. We therefore focus, much like Bjorvatn and Eckel (2006), on the

[6] If the wage differential exceeds the abovementioned threshold, the resulting distortion, i.e. the reduction in consumer surplus due to the increase in the price of x, will become so large that A would be worse off when hosting f compared to the firm going to B.

non-trivial case where A has the larger market, i.e., $0.5 < n < 1$.

Now, to complete the argument, note that only if $\Delta_A > O_A$, country A actually wants to attract the investment. Setting Δ_A equal to O_A and solving for τ, we get a critical level of trade costs above which country A will win the investment. This is

$$\tau^{cr} = \frac{1}{6}(6\alpha - w_A - 5) + \frac{w_A - 1}{6(2n-1)} - \frac{\delta}{3(2n-1)}, \tag{8}$$

with $\delta \equiv \sqrt{(3\alpha - n(6\alpha - 5) - (1-n)w_A - 2)^2 - 3(2n-1)(w_A - 1)(2\alpha + w_A - 3)}$.[7] Observe that this suffices to show that B does not want to attract the investment: The difference in f's profits, $\pi^i - \pi^j$, equals $\Delta_j - O_i = O_j - \Delta_i$.[8] The intuition why lower trade costs make it less likely for A to win the investment is straightforward: Only if markets are sufficiently separated, a difference in market size can have the potential to make entering the high-cost country a profitable option for the foreign firm. This, in turn, makes it easier for the high-cost country to attract the investment.

So far the analysis has shown the regime border between the international firm going to A or B, respectively. In order to be able to infer the differential impact of tax competition on the outcome, we have to compare these results to the outcome that would prevail if taxes/subsidies could not be used by governments. The analogous critical value of trade costs above which the firm goes to A in the *absence* of tax policy (obtained from solving $\pi^A = \pi^B$ for τ) equals

$$\tau^0 = (w_A - 1)/(2n - 1). \tag{9}$$

Confirming our restriction to cases where $0.5 < n < 1$ from above, we find from (8) and (9) that for $0 < n \leq 0.5$, there are no non-prohibitive $\tau^{cr} > 0$ or $\tau^0 > 0$

[7]This latter term's sign is ambiguous because of the square root. However, it is easy to see that the positive root is the relevant one: Adding the first two terms in (8), one obtains an expression that is larger than t^{proh}. For trade to be viable, therefore, the last term must be positive.

[8]For the proof that country A will in fact win if trade costs exceed τ^{cr}-line, notice that

$$\left.\frac{\partial(\Delta_A - O_A)}{\partial\tau}\right|_{\tau=\tau^{cr}} = \frac{\delta}{4\beta} > 0.$$

permitting A to attract f. For $0.5 < n < 1$, however, the critical level of trade costs τ^{cr} in the subsidy race is strictly smaller than the one that would prevail without subsidies. In between those two trade cost levels, tax policy leads to the mobile firm's settling in country A, in spite of the higher cost, while it would go to B in the absence of tax competition.[9]

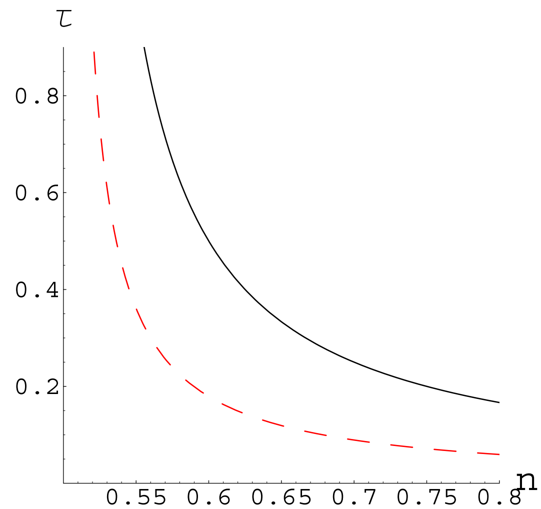
Figure 2 illustrates the effect in (n, τ) - space: The dashed line displays the regime border between A (above) and B (below) winning, respectively, with subsidies. The solid line is the regime border that would prevail if the use of policy instruments was ruled out. As is typical for a bidding race, we get subsidies in equilibrium in a large range of the parameter space. However, upon examination of O_A from (7), it is easy to see that if the high-wage country is large enough and trade costs are above a certain level, A will even be able to charge a tax in equilibrium despite its higher labor costs. This occurs in the northeast of the parameter space of Figure 2. Hence, tax policy gives a country both the opportunity and the incentive to attract investment where it otherwise would not (due to its relatively disadvantageous position in terms of labor costs).

[9]The algebraic demonstration that $\tau^{cr} < \tau^0$ is as follows: Setting τ^{cr} equal to τ^0, and solving, e.g., for α, one obtains

$$\alpha = \frac{n(w_A + 1) - 1}{2n - 1}.$$

Now, α equaling $(n(w_A + 1) - 1)/(2n - 1)$ is inconsistent with $\tau = \tau^0 = (w_A - 1)/(2n - 1)$ lying in between 0 and $\tau^{proh} = \alpha - w_A$, and $w_A > w_B = 1$ while $n > 0$. Having shown that $\tau^{cr} \neq \tau^0$ and noting that the two are continuous, plugging in any values demonstrates that $\tau^{cr} < \tau^0$.

Figure 2: The effect of the presence of tax policy on the equilibrium allocation



$\alpha = 2$; $\beta = 4$; $w_B = 1$; $w_A = w_B + \frac{1}{10}(\alpha - w_B)$.

3 Evidence

3.1 Estimation approach

The model from Section 2 implies that it may be optimal for governments to compensate firms for international labor cost differentials, and that, for moderate labor cost differentials, the level of business taxes should negatively depend on a country's level of labor costs relative to that of its competitors for FDI. In the following, we test this implication empirically. For this purpose we use an unbalanced panel of 16 western European countries for the period from 1982 to 2005.[10] While it would be desirable to use the level of direct subsidies to firms as the dependent variable, this is impossible for a very practical reason: comprehensive information on the level of such subsidies is unavailable. We therefore employ as our dependent variable the statutory corporate income tax rate. This may actually be seen as an advantage over using subsidies because the tax rate is a fairly broad measure for the attractiveness

[10] The countries are Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, UK.

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.

In order to provide us with a test of the hypothesis delineated from the theoretical model, the empirical model relates the corporate income tax rate to the labor cost differential plus controls. Assuming a linear relation between taxes and labor costs, our estimation equation reads

$$TAX_{it} = \alpha \Delta LC_{it} + X_{it}\beta + \gamma_t + c_i + \epsilon_{it}, \quad i = 1\ldots, N, \quad t = 1982, \ldots, 2005, \tag{10}$$

where TAX_{it} represents the corporate income tax rate, ΔLC_{it} is the labor cost differential, X_{it} is a vector of controls, c_i denotes country-specific and γ_t period-specific effects. From the theoretical model we expect a negative α, indicating that countries with less competitive labor costs tend to set lower tax rates.

The labor cost differential is defined as the difference between a country's own labor cost and that of a predefined composite neighbor, $\Delta LC_{it} = LC_{it} - \sum_j w_{ij} LC_{jt}$. The composite neighbor is constructed using weights of competitors w_{ij} which are based on geographical distance, d_{ij}, and population, pop_i. More precisely, these weights are determined as $w_{ij} = \frac{\ln(pop_j)/d_{ij}^2}{\sum_{k \neq i} \ln(pop_k)/d_{ik}^2}$ for $j \neq i$ and $w_{ij} = 0$ for $j = i$. 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. One could argue that GDP would be a better proxy for market size, but a possible interdependence between TAX_i and other countries' GDP induced by fiscal externalities would burden the estimation of the model parameters with an additional endogeneity problem that would be difficult to cope with. We therefore prefer to use population in the weight formula because it can plausibly be treated as exogenous to the model.

Note that the weights are normalized such that $\sum_j w_{ij} = 1 \; \forall i$. This facilitates the interpretation of α, for the labor cost differential is simply the difference between a country's own labor cost and the weighted average of costs in competing countries. As the weights have to be imposed on the model and cannot be tested for their appropriateness, we report several robustness tests using alternative weight schemes in the results section.

As regards the choice of an estimator for model (10), it is clear that naive OLS estimates of the model parameters will generally be uninformative. This is because there are at least two reasons to believe that causality runs not only from wages to the tax rate, but also from the tax rate to the wage level. First, as shown by Devereux and Griffith (1998) and Büttner and Ruf (2007), the corporate income tax is one of the determinants of 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 argues that firms can shift part of the burden of a corporate tax onto labor in the form of lower real wages (Hassett and Mathur, 2006; Felix, 2007; Arulampalam et al., 2007; Desai et al., 2007, Felix and Hines, 2009).

If the tax rate and the wage level relative to other countries are jointly determined variables, LC_{it} and ϵ_{it} will be correlated, which renders OLS estimates inconsistent.[11] We therefore treat the labor cost differential as an endogenous regressor and devise an instrumental variable (IV) approach to obtain consistent estimates for α. Our IV exploits the breakdown of the communist regimes in eastern Europe around 1989/90 as a source of exogenous variation in labor cost differentials. More specifically, we

[11] As 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 have no strong prior about the direction of the bias when estimating α from naive OLS regressions.

construct and use as an IV an indicator measuring the geographical exposure of the different locations in western Europe to the economic shock that was implied by the 1989 revolution and the subsequent integration between western and eastern Europe. The indicator is constructed as follows. Based on the count of the number of countries one has to drive through (or to fly over in case of no land connection) starting from j's capital and heading at the closest eastern European capital, $DIST\,EAST_j$,[12] we construct the IV as $\sum_j w_{ij}(5 - DIST\,EAST_j) \times (2006 - t) \times D_{1990}$, where D_{1990} is a dummy for post-1989 years.[13]

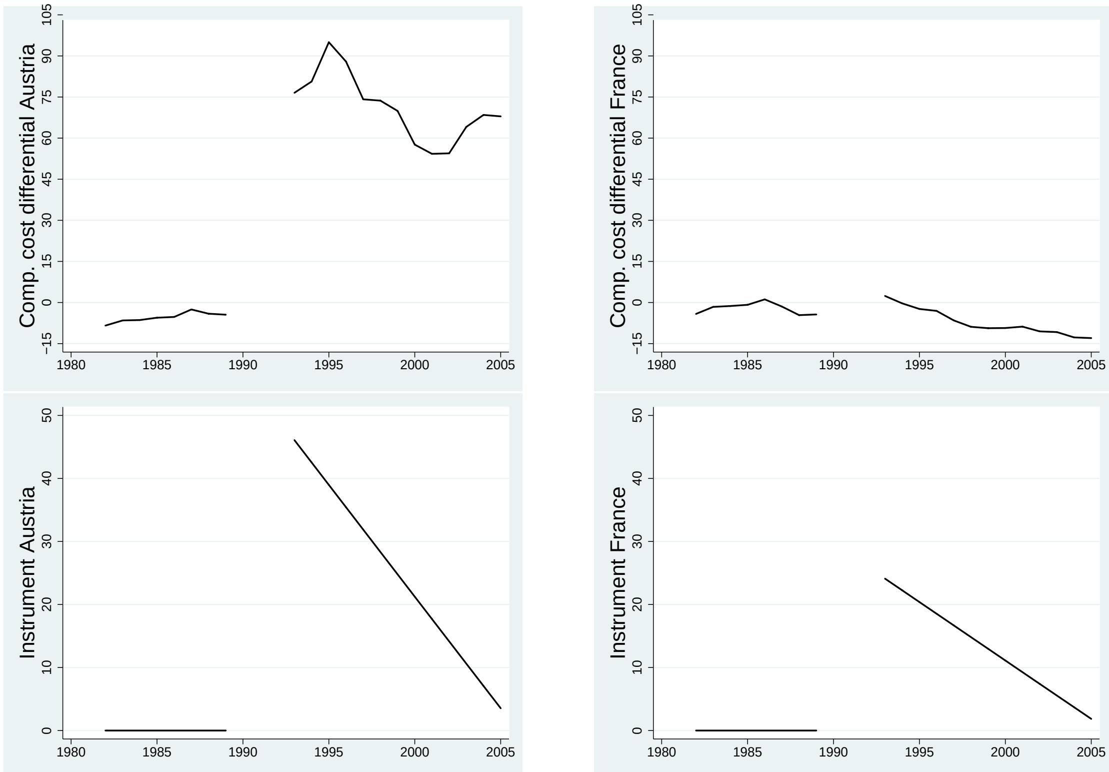
Note that the IV captures variation in ΔLC_{it} driven by differences between countries in terms of their exposure to countries in eastern Europe with initially low (and then slowly increasing) relative labor costs. How the instrument captures exogenous variation in labor cost differentials can best be understood by looking at two countries like Austria and France. While Austria had a wage level similar to that of most of its (western European) competitors before 1989, it suddenly became a high-wage location relative to its neighbors after 1989: due to its geographical location close to countries like the Czech and Slovak Republic, Slovenia, Hungary and Croatia, its labor cost differential experienced a significant jump when all these low-wage countries became new competitors for FDI. The instrument $\sum_j w_{ij}(5 - DIST\,EAST_j) \times (2006 - t) \times D_{1990}$ captures this shock because the average distance to eastern Europe of Austria's neighbors is small. In contrast, France is a country that, due to its geographical position, was much less exposed to the integration shock. Figure 3 illustrates this point and the rationale for the choice of the instrument by jointly showing the labor cost differential and the instrument for both countries. By construction of the instrument, we expect it to be positively correlated with the labor cost differential, an assumption that will be confirmed in the first-stage regressions reported below.

To ensure the validity of our IV we need to account for the direct effect of the 1989/90 break on taxes. We do this by including as an ordinary regressor an indicator

[12] Counting both i and the country of the closest eastern European capital, this gives, for instance, a value of one for Poland, two for Germany, three for France, and four for the UK.

[13] Using $(5 - DIST\,EAST_i) \times (2006 - t) \times D_{1990}$ as IV gives similar, but statistically less significant results.

Figure 3: Compensation cost differential and instrument for Austria and France



Compensation cost differential defined as a country's own labor cost minus that of neighbors, $\Delta LC_{it} = LC_{it} - \sum_j w_{ij} LC_{jt}$. Instrument defined as $\sum_j w_{ij}(5 - DIST\,EAST_j) \times (2006 - t) \times D_{1990}$. See text for details.

equal to $(5 - DIST\,EAST_i) \times (1989 - t) \times D_{1990}$. Note that, in contrast to our IV, $(5 - DIST\,EAST_i) \times (1989 - t) \times D_{1990}$ does not show a discrete jump in 1990, reflecting the fact that the economic integration between East and West was a gradual process rather than an immediate result of the 1989/90 revolution. As an alternative, we use the indicator $BORDER_i \times (1989 - t) \times D_{1990}$, where $BORDER_i$ is a dummy for western European countries with immediate eastern European neighbors.[14] Note also that using the integration shock to identify the impact of labor cost differentials implies that only western European countries can be used for estimation. However, the available data on eastern Europe is used to compute ΔLC_{it}.

To estimate Equation (10), we use the statutory corporate income tax rate[15] together with a compensation cost index (U.S.=100) provided by the U.S. Bureau of

[14]The group comprises Austria, Denmark, Finland, Germany, Greece, Italy, and Sweden.

[15]We would like to thank Michael Overesch (ZEW Mannheim) for generously sharing his tax data with us.

Labor Statistics (BLS), comprising hourly compensation costs in manufacturing with a compensation cost index (USA=100). These are prepared by the BLS specifically in order to assess international differences in employer labor costs. The measure includes hourly direct pay and employer social insurance expenditures and other labor taxes. The exchange rates used are prevailing commercial market exchange rates. In addition, we use unit labor costs in manufacturing, representing the current cost of labor per 'real quantity unit' of output produced, taken from the ILO's 'Key Indicators of the Labor Market' database. This indicator represents a direct link between productivity and the cost of labor used in generating output, and it is specifically designed as an indicator of countries' cost competitiveness.

As regards the control variables, we follow the literature on the determinants of corporate tax rates and include country size (GDP or population in logs), and a measure for openness (share of exports and imports in GDP). We also control for preferences for public expenditures (percentage of population below 15 and above 65 years).[16] A further variable that needs to be considered is the personal income tax. Slemrod (2004) has argued that an increasing gap between personal and corporate income taxes may lead to an incentive to defer taxes by means of excessive retention of capital income at the corporate level. The corporate income tax may therefore serve as a backstop for the personal income tax. Indeed, Slemrod (2004) (and a number of more recent studies cited in the introduction) have found the top personal income tax rate to be positively correlated with the corporate income tax. Although Slemrod's argument is compelling, we are somewhat reluctant to treat the top personal income tax as a control variable, for the point to include it among the regressors also suggests it to be jointly determined with the corporate income tax. However, without a convincing instrument for the personal income tax in sight, treating it as an endogenous regressor is a serious complication. In light of these difficulties, we prefer to omit the top personal income tax rate from our baseline regressions. We then check the robustness of our findings by including it as an ordinary regressor.

[16] Data sources for the control variables are Eurostat and the World Development Indicators of the World Bank.

Table 1: Descriptive Statistics

Variable	Mean	Std.Dev.	Min	Max
Statutory tax rate	0.393	0.102	0.125	0.659
Compensation cost differential [a]	5.79	27.1	-56.8	96.9
Unit labor cost differential [a]	0.031	0.165	-0.527	0.541
Log(GDP)	12.2	1.34	8.22	14.5
Log(Population)	9.37	1.37	5.90	11.3
Openness	0.870	0.510	0.366	2.89
% young	0.183	0.026	0.139	0.303
% old	0.149	0.018	0.105	0.197
Top personal income tax rate	0.547	0.102	0.390	0.870
$(5 - DIST\,EAST) \times (1989 - t) \times D_{1990}$	-14.1	14.6	-48.0	0
$BORDER \times (1989 - t) \times D_{1990}$	-2.09	3.80	-13.0	0
$\sum_j w_{ij}(5 - DIST\,EAST_j) \times (2006 - t) \times D_{1990}$ [a]	11.4	11.4	0	46.1

Unbalanced panel (16 countries, years 1982-1989 and 1993-2005, 304 observations).
[a] Competitors' weights based on squared inverse distance and population (in logs).

Table 1 presents descriptive statistics. We note that the key variables are characterized by substantial variation. The statutory tax ranges from 0.125 (Ireland, 2003-05) to 0.67 (Sweden, 1982-83). The compensation cost differential varies from values below -50 in Portugal throughout the 1990s and 2000s and values above 90 in Austria and Germany in the mid 1990s. The maximum compensation cost differential in the sample thus comes close to the absolute level of compensation costs in the U.S. (recall that the compensation cost index is indexed by the value 100 for the U.S. in all years). The unit labor cost differential also varies substantially, showing values below -0.5 in Ireland in the mid 2000s and values above 0.5 in Austria (mid 1990s) and Norway (mid 2000s). Note that due to missing data for labor costs in eastern Europe prior to 1993, we do not make use of the cross-sections 1990-1992.

3.2 Results

In presenting the results of our empirical analysis, we will proceed in three steps. First, we will briefly discuss simple OLS estimations which ignore the likely endogeneity of the wage differential. Second, we will present the 2SLS estimation results for a number of baseline estimations. Third, we will report on some robustness checks of our main findings.

Let us first turn to the OLS estimations, assembled in Table 2. Columns (1) to (3) report estimations using the compensation cost differential as our main explanatory variable. In columns (1) and (2) we check whether measuring country size by GDP or population makes any difference, but the coefficient of the labor cost differential turns out to be insignificant in both regressions. In column (3) we use the top personal income tax rate as an additional regressor. We now obtain a weakly significant (10% level) negative effect of the labor cost differential. Among the controls, we find a positive coefficient for GDP (in logs), confirming the result familiar from other studies that larger economies tend to set higher corporate tax rates. Moreover, the estimations point to a positive partial correlation between the statutory tax rates and the percentage of elderly people as our proxy for the demand for public services and welfare, and the top personal income tax rate. Finally, the results suggest that more open economies have lower tax rates. While all these findings are well in line with previous studies, our results regarding the role of relative labor costs are inconclusive. Turning to the estimations using the unit labor costs instead of compensation costs to measure the relative cost of labor in columns (4) to (6), we find the results for the control variables confirmed. However, the coefficients for the unit labor cost differential is insignificant across all estimations.

The next step is to see whether accounting for the likely endogeneity of the labor cost differential makes any difference. Before turning to the main results it is instructive to have a brief look at the first-stage regression outcomes, displayed in Table 3. The first three columns report first-stage regressions for the compensation cost differential. Irrespective of whether and how we control for a possible direct effect of the integration shock on tax rates (coefficients of remaining control variables not reported), we find a strong positive partial correlation between the compensation cost differential and the instrument, $\sum_j w_{ij}(5 - DIST\,EAST_j) \times (2006 - t) \times D_{1990}$. Hence, the first-stage regressions support the logic of the instrumental variable's design. It is also worth

Table 2: Labor cost differentials and tax policies, OLS estimations

Dependent variable: Statutory tax rate	(1)	(2)	(3)	(4)	(5)	(6)
Compensation cost differential	-0.0004	-0.0004	-0.0007*	-	-	-
	(0.0004)	(0.0004)	(0.0004)			
Unit labor cost differential	-	-	-	0.067	0.083	0.042
				(0.074)	(0.077)	(0.069)
Log(GDP)	0.143**	-	0.133**	0.132**	-	0.125**
	(0.063)		(0.057)	(0.062)		(0.057)
Log(Population)	-	0.010	-	-	0.089	-
		(0.366)			(0.361)	
Openness	-0.145***	-0.074	-0.115**	-0.104*	-0.042	-0.080
	(0.052)	(0.055)	(0.055)	(0.053)	(0.056)	(0.057)
% young	0.745	0.455	0.671	0.520	0.180	0.517
	(0.698)	(0.767)	(0.687)	(0.673)	(0.782)	(0.674)
% old	3.25***	2.62***	3.37***	3.20***	2.61***	3.39***
	(0.985)	(0.970)	(0.921)	(0.907)	(0.893)	(0.879)
Top personal income tax rate	-	-	0.358**	-	-	0.305**
			(0.156)			(0.146)
R^2	0.791	0.778	0.811	0.792	0.781	0.806

Years 1982-1989 and 1993-2005, 304 observations. Standard errors are robust to heteroscedasticity and clustering by country using four-year windows. All regressions include a full series of country and year effects.

noting that the diagnostic statistics regarding the strength of the instrument are quite impressive, with partial values of the R^2 between 0.31 and 0.37 and F-statistics of the IV between 19.8 and 30.6. Columns (4) to (6) show the first-stage regressions for the unit labor cost differential. Again we find a highly significant positive partial correlation between the differential and the instrument. While the diagnostic statistics are weaker than in the regressions for the compensation cost differential, they still signal that we do not have to worry about problems of weak identification. Taken together, the first-stage results lend strong support to our instruments.

Having confirmed that the instrument provides sufficient variation to identify the effect of the labor cost differential on tax rates (assuming that the instrument is exogenous), we can now turn to the results for the main regression. Table 4 displays results of a set of baseline two-stage least squares (2SLS) estimations accounting for the endogeneity of labor cost differentials.[17] Columns (1) to (3) use the compensation cost differential as the key explanatory variable. Irrespective of whether and how we control for the direct effect of the 1989/90 shock on tax policies, the estimates point to a statistically significant impact of labor cost differentials on tax rates. As suggested by the theoretical model, the estimated effect is negative, meaning that countries with relatively high labor costs tend to set lower corporate income tax rates. But the estimated effects are also economically significant: If the compensation cost differential increases by one percent of the current compensation cost in the U.S., firms are, on average, compensated by a 0.19 percentage point cut in the tax rate. A one-standard deviation increase in the compensation cost differential thus triggers a 5.1 percentage point cut in taxes. Among the control variables, we confirm the familiar result that bigger and more economically closed countries have higher corporate taxes. Moreover, the results point to the percentage of elderly people and the associated need for social services to be positively correlated with taxes.

If we take into account differences in labor productivity we find similar effects. As shown in columns (4) to (6), a one-standard deviation increase in the unit labor cost

[17] Due to the limited number of cross-sectional observations, we report standard errors which are robust to clustering by country within four-year windows.

Table 3: First-stage regressions

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable	Compensation cost differential			Unit labor cost differential		
$\sum_j w_{ij}(5 - DIST\,EAST_j) \times (2006 - t) \times D_{1990}$	2.63***	2.65***	2.69***	0.011***	0.011***	0.011***
	(0.592)	(0.479)	(0.500)	(0.003)	(0.003)	(0.003)
$(5 - DIST\,EAST) \times (1989 - t) \times D_{1990}$	-	-1.22***	-	-	-0.002	-
		(0.274)			(0.002)	
$BORDER \times (1989 - t) \times D_{1990}$	-	-	-2.40***	-	-	-0.003
			(0.485)			(0.004)
Partial R^2	0.305	0.362	0.370	0.115	0.117	0.118
F-statistic for IV	19.77	30.59	29.10	10.69	11.42	11.19

Unbalanced panel (16 countries, years 1982-1989 and 1993-2005, 304 observations). Standard errors are robust to heteroscedasticity and clustering by country using four-year windows. All regressions include a full series of country and year effects together with the control variables Log(GDP), Openness, % young, and % old.

Table 4: Labor cost differentials and tax policies, baseline 2SLS estimations

Dependent variable: Statutory tax rate	(1)	(2)	(3)	(4)	(5)	(6)
Compensation cost differential	-0.0019***	-0.0019***	-0.0019***	-	-	-
	(0.0007)	(0.0006)	(0.0007)			
Unit labor cost differential	-	-	-	-0.443**	-0.442**	-0.454**
				(0.186)	(0.183)	(0.192)
Log(GDP)	0.156**	0.209***	0.139**	0.184**	0.202**	0.131
	(0.062)	(0.064)	(0.060)	(0.088)	(0.092)	(0.085)
Openness	-0.199***	-0.220***	-0.194***	-0.299***	-0.306***	-0.288***
	(0.053)	(0.055)	(0.052)	(0.103)	(0.104)	(0.099)
% young	0.832	0.346	0.836	2.04**	1.87*	2.08**
	(0.591)	(0.629)	(0.591)	(1.00)	(1.03)	(1.013)
% old	2.976***	2.61***	2.96***	4.18***	4.06***	4.17***
	(0.883)	(0.894)	(0.876)	(1.27)	(1.28)	(1.26)
(5-DIST EAST)$\times(1989-t)\times D_{1990}$	-	-0.002	-	-	-0.0007	-
		(0.001)			(0.001)	
BORDER$\times(1989-t)\times D_{1990}$	-	-	0.001	-	-	0.004*
			(0.002)			(0.002)
R^2	0.764	0.769	0.764	0.631	0.632	0.631

Years 1982-1989 and 1993-2005, 304 observations. Standard errors are robust to heteroscedasticity and clustering by country using four-year windows. All regressions include a full series of country and year effects.

differential is estimated to decrease the statutory tax rate by 7.3 to 7.5 percentage points. It is reassuring to see that the effect of labor costs on taxes is stronger when productivity differences are taken into account, for simple labor cost differentials should partly reflect cross-country differences in labor productivity.

Table 5 is devoted to a number of robustness checks of our main findings. For brevity, we only display results for estimations using unit labor costs to define the key explanatory variable. Similarly, we use $(5 - DIST\,EAST_i) \times (1989 - t) \times D_{1990}$ to account for the direct effect of the integration shock on taxes in all regressions reported. Hence, the point of reference for all estimations in Table 5 is column (5) from Table 4. Column (1) reports a 2SLS estimation where we account for market size by population (in logs) instead of GDP. The coefficient of the unit labor cost differential is still significant at the five percent level and very close to the one obtained using log(GDP). Column (2) adds the top personal income tax rate. The effect of the labor cost differential is now somewhat smaller, but still very close to the value obtained before. We conclude that potential endogeneity problems associated with using GDP and the top personal income tax rate as explanatory variables are of no practical importance for our study.

The remaining columns report robustness checks with respect to the weight matrix that we have to impose in order to be able to derive the labor cost differential. First, we display an estimation where the cost differential (together with the instrument) has been derived using $w_{ij} = \ln(pop_j)/d_{ij}$ to compute the weights.[18] Hence, in contrast to the estimations in Table 4 and those reported in columns (1) and (2) of Table 5, we employ a weaker form of distance decay. We note that the coefficient of the labor cost differential is now significantly larger. At the same time, it is estimated with much less precision. The result that weights with an insufficient degree of distance decay produce imprecise coefficient estimates in panel applications is familiar from the applied literature dealing with cross-sectional dependence.[19] The problem can

[18] Note that, as before, we standardize the weights such that $\sum_j w_{ij} = 1 \; \forall i$ before computing the average labor cost of competitors.

[19] For a more detailed discussion in a related context, we refer the reader to Overesch and Rincke (2010).

Table 5: Robustness, 2SLS estimations

Dependent variable: Statutory tax rate	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Weights to compute labor cost differential	$\ln(pop_j)/d_{ij}^2$	$\ln(pop_j)/d_{ij}^2$	$\ln(pop_j)/d_{ij}$	$1/d_{ij}^2$	$1/d_{ij}$	$\ln(pop_j)/d_{ij}^2$	$1/d_{ij}^2$
Instrumental variable	$\sum_j w_{ij}(5 - DIST\,EAST_j) \times (2006 - t) \times D_{1990}$					$BORDER_i \times D_{1990}$	
Unit labor cost differential	-0.429**	-0.390**	-0.784*	-0.387**	-0.643*	-0.661**	-0.700**
	(0.184)	(0.164)	(0.428)	(0.153)	(0.293)	(0.327)	(0.356)
Log(GDP)	-	0.171**	0.248*	0.191**	0.226**	0.235*	0.237*
		(0.083)	(0.133)	(0.087)	(0.112)	(0.127)	(0.133)
Log(Population)	-0.586	-	-	-	-	-	
	(0.480)						
Openness	-0.156**	-0.233**	-0.445**	-0.288***	-0.392***	-0.394**	-0.418**
	(0.078)	(0.098)	(0.205)	(0.096)	(0.152)	(0.165)	(0.181)
% young	2.51**	1.71*	2.95*	1.69*	2.54*	2.42*	2.44*
	(1.18)	(0.977)	(1.714)	(0.937)	(1.32)	(1.38)	(1.42)
% old	3.75***	4.24***	4.63**	3.98***	4.43***	4.40**	4.47**
	(1.26)	(1.09)	(1.85)	(1.22)	(1.57)	(1.72)	(1.82)
Top personal income tax rate	-	0.438**	-	-	-	-	
		(0.187)					
(5-DIST EAST)$\times(1989 - t) \times D_{1990}$	0.002	-0.0002	0.0002	-0.0004	0.0003	-0.001	-0.001
	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.002)	(0.002)
Partial R^2 (instrument)	0.128	0.129	0.057	0.132	0.065	0.100	0.089
F-statistic (instrument)	8.30	9.48	4.41	9.82	5.00	7.85	6.99

Years 1982-1989 and 1993-2005, 304 observations. Standard errors are robust to heteroscedasticity and clustering by country using four-year windows. All regressions include a full series of country and year effects.

best be understood by considering the extreme case with no distance decay at all. Using $w_{ij} = \ln(pop_j)$, for instance, would provide us with a measure for neighbors' labor costs at time t, $\sum_{j=1}^{N} w_{ij} LC_{jt}$, that does not vary across i for $N \rightarrow \infty$. In a finite sample, the labor cost differential would thus boil down to a country's own cost, minus a variable that, for increasing N, approaches a period-specific constant equal to the average labor costs of *all* countries in the sample. As a consequence, we could no longer identify the labor cost differential in our estimations. Noting that our instrument is also based on the weights, it seems natural that 2SLS estimates with insufficient distance decay tend to be imprecise. This notion is supported by the diagnostic statistics reported at the bottom of Table 5. Both the partial R^2 and the F-statistic of the instrument decrease considerably once we employ weights based on $\ln(pop_j)/d_{ij}$.

Turning to column (4) we note that, while a sufficient degree of distance decay is essential for our purpose, the adjustment of weights according to population is not. With weight scheme $w_{ij} = 1/d_{ij}^2$, we obtain results which are again very similar to those from the first two columns. In accordance with the discussion of the role of distance decay for identification, we find that the diagnostic statistics indicate the presence of a strong instrument. Finally, column (5) presents an estimation using weights based on simple inverse distance, $w_{ij} = 1/d_{ij}$. The outcome confirms our previous finding that insufficient distance decay gives rise to an imprecise estimate of α and a performance of the instrument which is not satisfactory according to all established standards.

Finally, columns (6) and (7) test for robustness regarding the specification of the instrumental variable. As an alternative to the specification used so far, one might think of using only variation in labor cost differentials for identification that is related to the difference in terms of exposure to the integration shock between border and non-border countries. The most straightforward way to capture this variation is to use as an instrumental variable the interaction between $BORDER_i$ and the indicator for post-shock years, D_{1990}. Column (6) shows the outcome of the 2SLS procedure when using weights based on $\ln(pop_j)/d_{ij}^2$, while column (7) uses weights derived from $1/d_{ij}^2$. The results confirm the negative impact of the unit labor cost differential on the tax rate at the five percent level of significance. We also note, however, that the point estimates are higher compared to the reference estimation from Table 4, column (5), and significantly less precise. Furthermore, the F-statistic of the IV indicates that $BORDER_i \times D_{1990}$ is not as strong a predictor of the labor cost differential as $\sum_j w_{ij}(5 - DIST\,EAST_j) \times (2006 - t) \times D_{1990}$. We conclude that estimations exploiting for identification only the difference in exposure to the integration shock between border and non-border countries generally support the findings obtained using the more elaborate instrumental variable, but that accounting for the differences between western European countries in terms of their geographical position relative to eastern Europe in a more flexible way significantly improves the precision of our estimates.

4 Discussion

We have developed a simple model highlighting the behavior of governments in a bidding race for FDI when countries differ in labor costs. The key insight from the model is that governments of high-wage countries tend to set tax policies which are more favorable for firms than policies chosen by low-wage countries. Hence, 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. We have then put the model prediction to an empirical test. Using data on western Europe, we have estimated a substantial effect of labor cost differentials on corporate tax rates, 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 those western European countries located geographically close to eastern Europe.

Testing the hypothesis of governments compensating firms for wage differentials with European data covering the 1989/90 break is advantageous because the breakdown of communism in eastern Europe lends itself as a credible source of exogenous variation in wage differentials. However, it also carries a limitation because the cross-sectional dimension of the data set is rather small. An obvious alternative would be to consider the U.S. states, where data availability is less of an issue.[20] We experimented with U.S. data, but could not come up with conclusive results. This might have to do with the fact that the variation in tax rates over time in the U.S. is very limited for most states, and that it is difficult to identify a source of exogenous variation that can be exploited to construct instrumental variables. We experimented with data on unionization and other labor market institutions, but the problem of limited variation over time appeared to be present here, too. Hence, although the cross-sectional variation is very limited in our application, it seems that coming up with more promising data is not at all an easy task.

The policy conclusion of our analysis is that if labor unions are successful in setting wages above the competitive level, this may not only cause unemployment, but also force the government to compensate firms by reducing corporate income taxes. Hence, unions which are successful in the sense that they manage to implement a high wage level will perhaps also trigger tax policies which unionists often characterize as favoring the interests of 'capital' over those of 'labor'.

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[20]For an analysis of recently compiled data on state investment tax incentives and their effect on capital formation, see Chinn and Ito (2008).

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