

Janeba, Eckhard

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## Political Ideology and Tax Competition: Experimental Evidence

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# Political Ideology and Tax Competition

## Experimental Evidence

Eckhard Janeba\*

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*Very preliminary*

**Abstract:** This paper analyzes tax competition theory in an experimental setting. Economically trained students act as government and must select a labor and a capital tax rate to fund a public good, both in closed and open economy settings. Several results emerge: i) There is only weak evidence that better students choose labor tax rates closer to their (Nash) optima. ii) Tax rates on capital fall when capital becomes mobile, but much less so than theory predicts. iii) In the open economy female students choose about 9 percentage points higher tax rates on capital than male students. iv) Political ideology influences capital tax rate choices in the open economy when subjects are matched on the basis of party preference, but not when randomly matched. With political preference matching left leaning students choose about 8 percentage points higher tax rates on capital than right of center students, even though rational behavior predicts no relevance for political ideology.

Keywords: Tax Competition, Political Preference, Experiment

JEL Classification: D78, H21, H73

\* University of Mannheim, CESifo and ZEW. Address: Department of Economics, University of Mannheim, L7, 3-5, 68131 Mannheim, Germany; [janeba@uni-mannheim.de](mailto:janeba@uni-mannheim.de). Excellent research assistance was provided by Benedikt Rydzek and Christoph Esslinger.

## 1. Introduction

The literature on fiscal competition is large, starting with the seminal papers by Zodrow and Mieszkowski (1986) and Wilson (1986). Yet we know very little about the actual political decision making process and the determinants of fiscal choices in fiscal competition games. For example, the theoretical literature offers only few political economy models (Keen and Edwards (1996), Eggert and Sorensen (2008), Janeba and Schelderup, 2009), and in those the political environment is still fairly simple. At the empirical level it is often difficult to correctly identify the channel of fiscal interaction as the same reduced form is estimated, in which the tax rate of one region is a function of the neighboring regions' tax rates. As argued by Revelli (2005), this model is compatible with any one of the following explanations: tax base mobility, public goods spillovers, yardstick competition, or autocorrelated shocks.

One way to overcome our lack of understanding as to how tax policy decisions are made is to ask politicians directly. Ashworth and Heyndels (1997, 2000) as well as Heinemann and Janeba (2009) use questionnaires to study the thinking of politicians. Heinemann and Janeba (2009) find strong evidence that answers are both economically and statistically significant driven by party membership. For example, left leaning politicians believe that taxation plays less a role in firms' investment location decisions than right-leaning politicians. This is surprising in so far as the questions were not directed at redistributive preferences directly. While the survey approach is useful it faces problems of its own: How to control and account for the information available to policymakers, the possibility of strategic behaviour of politicians, or simple framing effects?

The present paper takes a different, complementary route and attempts to improve our understanding of fiscal competition phenomena by putting a simple model of government competition to an experimental test. To the best of my knowledge, this is the first paper to do so. 116 Economics and Business Administration students of the University of Mannheim in Germany participated during a public finance class in a tax competition experiment. Students were asked to act as governments and choose tax rates on labor and capital to fund a public good. The private sector comprises workers and capital owners. The government objective is to maximize the country's worker utility. The entire model is fully microfounded and requires some training in microeconomics to solve optimization problems. The students have sufficient training and are of similar academic standing.

Three different experimental settings were performed to simulate a closed economy with no international capital mobility (Experiment 1), and an open economy with full capital mobility (Experiments 2 and 3). The first experiment amounts to a simple maximization problem with no strategic interaction and many students got the correct answer. This suggests that students understand the model at hand. In the latter experiments two students, representing two countries, were matched to determine payoffs. An important aspect is the matching procedure. In Experiment 2 students were matched randomly, whereas in Experiment 3 matching was done randomly among the students with the same political party preference.

Rational behavior predicts clear outcomes. In particular, the tax rate on capital should fall from a strictly positive level in the closed economy (close) to zero in Experiments 2 and 3, as capital is infinitely elastic at the point of equal capital tax rates across countries (in this sense the game represents best the competition for a plant ). The experimental results for the closed economy suggest that students understand well the economic issue at hand, as average tax rates chosen by

students are very close to theoretical predictions. In the open economy, actual behavior deviates substantially from rationality, yet in a systematic way. Capital tax rates in the open economy are not close to zero, although clearly much lower than in the closed economy. Hence a basic prediction of tax competition theory holds: Factor (capital) mobility shifts the tax burden from the mobile factor (capital) to the immobile factor (labor).

Yet other aspects come into play. First, in the open economy female students play substantially higher tax rates on capital than male students in the order of 9 percentage points (both when controlling and not controlling for other factors). Secondly, political ideology matters in the open economy, but only when matching occurs on the basis of political preferences. Supporters of the right of center Christian Democratic Party choose a capital tax rate that is about 7 percentage points higher than supporters of the Social Democrats. Such a difference is not found for the labor tax. The effect becomes clearer and at a higher statistical significance level when parties are collected in a left-right block dummy. Supporters of left-leaning parties, when matched with someone from their own party, choose a capital tax rate that is about 8 percentage points higher than the one chosen by right-of-center parties. Due to the small sample size using a left-right block dummy makes sense and shows more clearly the effect of political ideology. The role of ability in explaining actual choices seems limited. The grade point average is never significant. However, an endogenously generated measure of competence in Experiment 1 has some power in explaining capital tax rates in experiments with an open economy.

The paper is structured as follows. In section 2 the experimental setup is explained and the rational (Nash equilibrium) is derived. I describe the data and the econometric results in section 3. The final section concludes.

## **2. The Experiment**

### **2.1 General Setup**

The experiment was conducted as a classroom experiment in May 2009. The class is a compulsory class in public finance and students came from Economics (Bachelor and Diploma level) and Business Administration (Diploma level) backgrounds. The large majority of students were second year (4th semester) Bachelor students in Economics at the University of Mannheim, who had at the point of the experiment about 10 weeks of intensive lectures on issues in public economics, including the effect of taxes on investment and labor supply, though not on the issue of tax incidence in open economies. Diploma students in Economics had about one additional year of training in economics and a bit more advanced standing in public economics. Business students had only about 4 weeks of teaching in public economics and overall a bit less background in economics compared to the Bachelor students (yet at least two semesters of microeconomics).

The experiment was completely voluntary and anonymous, and thus could have no repercussion on the course grade. The winning prize was a €20 voucher for Amazon's online store in Germany. In total 121 students returned answer sheets, of which 5 were incomplete or faulty, resulting in 116 usable answer sheets. This amounts to about 85% of those who took the exam one month later. In a first session students were told about the experiment as such and about the general framework in a non-technical way. This session lasted about 20 minutes. The following week the experiment was conducted. An intensive handout including the response sheet was distributed. The information was

read and explained by working through the handout, which was simultaneously projected on a big screen. This took about 45 minutes. Then students were given ample time to complete the questionnaire, which took another 30 minutes. All questionnaires were then collected. Anonymity was guaranteed through a coding system, under which students were identified by a number and would allow the winner to pick up the prize from a secretary's office. The questionnaire included questions regarding personal characteristics which are used in the empirical analysis below. Personal characteristics included: study major, average grade, gender, and political preference.

## 2.2 The tax competition game

The basic tax competition game is similar to a standard model with two tax instruments (Bucovetsky and Wilson, 1991), albeit with some simplifications to make it appropriate for a classroom experiment. The main simplifications concern the technology of producing goods, the separation of ownership of factors of production, a reduced form of capital supply, and a specific (linear) form of preferences. The key comparison is between a closed economy, where capital is not mobile, and a two country model, where capital is costlessly mobile.

Each subject in the experiment represents the government of a country which is inhabited by a representative worker and a capital owner. The worker consumes a private (numeraire) good, whose price is normalized to one, supplies elastically labor which causes disutility, and consumes a public good provided by the government. One unit of the private good can be transformed into one unit of the public good. The utility function of the worker is given by

$$U(C, L, G) = C - \frac{1}{2}L^2 + \frac{3}{2}G \quad (1)$$

where  $C$  denotes consumption of the private good,  $L$  is labor and  $G$  stands for the public good. Note that the marginal utility of the public good is constant and greater than the marginal utility of the private good. Still, private consumption will be nonzero in equilibrium as the deadweight loss from taxation limits the supply of public goods.

The worker finances private consumption out of labor income net of the labor tax ( $T_L$ ). Hence the budget constraint reads

$$C = (W - T_L)L = (10 - T_L)L. \quad (2)$$

The wage rate  $W$  is constant and set equal to 10. In contrast to typical tax competition models the technology is linear and the wage is independent of the amount of capital employed in the country. While this is a drastic simplification, it is mostly done to keep the model's complexity at bay, as shown later.

The behaviour of the capital owner is modelled in a reduced form. Capital supply is endogenous and depends on the return to capital net of capital tax. When capital is internationally immobile (= closed economy) the capital owner invests an amount  $I$  equal to the domestic net of capital tax return, that is

$$I = R - T_K = 10 - T_K, \quad (3)$$

where the gross return to capital  $R$  is set equal to 10, like the wage rate. Constant factor prices allow me to abstract from complex incidence analysis. When capital is mobile internationally, the capital owner invests in the country with the lowest capital tax, as gross returns  $R = 10$  are assumed to be constant and identical across countries. The investment amount equals the maximum of the net of tax returns  $I = \max\{10 - T_K^i, 10 - T_K^j\}$ , where  $i$  and  $j$  are country indices. In a two country setting the total investment in country  $i$  depends on whether country  $i$  has the higher or lower tax rate compared to country  $j$ , that is,

$$I^i = \begin{cases} 0 & \text{when } T_K^i > T_K^j \\ 10 - T_K^i & \text{when } T_K^i = T_K^j \\ 2(10 - T_K^i) & \text{when } T_K^i < T_K^j \end{cases} \quad (4)$$

There is a discontinuity in (4) at the point of equal tax rates: Investment jumps from twice the highest net of tax return to zero. The investment function for country  $j$  is reversed. The implied drastic type of competition for capital applies more to the bidding process for discrete investment projects such as individual plants or headquarter location, and less so for a country's overall capital employed. An advantage in the context of the experiment, however, is that it makes the strategic nature of the interaction very transparent.

The government is assumed to maximize the utility of the representative worker (1) subject to the government budget constraint

$$G = T_L L + T_K I, \quad (5)$$

where the amount of investment is given by (3) or (4), and taking the optimal behaviour of workers and capital owners in both countries into account. The government's objective function does not include the utility of the capital owner. The reason is twofold. First, this assumption makes the analysis simpler, as the induced indirect utility function doesn't have to include an additional income term from capital (which would have to be derived explicitly from an intertemporal consumption-saving model). Second, as one objective of the analysis is to study the role of ideology in tax competition, the objective function gives a clear ideological underpinning.

### 2.3 Rational Behavior

The game was considered in two settings: closed economy and open economy. The difference lies in the investment opportunities of capital owners. In the closed economy capital owners must invest in their own country and hence there is no strategic interaction among countries. The government problem boils down to a simple constrained optimization problem. In the open economy, strategic interaction takes place and we employ Nash equilibrium to solve the model. The sequencing of moves is standard. In the first stage, the governments choose tax rates on labor and capital, as well as the level of the public good. In the second stage the worker and capital owner in each country maximize utility and net income, respectively, taking the fiscal policy vector (tax rates and  $G$ ) of both countries as given.

To solve the game backward induction is utilized. The worker maximizes utility (1) subject to the budget constraint (2), taking factor prices and fiscal policies as given. This gives optimal consumption  $C^* = (10 - T_L)^2$ , optimal labor supply  $L^* = 10 - T_L$ , and after inserting these into (1), the indirect utility function

$$U^* = \frac{1}{2}(10 - T_L)^2 + \frac{3}{2}G. \quad (6)$$

The government maximizes indirect utility (6) subject to (5), taking in the open economy the fiscal policy vector of the other country as given. In the closed economy public good provision equals

$$G = T_L(10 - T_L) + T_K(10 - T_K), \quad (7)$$

where the term in brackets represents the tax base for labor and capital, respectively. The tax revenue functions for both tax bases are the same, quadratic, and correspond to well known Laffer curves. In the closed economy the optimal tax rates are

$$T_L = 2.5, \quad T_K = 5. \quad (8)$$

The induced value of public good is 43.75 and the indirect utility level is 93.75. The optimal tax rate on labor is smaller than the tax rate on capital as the government considers the labor tax's distortion of labor supply, whereas for capital the tax's depressing effect on capital supply matters only for via the government budget.

In the open economy with two countries the optimization problem of the government of country  $i$  differs because the investment function is (4), and thus the government budget (5) now reads

$$G^i = T_L^i(10 - T_L^i) + T_K^i \begin{cases} 0 & \text{when } T_K^i > T_K^j \\ (10 - T_K^i) & \text{when } T_K^i = T_K^j \\ 2(10 - T_K^i) & \text{when } T_K^i < T_K^j \end{cases} \quad (9)$$

A Nash equilibrium in the simultaneous tax rate game is considered  $(T_L^i, T_K^i, T_L^j, T_K^j)$ .

Note a particular property of the model: Unlike most models in the literature on tax competition, the optimal labor tax is independent of the amount of investment and thus capital tax revenue, due to the linearity of production function. Hence the optimal labor tax in the open economy is the same as in the closed economy ( $T_L = 2.5$ ). This is an attractive feature in the context of an experiment, as it makes the model less complex. We can therefore focus on the Nash equilibrium in capital tax rates. As competition resembles a Bertrand game, the pure strategy equilibrium tax rates are zero. For the government capital matters only as source of fiscal revenue. Hence subsidizing capital is never optimal. It is easy to see that any deviation from a zero capital tax rate is not profitable. The equilibrium tax vector under rational behavior is thus

$$T_L = 2.5, \quad T_K = 0. \quad (10)$$

The public good level is 18.75 and indirect utility of the worker is 56.25. Clearly, a worker is worse off and the capital owner better off compared to the closed economy. The predicted changes in  $G$  and  $U^*$  are large.

The model captures the basic elements of the classic tax competition framework. Mobility of capital leads to lower tax rates on capital and thus less (and under) provision of public goods. The model is not meant to be realistic in all aspects, but rather captures a simple mechanism that in particular people on the political left fear (race to the bottom).

## 2.4 Experimental Details and Hypotheses

Students were introduced to the above game with a handout and detailed oral explanations. The handout explained both the worker's decision problem (equations (1) and (2)) and the government's problem (maximizing (6) subject to (7) and (9), respectively). In addition, the handout provided a series of (hypothetical) numerical examples for the closed and open economy in order to show how aggregate investment, public good levels and utility are computed for given tax rates. In the closed economy students selected on average tax rate values close to the optimal values. This suggests that subjects understand the main economic issue at hand. In addition, students were presented graphs for Laffer curves showing government revenue from taxing capital. In particular, for the open economy the discrete jumps at the point of equal tax rates were visualized, once on the upward sloping and once on the downward sloping portion of the Laffer curve. This should have made clear that tax competition is like a Bertrand game.

At the end of the handout students were asked to provide a pair of values for the labor and capital tax rates from the interval  $[0,10]$  for three different experiments (Part A) and answer to five questions concerning personal characteristics (Part B). The three experiments represent the closed economy and twice the open economy with capital mobility. Tax rates had to be given in absolute values with two decimal digits. Thus the smallest unit were Cents. This assumption avoids artificial fine tuning of answers, but introduces multiple Nash equilibria in the open economy. On top of the Nash equilibrium with zero capital tax rates, there exists a second Nash equilibrium in which both players choose capital tax rates of 0.01€. In a game with continuous action space undercutting by a very small amount would be beneficial and thus the pair (0.01,0.01) would be no equilibrium. In the discrete case undercutting requires a zero capital tax which is worse as now the small but positive revenue from taxing capital is lost. For practical matters, however, the multiplicity seems of little relevance, as revenues from taxing capital are negligible in both equilibria.

Unlike experiments in the laboratory, the classroom experiment implied that students selected pairs of tax rates for all three experiments without knowing how they did in the previous experiments. Effects from repetition and end-game behaviour cannot be studied, but could be considered in future.

The three experiments were designed as follows. **Experiment 1** simulates the closed economy, as capital owners cannot invest outside their country. The students task of selecting tax rates means solving a constraint optimization problem. There is no reason to think that personal characteristics other than knowledge and competence should matter. Note that the absence of strategic interaction in the closed economy was guaranteed by not matching the student with another player. This leads to

*Hypothesis 1: a) In the closed economy (Experiment 1) a student selects tax rates that are the closer in absolute value to the optimum given in (8) the better the competence. b) Other personal characteristics play no role.*

As discussed below I use actual grades and a measure of quality of answer in Experiment 1 as measure of competence.

In Experiments 2 and 3 students were matched with one other student in the classroom for the purpose of calculating payoffs. Students were told about the type of the matching process. The setting thus represents a two-country framework with strategic interaction and the Nash equilibrium

in tax rates involves labor taxes in both countries of 2.5 and capital tax rate pairs (0,0) or (0.01,0.01). In **Experiment 2** the matching was done randomly. **Experiment 3** repeated Experiment 2 albeit with a different, publicly announced matching process. Students were told that they are matched with another student who has the same political preference. The linearity of technology for labor and capital implies that the optimal labor tax rates should be unchanged regardless of the matching process and the degree of openness. For the capital tax rate rational behaviour predicts a fall to 0 or near 0 compared to Experiment 1. Since exact Nash behaviour is rarely observed in experiments a weaker prediction is that tax rates on capital fall when opening up the economy for capital mobility. This leads to the next hypothesis.

*Hypothesis 2: a) The labor tax rate in the closed and open economy are the same. b) The capital tax rate in the open economy is lower than in the closed economy. c) Capital tax rates in the open economy are strictly positive and significantly higher than 0.01.*

The last part is probably most controversial, but has some plausibility. It is unlikely that one could win the prize for the experiment if one were to play strictly Nash and set the capital tax (close) to zero. As long as one can expect that some other students deviate substantially from the zero tax rate on capital, either because of lack of understanding of the experiment or for ideological reasons, choosing a strictly positive capital tax rate gives a chance of winning the prize. This motivates Hypothesis 2c.

From other experimental tests it is also known that women behave differently (see ...). How better students behave is not obvious. On the one hand one can argue that more competent students play closer to Nash equilibrium because they better understand the strategic nature of the game. On the other hand, good students may anticipate that not all students properly understand the Nash concept and therefore could gain with a strictly positive tax rate on capital. I summarize in

*Hypothesis 3: a) In the open economy experiment male students are expected to play more aggressive than female students (i.e., choose lower tax rates on capital). b) A student academic standing has an ambiguous effect on capital taxes.*

The role of political ideology is not clear under random matching in the open economy. If a student expected that political ideology were to matter in the choice of tax setting by others, subjects would need to know the probability of being matched with a student of the same or similar party preference. To validate the hypothesis the prior beliefs of students about their fellow students' political preferences need to be known (but is not). As shown below, political preferences among students are similar, although a bit to the left, to German society as a whole and roughly split half between a left and right block. Therefore it is likely that political ideology should not play a significant role in explaining actual tax rate choices in the open economy with random matching.

In a rational world political preferences should also play no role in the open economy with political matching. The motivation for the role of political ideology comes from various sources. Heinemann and Janeba (2009) show its relevance in a survey of German members of national parliament about globalization and tax policy. On the theoretical side, Benabou (200?) presents theories why and how certain political views may be maintained despite contrary evidence. This leads to the final hypothesis.

*Hypothesis 4: a) Political ideology plays no role in explaining capital tax rates under random matching.  
b) In the open economy with political preference matching, the tax rate on capital is monotonically increasing from right to left.*

We now turn to the results of the experiment.

### 3. Results

#### 3.1 Descriptive Statistics

I begin with a summary of descriptive statistics. *Table 1* provides a summary of key variables, including grades, the means and variances of tax rates and payoffs for all student participants, and sliced according to individual characteristics.

Grade/Competence: Grades in Germany are given on a scale from 1.0 (best) to 5.0 (lowest/fail). The average grade for all participants is 2.40. Male students (2.38) are slightly better than female students (2.45). There is little variation in grades when conditioned on party membership, with one exception though. Supporters of the Left Party have much better grades, which may be surprising at first glance. This could be due to a small number effect.

In the empirical implementation it is difficult to properly control for competence as measured by grades. For instance, the optimal tax rate on labor is 2.5. Better students should be expected to play closer to this value, but this could be from above or below. We use a grid of four grade ranges to control for knowledge.

An alternative measure of competence in Experiments 2 and 3 is to use the proximity of choices in Experiment 1 to predicted values. This turns out to be fruitful. It does not matter whether competence is measured by proximity of both tax rates in Experiment 1 or only the labor tax.

Gender: Female students show different behaviour on average. They choose a slightly higher tax rate on labor than men in the closed economy, but the reverse is true in the open economy. Note that capital tax rates in the open economy chosen by women (3.66 and 3.72 in Experiments 2 and 3) are much higher than those for men (2.72 and 2.80).

Political preference: Students were required to indicate their political preference for one of six parties/groups. The Christian Democrats (CDU/CSU) are a centre-right party with moderately pro market views. The Free Democrats (FDP) are the most pro market oriented party in Germany. On social issues the party is rather liberal and thus to the left of the CDU/CSU. The Social Democrats (SPD) are a centre-left party with moderate pro to skeptical views about the advantages of a market economy. The Green Party (Bündnis 90/Grüne) puts most emphasis on environmental and social issues and is left of center. The Left Party (Die Linke) represents mostly unemployed and socially disadvantaged individuals as well as former communists, in particular from East Germany, and is the least market friendly party in Germany. The remaining group is Other. All five parties (except for Others) are represented in the German national parliament (Bundestag) at the time of the experiment. For some purposes it will be useful to group the five major parties into two blocks. The right block consists of Christian Democrats and Free Democrats, while the left block comprises Greens, Social Democrats and the Left Party.

The distribution of political preferences among economics and business students is different from the general public at the disaggregated level, but is fairly similar at a more aggregated level (source: Forschungsgruppe Wahlen, Politbarometer Mai 2009). *Table 2* gives a comparison of the political preferences in class and in the general population based on national surveys taken at the time of the experiment. Supporters of the Green Party and the Free Democrats are strongly overrepresented among students, while supporters of the Christian Democrats are heavily underrepresented. Yet, when aggregated into two blocks (right and left, „Others“ in a separate group), proportions are roughly representative, although with a slight left-leaning bias among students. A right block of Christian and Free Democrats has a share of 45.7% (53 of 116) in the student body, while 50% in the general population, while a block of parties left of centre (Greens, Social Democrats and Left Party) command 48.3% (56 of 116) among students and 46% in the general public.

*Figure 1* provides first insights. In the closed economy the average tax rates for labor and capital (2.46 and 5.02) are close to the optimal values given in (8), which are 2.5 and 5, respectively. This points to a good understanding of the economic problem underlying the experiment. In fact, in the first Experiment 66 students choose the optimal labor tax (2.5) and 96 students choose the optimal capital tax. As mentioned above, we use a student's proximity to the optimal values as a measure of competence in Experiments 2 and 3.

The tax rate on labor increases substantially from the closed economy to the open economy regardless of the matching procedure (2.46 to 3.01/2.95), which is in contrast to Hypothesis 2a. Still, both in Experiments 2 and 3 57 students choose the correct optimal labor tax of 2.5. Tax rates on capital are clearly positive (average 2.96 and 3.04, respectively). The number of tax rate values for capital equal to zero or close to zero, that is no more than 0.1 is six and seven in Experiments 2 and 3. Capital taxes are much smaller in the open economy (2.96/3.04) than in the closed case (5.02). The latter observations confirm Hypotheses 2b and 2c, and thus are in line with general tax competition theory.

There is a lot of interesting variation, however, in particular when tax rate choices are conditioned on the basis of party preference. In the open economy with random matching, tax rates on capital chosen by the Greens (3.50) and the Left Party (3.35) are substantially higher than those chosen by all other parties (SPD 2.96, CDU/CSU 2.72, and Free Democrats 3.00). This does not exactly correspond to a clean left-right division, as supporters of the Social Democrats choose relatively low tax rates, pointing to the relevance of Hypothesis 4a.

Tax rate choices in open economy setting with political preference matching, however, strongly suggest the relevance of political ideology. Compared to the open economy with random matching there is strong or very strong increase in capital tax rates for supporters of left of center parties: Social Democrats (2.90 to 3.20), Green Party (3.50 to 3.85) and Left Party (3.35 to 4.04). Declines are found for more market friendly parties right of center: Christian Democrats (2.72 to 2.54) and Free Democrats (3.00 to 2.71). Based on these averages Hypothesis 4b finds strong support. I turn next to a more systematic analysis to control for other personal characteristics.

### **3.2 Econometric Analysis**

The descriptive results are suggestive but a more rigorous analysis is warranted. In the following I use simple OLS regressions, in which the dependent variables, labor and capital tax rate respectively, are

functions of personal characteristics, a constant and error term. Let a student be indexed by  $i$ , the following regression approach is considered

$$T_L^i = a_0 + a_1 \cdot D_{DEcon}^i + a_2 \cdot D_{DBus}^i + a_3 \cdot Female^i + \sum_P a_P D_P + \sum_{Gj} a_{Gj} \cdot Grade_j + \epsilon_L^i \quad (11)$$

$$T_K^i = b_0 + b_1 \cdot D_{DEcon}^i + b_2 \cdot D_{DBus}^i + b_3 \cdot Female^i + \sum_P b_P D_P + \sum_{Gj} b_{Gj} \cdot Grade_j + \epsilon_K^i, \quad (12)$$

where  $P$  describes the set of parties {Left Party, Social Democrats, Green Party, Christian Democrats, Free Democrats, Others}, and  $D_P$  are dummy variables for each party. In the empirical analysis Social Democratic party is the reference party. The variables  $D_{DEcon}^i$  and  $D_{DBus}^i$  are dummy variables for diploma students in economics and business administration, respectively. The reference category is Bachelor students in Economics. *Female* is a dummy variable which takes on the value of 1 for female students and 0 for male students.

Finally, a student's ability/knowledge is measured by the grade point average in his or her major. The grade grid is divided in four ranges (1-1.5, 1.5-2.5, 2.5-3.5, 3.5-4.0) to construct dummies. There is no student in the lowest grade category and hence I analyze how students with grades in the first and second range behave relative to the reference category which is grade range 3 (2.5-3.5). Most students have a grade point average that falls in categories 2 and 3, that is between grade 1.5 and 3.5. Changing the partition of grades does not affect results in an important way.

The two equations for tax rates are estimated independently, as the labor tax should not be influenced by the capital tax and (vice versa). Separate regressions are run for the three experiments.

Table 3 gives the results for the baseline regression. In the closed economy (**Experiment 1**) none of the personal characteristics is significant in explaining the labor tax. Many students (66) chose the "correct" value of 2.5. Somewhat surprisingly, this choice does not seem to be driven by ability when measured by grade point average. There is more explanatory power in explaining the capital tax in the closed economy. Diploma students in Economics and Business Administration choose a lower tax rate by about four percentage points compared to Bachelor Economics students. The female dummy is not significant, but note the positive coefficient. Most party dummies are insignificant. Only supporters of the Green Party choose a tax rate that is close to four percentage points and significantly lower than supporters of Social Democrats. The results for ability when measured by grades is close to significant for good students who choose about 2 percentage point higher tax rate on capital. However, the effect is not confirmed when considering top students (Grade 1).

In the open economy with random matching (**Experiment 2**) results do not change in an important way for the labor tax. The grade dummies as well as all other variables (except the constant) are not significant. For the capital tax the female dummy gains significance. Female students choose a capital tax rate that is almost 10 percentage points higher than male students. This variable is significant at the 1% level. The sign of the party dummies makes some sense (except for the Free Democrats for whom the coefficient is higher than for the Social Democrats), but none is close to being statistically significant. Only the gender of the student seems relevant in explaining the outcome when students are matched randomly. In a robustness check below I will show that an alternative measure of ability provides limited support for the role of ability and competence.

In **Experiment 3**, Open Economy with Political Matching, none of the variables explains the labor tax in a statistically significant way. By contrast, the female students again choose significantly higher tax rates on capital than male students. The coefficient size is comparable to the previous experiment

with random matching. Interestingly, the party dummies show a reasonable pattern in terms of size and sign of coefficients. Supporters of the Green Party (about 6 percentage points) and the Left Party (about 10 percentage points) choose higher capital tax rates than Social Democratic supporters, while the opposite holds for more market friendly supporters of Christian Democrats (almost 7 percentage points) and Free Democrats (almost 4 percentage points). The Christian Democratic dummy is marginally significant, while the other dummies are not far away from being significant. The reason may be the small sample size. The Grade dummies are not significant.

To highlight the role of political ideology that became apparent in Figure 1 I modify the regression to create a left block dummy for supporters of the Social Democrats, Greens, and Left Party. In Table 4 the sample has been reduced by those 7 students who checked the party „other“, leaving 109 observations. Without changing the matching to determine payoffs, this new regression shows in the last column that supporters of left leaning parties (Green Party, Social Democrats and Left Party) choose a capital tax rate that is close to 8 percentage points higher than supporters of right of center parties (Christian and Free Democrats). The dummy is significant at the 5% level. Grouping political parties in the same way has no impact in explaining the labor tax in Experiment 3 (second to last column) or tax rates in Experiment 2 (not shown). Note also that the introduction of a left-right block dummy has little effect on other variables. The comparison of columns for Political Matching I and II demonstrates this. In particular, the female dummy is still significant at the 5% level, with a coefficient estimate that implies an about 1 percentage point smaller capital tax rate now.

The baseline regression suggests the somewhat surprising result that ability or knowledge, when measured by grade point average, does not seem important in explaining tax rate choices. To check the robustness of this finding I construct a second measure of ability from observed behavior in Experiment 1. In that experiment there is no strategic interaction and hence solving an optimization problem should reasonably reflect competence. I define two measures of competence, one from the closeness of the actual labor tax rate choice ( $T_L$ ) to the optimal value ( $T_L^*$ )

$$L - Competence = 1 - 0.333 \left[ \frac{|T_L - T_L^*|}{T_L^*} \right] \quad (13)$$

and similarly for the capital tax rate

$$K - Competence = 1 - 0.5 \left[ \frac{|T_K - T_K^*|}{T_K^*} \right]. \quad (14)$$

This formula leads to a continuous competence level between 0 and 1. A student who in Experiment 1 chooses the correct values of 2.5 (labor tax) or 5.0 (capital tax) obtains has competence level of 1. A student who chooses a labor tax of 10 or a capital tax of 0 or 10 has a competence level of 0. The reason for constructing two different competence measures is simple. The optimal choice of the labor tax in Experiments 1 to 3 is the same. Therefore we should measure competence in explaining the labor tax in Experiments 2 and 3 not with the actual choice of the labor tax in Experiment 1, and similarly for the capital tax. Instead I use the L-competence to explain the capital tax subsequently, and the K-competence to explain the labor tax.

Table 4 presents the results for the open economy. Note first that the variables found significant in the baseline regression (Table 3) are still significant and with very similar coefficients. Female students choose significantly higher while supporters of the Christian Democrats choose significantly lower capital tax rates. The left-block dummy is virtually unchanged. The new ability measures are

now modestly successful in explaining tax rates. In particular, the L-competence measure contributes in explaining capital tax rates. Higher competence students choose higher capital tax rates. Better competence in choosing capital tax rate in Experiment 1 leads to lower labor tax rates, but not significantly so. All in all, the results confirm the previous finding.

#### **4. Conclusion**

This paper has analyzed a simple tax competition framework in an experimental setting. The nature of strategic fiscal interaction makes it necessary that economically trained students play the game. The subjects seem to be adequately prepared as the first Experiment showed, in which no strategic interaction was involved. The main purpose of using this experimental setting was twofold. For one, it allows us to test for a specific channel of fiscal interaction (here tax base mobility). This is important because empirical studies often have difficulties in properly identifying the channel of interaction as tax base mobility, public good spillovers and yardstick competition models share a common reduced form. The experiment described in this paper supports the role of tax base mobility, although subjects in the open economy reduce capital tax rates less than theory predicts and increase the labor tax more than efficiency would dictate.

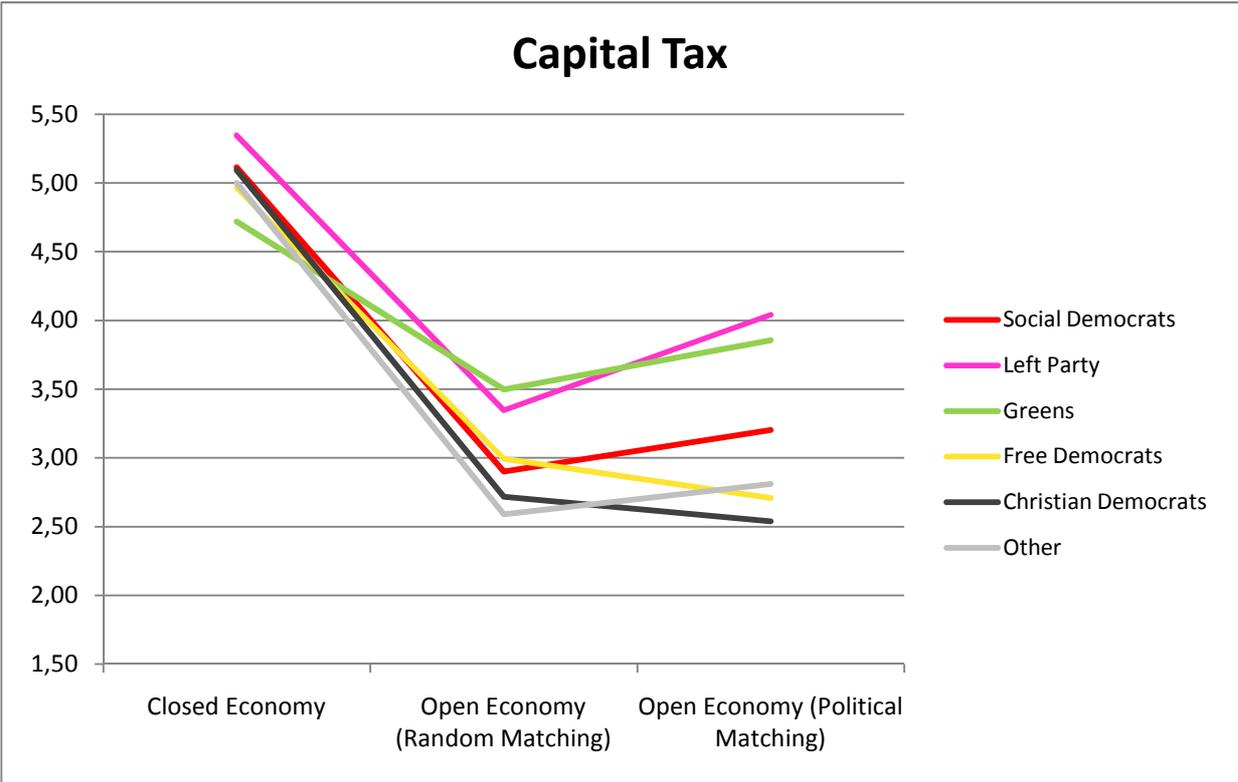
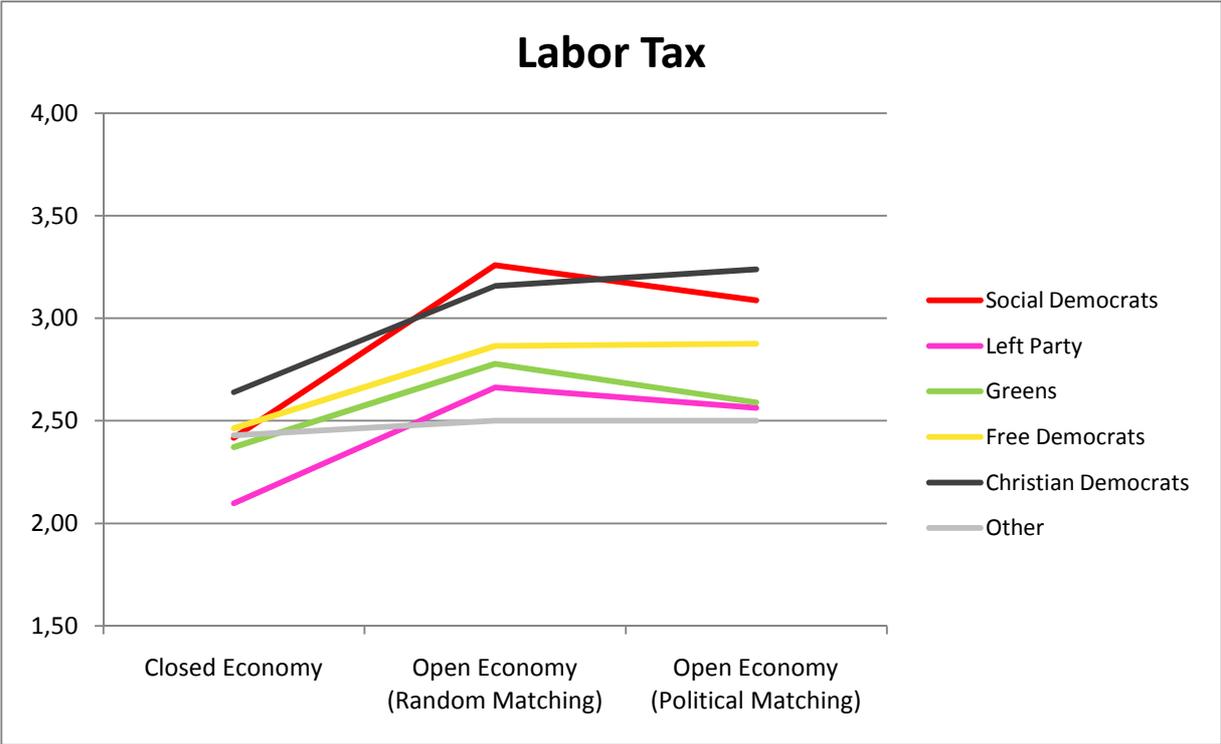
The second main finding lies in the identification of factors that traditional models of fiscal competition do not give any role. There is robust evidence that female students choose in the open economy about 9 percentage points higher tax rates on capital than male students. In addition, left-leaning students behave different from right-leaning students by selecting capital tax rates that are about 8 percentage points higher.

This evidence needs to be treated with caution and further experimental tests are warranted both to confirm these findings but also to gain further insight. For example, it would be useful to disentangle whose political ideology is responsible for the results, as in the political matching game both players have the same party preference. A simple way to tackle this issue is to have an experiment with random matching, matching on same party preference, and – the new way – matching of political opposition. It is also left to future work to search for equivalent findings in real world data.

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Figure 1



**Table 1 Descriptive Data**

	Obs.	Grade	Experiment 1 Closed Economy			Experiment 2 Open Economy Random Matching			Experiment 3 Open Economy Political Matching		
			T <sub>L</sub>	T <sub>K</sub>	U	T <sub>L</sub>	T <sub>K</sub>	U	T <sub>L</sub>	T <sub>K</sub>	U
Theoretical Prediction			2.50	5.00	93.75	2.50	0.00/ 0.01	56.25	2.50	0.00/ 0.01	56.25
All	116	2.41 (0.50)	2.46 (1.16)	5.02 (0.67)	91.73 (3.68)	3.01 (1.42)	2.96 (1.55)	76.96 (25.89)	2.95 (1.42)	3.04 (1.59)	76.98 (27.48)
Male	86	2.39 (0.51)	2.41 (1.13)	5.03 (0.73)	91.68 (3.97)	3.04 (1.48)	2.72 (1.40)	76.47 (24.89)	3.00 (1.52)	2.80 (1.50)	77.73 (27.65)
Female	30	2.46 (0.47)	2.60 (1.27)	5.02 (0.46)	91.88 (2.77)	2.92 (1.26)	3.66 (1.76)	78.36 (28.97)	2.78 (1.09)	3.72 (1.66)	74.86 (27.35)
Left Party	5	2.08 (0.55)	2.10 (1.08)	5.35 (0.61)	92.03 (1.91)	2.66 (1.12)	3.35 (1.65)	64.45 (21.25)	2.56 (1.07)	4.04 (1.28)	80.67 (36.07)
Social Dem	35	2.44 (0.48)	2.42 (1.31)	5.11 (0.52)	91.66 (3.58)	3.26 (1.45)	2.90 (1.17)	81.09 (28.19)	3.09 (1.41)	3.20 (1.43)	80.89 (28.01)
Green Party	16	2.53 (0.46)	2.37 (0.95)	4.72 (1.31)	90.34 (6.50)	2.78 (1.39)	3.50 (2.11)	79.02 (28.33)	2.59 (1.13)	3.85 (1.75)	80.99 (29.23)
Free Dem	26	2.47 (0.48)	2.46 (1.19)	4.96 (0.44)	92.11 (2.60)	2.87 (1.04)	3.00 (1.58)	73.12 (22.36)	2.88 (1.03)	2.71 (1.78)	72.66 (25.34)
Christian Dem	27	2.33 (0.53)	2.64 (1.07)	5.09 (0.56)	92.18 (2.84)	3.16 (1.80)	2.72 (1.60)	76.62 (27.19)	3.24 (1.94)	2.54 (1.36)	72.42 (28.50)
Other	7	2.30 (0.61)	2.43 (1.46)	5.00 (0.00)	91.93 (3.03)	2.50 (1.22)	2.59 (1.58)	76.12 (21.14)	2.50 (1.22)	2.81 (1.53)	79.32 (22.57)
Bachelor Econ	83	2.38 (0.51)	2.40 (1.15)	5.14 (0.54)	91.97 (3.19)	3.02 (1.53)	2.87 (1.49)	76.22 (26.02)	2.91 (1.52)	3.01 (1.65)	77.01 (27.58)
Diploma Econ	16	2.68 (0.29)	2.47 (1.40)	4.68 (0.60)	91.26 (2.69)	3.00 (1.00)	2.88 (1.10)	82.89 (25.89)	3.13 (1.12)	2.97 (1.15)	84.01 (27.86)
Diploma Bus	17	2.29 (0.51)	2.74 (1.00)	4.76 (1.08)	91.03 (6.12)	2.97 (1.24)	3.49 (2.08)	75.02 (26.05)	2.99 (1.17)	3.26 (1.71)	70.26 (26.55)

**Table 2 Political Preferences in Student Sample and General Public**

	Left Party (Die Linke)	Greens (Grüne/ Bündnis 90)	Social Democrats (SPD)	Christian Democrats (CDU/CSU)	Free Democrats (FDP)	Other
General Population Survey	10	9	27	37	13	4
Political Blocks	46			50		4
Student Sample	4.3	13.8	30.2	23.3	22.4	6.0
Political Blocks	48.3			45.7		6

General population survey done by Forschungsgruppe Wahlen e.V.: [www.forschungsgruppe.de](http://www.forschungsgruppe.de);  
Politbarometer May 2009; Question „Which party would you vote for if elections were held next  
Sunday?“

**Table 3: Baseline Regression**

Variable	Closed Economy		Open Economy Random Matching		Open Economy Political Matching I		Open Economy Political Matching II	
	T <sub>L</sub>	T <sub>K</sub>	T <sub>L</sub>	T <sub>K</sub>	T <sub>L</sub>	T <sub>K</sub>	T <sub>L</sub>	T <sub>K</sub>
DEcon	-0.067 (-0.20)	-0.436** (-2.36)	-0.004 (-0.01)	0.051 (0.12)	0.267 (0.65)	0.087 (0.20)	0.198 (0.46)	-0.038 (-0.08)
DBus	0.275 (0.82)	-0.412** (-2.27)	-0.009 (-0.02)	0.454 (1.07)	0.086 (0.21)	0.190 (0.45)	0.023 (-0.06)	0.185 (0.42)
Female	0.160 (0.59)	0.136 (0.93)	-0.081 (-0.25)	0.977*** (2.85)	-0.175 (-0.54)	0.911*** (2.65)	-0.043 (-0.13)	0.805** (2.22)
Left Party	-0.180 (-0.31)	0.101 (0.32)	-0.749 (-1.06)	0.752 (1.02)	-0.698 (-0.99)	1.025 (1.38)		
Green Party	-0.094 (-0.26)	-0.372* (-1.89)	-0.525 (-1.19)	0.505 (1.09)	-0.546 (-1.25)	0.583 (1.26)		
Christian Democrats	0.240 (0.75)	0.051 (0.30)	0.105 (-0.27)	-0.205 (-0.51)	0.095 (0.25)	-0.674* (-1.66)		
Free Democrats	0.363 (0.11)	-0.086 (-0.51)	-0.379 (-0.99)	0.206 (0.52)	-0.211 (-0.56)	-0.355 (-0.89)		
Other	-0.001 (-0.00)	-0.063 (-0.23)	-0.691 (-1.13)	-0.670 (-1.05)	-0.556 (-0.91)	-0.732 (-1.14)		
Left Block							-0.194 (-0.67)	0.782** (2.55)
Grade 1	-0.328 (-0.70)	-0.002 (-0.01)	-0.658 (-1.17)	0.621 (1.05)	-0.567 (-1.01)	0.633 (1.07)	-0.541 (-0.92)	0.525 (0.84)
Grade 2	-0.231 (-0.94)	0.203 (1.53)	0.207 (0.70)	0.160 (0.52)	0.299 (1.02)	0.369 (1.19)	0.392 (1.32)	0.407 (1.29)
Observations	116	116	116	116	116	116	109	109
R <sup>2</sup>	0.032	0.151	0.051	0.128	0.063	0.167	0.037	0.134

\*/\*\*/\*\*\*: significant at 10/5/1 percent level; t-values in parenthesis; omitted category for dummy variables are Bachelor Economics (study major), Social Democrats (party preference) in columns 1 to 4, Free Democrats and Christian Democrats in columns 5 to 6; and Grade 3; constant not shown

**Table 4: Regression when ability measured by competence from Experiment 1**

Variable	Open Economy Random Matching		Open Economy Political Matching I		Open Economy Political Matching II	
	T <sub>L</sub>	T <sub>K</sub>	T <sub>L</sub>	T <sub>K</sub>	T <sub>L</sub>	T <sub>K</sub>
DEcon	-0.016 (-0.04)	0.048 (0.12)	0.196 (0.49)	0.028 (0.07)	0.130 (0.31)	-0.099 (-0.22)
DBus	-0.036 (-0.09)	0.465 (1.12)	0.031 (0.08)	0.225 (0.54)	0.134 (0.03)	0.227 (0.52)
Female	-0.086 (-0.26)	0.985*** (2.93)	-0.167 (-0.51)	0.894*** (2.64)	-0.103 (-0.30)	0.749** (2.10)
Left Party	-0.653 (-0.92)	0.787 (1.09)	-0.612 (-0.87)	1.135 (1.56)		
Green Party	-0.508 (-1.12)	0.417 (0.92)	-0.584 (-1.31)	0.510 (1.12)		
Christian Democrats	-0.105 (-0.27)	-0.228 (-0.58)	0.123 (0.32)	-0.668* (-1.67)		
Free Democrats	-0.403 (-1.05)	0.182 (0.47)	-0.236 (-0.62)	-0.398 (-1.01)		
Other	-0.715 (-1.17)	-0.615 (-0.98)	-0.535 (-0.88)	-0.651 (-1.03)		
Left Block					-0.170 (-0.58)	0.796*** (2.63)
L-Competence		2.157* (1.92)		2.015* (1.77)		1.699 (1.42)
K-Competence	-0.444 (-0.39)		-1.139 (-1.01)		-0.839 (-0.75)	
Observations	116	116	116	116	109	109
R <sup>2</sup>	0.030	0.148	0.047	0.176	0.011	0.135

\*/\*\*/\*\*\*: significant at 10/5/1 percent level; t-values in parenthesis; omitted category for dummy variables are Bachelor Economics (study major), Social Democrats (party preference) in columns 1 to 4, Free Democrats and Christian Democrats in columns 5 to 6; constant not shown