Culture and Taxes: Towards Identifying Tax Competition*

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Abstract

We propose a new strategy to identify the existence of interjurisdictional tax competition and to estimate its spatial reach. Our strategy rests on differences between desired tax levels, determined by culture-specific preferences, and equilibrium tax levels, determined by interjurisdictional fiscal externalities as well as by preferences. While fiscal preferences differ systematically and demonstrably between French-speaking and German-speaking Swiss regions, we find that local income tax burdens do not change discretely at the language border but exhibit smooth spatial gradients. The slope of these gradients implies that tax competition constrains tax choices of jurisdictions with a preference for higher taxes at a distance of up to 20 kilometres. Hence, tax competition does constrain income taxation by local governments. When, as in the Swiss system, local jurisdictions are constrained to decide on a single shifter of an exogenously given tax schedule, the effect of tax competition are confined to a small spatial scale.

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Tax competition over mobile resources is a theoretically well understood mechanism. Yet, rigorous research allowing this mechanism to be identified empirically remains comparatively scarce. We employ a quasi-experimental design using measurable and discrete spatial differences in voter preferences as a means to search for evidence of tax competition. The related empirical literature has traditionally treated cultural differences as an exogenous covariate simply to be controlled for. We claim instead that systematic differences in voter preferences among jurisdictions offer a unique opportunity for identifying the existence of tax competition as well as for estimating its spatial reach.

For resource-flow tax competition to arise, two conditions need to hold. First, tax bases have to be mobile in response to tax differentials. This aspect has been extensively studied, and a negative relationship between taxation and the location of individuals and firms is well documented (see e.g. Hines [1996], Devereux and Griffith [1998] for the U.S., and Feld and Kirchgässner [2002] for Switzerland).

The second condition is that in tax-setting, jurisdictions set tax rates strategically with respect to the mobile tax base. Prior empirical research has estimated tax reaction functions through spatial econometric models. However, identification of the existence of strategic interactions among governments is typically plagued by the reflection problem (Manski [1993]). The most prominent empirical analyses of tax reaction functions include a large set of controls including jurisdiction fixed effects to control for time invariant differences in preferences and amenities, and time fixed effects to account for common shocks (e.g. Devereux et al. [2008]). Identification therefore relies on the comparison of differing time patterns of tax rates of the jurisdiction of interest and its neighbours. This approach assumes that it is possible to control for all spatial and temporal observed and unobserved correlations. If this assumption is violated, similarities of neighbouring communities will lead to spurious estimates of tax interactions. Furthermore, identification relies on the existence of substantial strategic variations in tax rates. However, unchanged tax rates do not imply the absence of tax competition. Rather, they could be the equilibrium outcome of tax competition.[1]

[1] Brueckner [2003] surveys the empirical literature on strategic interactions among jurisdictions and points to three main challenges to the identification of tax competition. First, the variable of interest (tax rates of neighbours) is endogenous by definition. Second, correlations between jurisdictional characteristics and the error term may arise e.g. from endogenous sorting of households. Finally, omitted variables can cause spatial error dependence that biases upwards the inferred intensity of policy interactions.

We propose that the empirical study of tax competition be rethought along other lines than estimating spatial reaction functions. Quasi-experimental methods seem to be well-suited to solve these identification problems. Chirinko and Wilson [2008], Rathelot and Sillard [2008], and Duranton et al. [2011] provide interesting applications, using state borders to identify the effect of local taxation on the location of manufacturing in the U.S., in France and in the UK. They find higher employment growth and firm entry when crossing a state border, where local taxation is lower but locational characteristics unrelated to taxation exhibit no spatial discontinuity. This confirms the mobility of the tax base, but says nothing about the existence of strategic interactions among local jurisdictions.

Another issue is the identification of the spatial reach of tax competition, that is the distance up to which tax competition exerts its pressure. The above literature assumes implicitly or shows explicitly an inverse relationship between distance to a state border and mobility of the tax base.[2] Agrawal [2011] shows that localities set local sales tax rates strategically as a function of the distance to a state border, where state sales taxes change discontinuously.

Using a discrete and measurable discontinuity in voter preferences at the Swiss language border, we propose a novel method to identify the presence of strategic interactions in tax setting and the spatial reach of tax competition. Consider two jurisdictions where a historically determined cultural break between the two leads to a sharp, constant and measurable difference in preferences over publicly provided goods. We expect jurisdictions with a higher valuation for these goods to opt for higher taxes.[3] However, if these jurisdictions are spatially close, tax competition might constrain tax choices and reduce observed tax differentials relative to their desired levels. We propose to identify tax competition and its spatial reach by comparing preference-related tax differentials between jurisdictions that share a common border at which preferences change discontinuously, and between jurisdictions with the same differences in preferences, but that are not spatially close and

[2] A similar relationship between distance to a border and demand elasticity of cross-border consumption is found in e.g. Lovenheim [2008].

[3] Alesina and Angeletos [2005] and Benabou and Tirole [2006] provide a theoretical model that links different beliefs to different tax rates. In these models multiple equilibria arise, where one equilibrium type is characterised by a belief that luck determines success, high taxes and high levels of redistribution ("Europe"), whereas the other is characterized by a belief that effort pays off, low taxes and low redistribution ("U.S."). To our knowledge, there exists no empirical literature that estimates the effect of beliefs on tax levels empirically.

thus are less likely to compete with each other.

For empirical identification, we take advantage of the fact that, in Switzerland, fiscal preferences differ systematically and demonstrably at the language border between French-speaking and German-speaking regions within the three bilingual cantons, whereas other characteristics and policies are identical on either side of that border. We show that voting patterns in German-speaking municipalities consistently reflect lower valuations for publicly provided goods. Hence we expect these jurisdictions, other things equal, to choose lower tax rates than their French-speaking counterparts. Comparing municipalities located further away from the language border, and controlling for various municipality characteristics, we indeed find that culture-specific preferences are reflected in statistically significant differences in tax levels, with taxes in French-speaking municipalities being 0.45 standard deviations higher.

In the absence of strategic interactions among municipalities, we would expect tax rates to jump discretely at the language border. We find, however, that local income tax burdens do not change discretely at the border, but exhibit smooth spatial gradients as one moves away from the border. The slope of these estimated gradients implies that tax competition significantly constrains tax choices of the jurisdictions with a preference for higher taxes at a distance of up to some 20 kilometres. This finding is consistent with a setting of local tax competition among municipalities and fits moving and commuting patterns in Switzerland.

Another prominent explanation of strategic tax interactions among local jurisdictions is "yardstick competition", where voters inform themselves about the quality of their politicians by comparing the performance of their government with the one of neighboring jurisdictions. Rent-seeking governments are then disciplined by the threat of non-election by their voters (Besley and Case [1995]). We provide evidence that it is not yardstick competition that drives our results.

The paper is proceeds as follows. Section 1 presents a stylized tax competition model allowing for different preferences for a publicly provided good in neighboring jurisdictions, and it develops our strategy to identify tax competition. Section 2 provides relevant background on Switzerland and establishes the existence of systematic differences in preferences and taxation between the two main language regions. Section 3 contains the empirical analysis of the effect of culture on taxes, the existence of tax competition, and its spatial reach. Section 4 discusses the results in light of commuting and moving patterns, yardstick competition, and tax competition over high-income and wealthy taxpayers. Section 5 concludes.

1 Identifying tax competition across cultural regions

As a fomal underpinning for our empirical strategy, we construct a two-region, two-jurisdiction, tax competition model allowing for different region-level preferences. Consider two jurisdictions where the residents derive their utility from a private consumption good and a publicly provided good financed by a residence-based proportional income tax. In each jurisdiction, a homogeneous majority of residents are immobile and a homogeneous minority are mobile. Mobile workers are more productive, value the publicly provided good less, and can switch jurisdiction at a finite cost.[4] Tax rates in each jurisdiction are set by majority rule, that is, by the immobile workers. The timing is as follows: first, the representative immobile workers of each jurisdiction set simultaneously the tax rate. Second, mobile workers choose where to reside depending on the tax rates of the two jurisdictions and their mobility costs.Consider now two contiguous cultural regions, A and B. Populations born in each region are characterized by different valuations of the publicly provided good. We explore the resulting equilibrium tax rates for the case where the two jurisdictions are located in the same region, and for the case where the jurisdictions belong to different cultural regions.

Each jurisdiction hosts a unit mass of immobile workers. Their productivity α is normalized to 1, as is their wage. Furthermore, each jurisdiction initially hosts $x < 0.5$ mobile workers. Mobile workers have productivity $\alpha > 1$ and receive income α according to their productivity. They can switch jurisdiction at a cost $c \sim U[0, \bar{c}]$.

We denote workers' utility $U(C, G)$ with C standing for a private consumption good and G for a publicly provided good. Workers fully consume their after-tax wage: $C(t_i) = \alpha(1 - t_i)$, where $i \in \{A, B\}$ stands for the region they live in. G is financed by a residence-based proportional income tax set by the representative immobile worker. $G(t_i, n_i)$ is the

[4] This setting is borrowed from Smith and Webb [2001].

publicly provided good produced and consumed in region i. It depends on the tax rate t_i and the endogenous number of mobile residents n_i in the respective regions. We further assume that more productive workers, and workers born in region A value the public good relatively less. The culture-specific valuation of the publicly provided good is captured by a parameter δ_A for region A and δ_B for region B.

Mobile workers take tax rates as given and choose where to live depending on their specific mobility cost. In equilibrium, the mobility cost c_i^* that makes the mobile worker born in region i indifferent between staying or leaving, are implicitly given by:

$$
\begin{aligned}
U_A^m\left(C(t_A), G\left(t_A, x\frac{1-c_A^*+c_B^*}{\bar{c}}\right)\right) &= U_A^m\left(C(t_B), G\left(t_B, x\frac{c_A^*+1-c_B^*}{\bar{c}}\right)\right) - c_A^*, \\
U_B^m\left(C(t_B), G\left(t_B, x\frac{c_A^*+1-c_B^*}{\bar{c}}\right)\right) &= U_B^m\left(C(t_A), G\left(t_A, x\frac{1-c_A^*+c_B^*}{\bar{c}}\right)\right) - c_B^*,
\end{aligned}
$$

where $\frac{1-c_i^*}{\bar{c}}$ is the fraction of stayers and $\frac{c_i^*}{\bar{c}}$ is the fraction of movers.

The immobile representative worker in region A, anticipating the location decision of mobile workers, chooses the tax rate t_A that maximizes his constrained utility:

$$\max_{t_A} U_A^{im}(C_A, G_A) \qquad \text{s.t.} \qquad G = G(t_A, n_A^*)$$

where $n_A^* = x\left(\frac{1-c_A^*}{\bar{c}} + \frac{c_B^*}{\bar{c}}\right)$.

This implicitly defines a tax reaction function $t_A(t_B)$. The same logic leads to a tax reaction function $t_B(t_A)$ for region B. The intersection of these two tax reaction functions defines equilibrium tax rates.

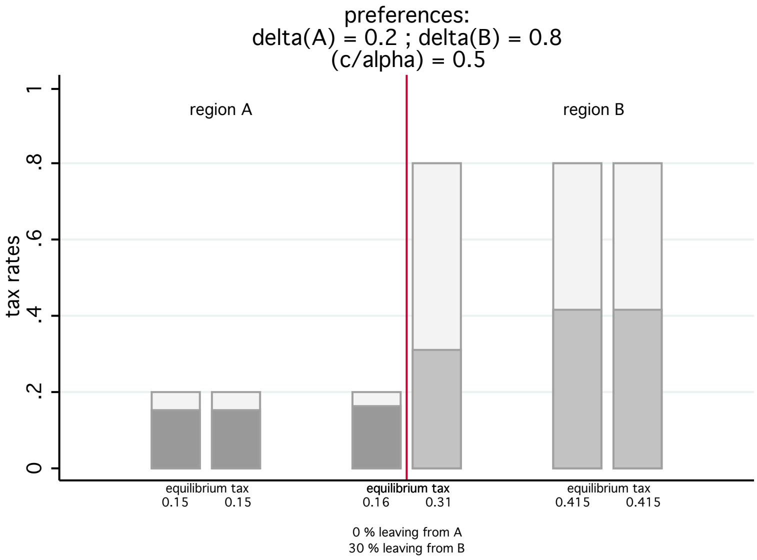
We solve the model assuming the following utility functions for mobile and immobile workers born in region A:

$$U_A^m = \alpha(1-t_i),$$

$$U_A^{im} = (1-t_A)^{1-\delta_A}\left(G(t_A, n_A)\right)^{\delta_A},$$

where $G(t_A, n_A) = t_A * n_A$.

Figure 1: Equilibrium tax rates with tax competition



Note: Pairs of bars represent two neighboring jurisdictions that can be located in the same cultural region, or one in region A and one in region B. The line indicates the region border. White bars represent tax rates without mobility. Dark grey and light grey bars are equilibrium tax rates with mobility. If equilibrium tax rates are the same, mobile workers do not move.

This specification represents, without loss of generality, the case where mobile workers value only private consumption. Furthermore, we introduce a complementarity between immobile and mobile workers in the production of the publicly provided good. If no mobile worker resides in a region, no publicly provided good can be produced and immobile workers have utility of zero. This complementarity rules out special cases where tax reaction functions can be discontinuous and equilibrium tax rates may not exist. Solving this stylized model leads to a tax reaction function

$$t_i(t_j) = f(t_j|\frac{\bar{c}}{\alpha}, \delta_i,)$$

where one can show that $\frac{\partial t_i}{\partial t_j} > 0$, $\frac{\partial t_i}{\partial(\frac{\bar{c}}{\alpha})} > 0$, and $\frac{\partial t_i}{\partial \delta_i} > 0$ (see Appendix A.1). Taxes are thus strategic complements. The ratio $\frac{\bar{c}}{\alpha}$ is an inverse measure of the intensity of tax competition: when mobility costs, $\bar{c}$, relative to the wage α of mobile workers are lower, equilibrium tax rates will be lower. Finally, tax rates are higher when immobile workers have stronger preferences for the publicly provided good.

Figure 1 illustrates equilibrium tax rates with and without mobile workers for $\delta_A =$

0.2, $\delta_B = 0.8$ and a maximum mobility cost $\bar{c} = 2$. We concentrate on the case where mobile workers represent a low fraction of the population ($x = 0.25$) but are four times as productive as immobile workers ($\alpha = 4$).[5] Each pair of bars represents two neighboring jurisdictions that can be located in the same cultural region, in which case immobile workers have the same preferences, or they can lie on either side of the region border such that immobile workers have different preferences for the publicly provided good. Without mobility, tax rates perfectly reflect the differences in preferences (white bars in Figure 1) and change discretely at the border between the two cultural regions. If some workers are mobile, jurisdictions in region B still set higher tax rates, but the jurisdiction at the region border has to lower its tax rate more than if it were in competition with a jurisdiction from the same cultural region, because of the pressure imposed by low-preference and hence low-tax jurisdictions on the other side of the border.[6]

The observed size of the tax differential among jurisdictions located at the border between two cultural regions will therefore reflect the joint effect of differences in preferences and tax competition. To disentangle the two effects, we need counterfactual jurisdictions in each region that do not compete in taxes with jurisdictions of the other region. Assuming that the mobility cost increases with distance, due, for instance, to longer commuting to an unchanged workplace, one can use as counterfactual jurisdictions those located sufficiently far away from the region border. If the size of the tax differential is higher between counterfactual jurisdictions located in the interior of two cultural regions than between jurisdictions at the region border, this would represent evidence for the existence of tax competition.

Our identification strategy thus depends on the crucial assumption that median voter preferences for publicly provided goods are significantly different across the two cultural regions and change discretely at the border. If we can measure preferences, this assumption can be tested empirically by comparing fiscal preferences in the two cultural regions and at the region border.

[5]This matches the income difference between the first and the fourth income quartile in Switzerland.

[6]This conclusion is robust to varying the calibration of δ_A and δ_B. Note that, we imply that there is no additional psychological cost of living in the other region. Higher mobility costs when changing region would result in a higher tax differential at the region border. Conversely, with a zero mobility cost, all jurisdictions set the lowest possible positive tax rate, following standard race-to-the-bottom logic (see Appendix Figure A.1).

Table 1: Stated preferences for government spending and redistribution

% of respondents agreeing	German	French	Difference French-German
Government redistribute wealth	46.22	66.81	20.58***
			(2.58)
More social services vs lower taxes	38.83	46.77	7.93***
			(3.06)
Government should spend more on...			
health	29.11	47.51	18.40***
			(2.42)
education	51.25	53.46	2.21
			(2.61)
retirement	28.04	49.3	21.33***
			(2.41)
unemployment benefits	17.51	29.88	12.36***
			(2.08)
culture, arts	15.26	23.34	8.08***
			(1.98)

Note: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.10. The number of observations varies by question. German-speaking respondents: 1236-1600; French-speaking respondents: 325-482. Source: International Social Survey Program (ISSP), Role of Government, 1996. Switzerland.

In the next section, we show the existence of large, persistent and discrete differences in voter preferences and local tax rates between the two main language regions in Switzerland.

2 Setting: Languages, preferences, and taxation in Switzerland

2.1 Language regions and culture

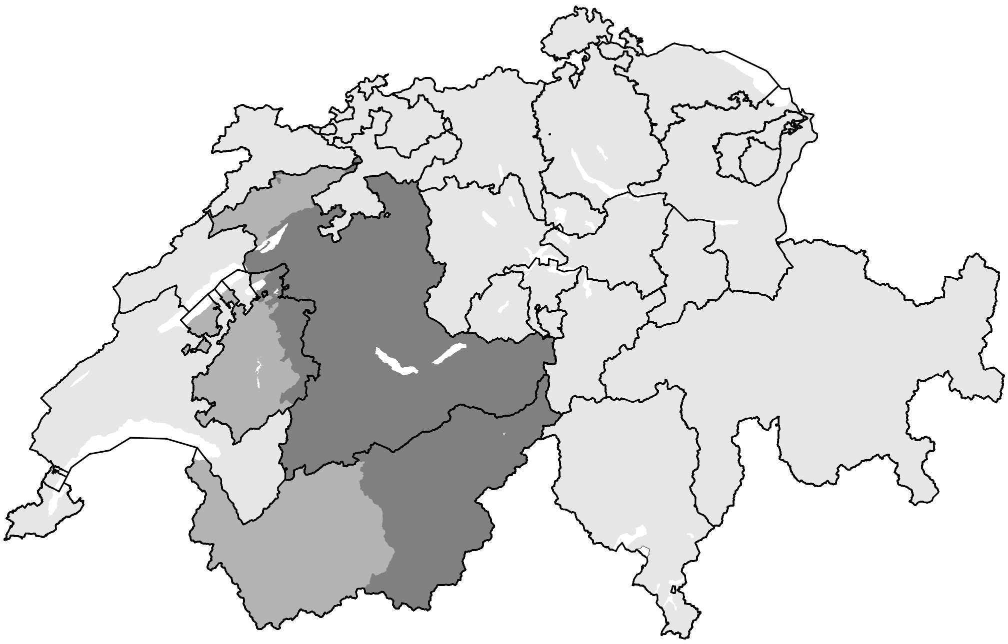
Switzerland consists of two main language regions, German and French.[7] Eugster et al. [2009] and Eugster et al. [2011] have shown that cultural differences across language regions are deeply rooted and reveal themselves in different attitudes toward work and demand for social insurance.

Table 1 provides illustrative evidence from a 1996 survey on attitudes to government spending and redistribution in the two largest Swiss language regions. French-speaking respondents expressed consistently stronger support for redistribution and social services, even at the expense of higher taxes. Especially, they favoured more government spending in social policy areas such as health, retirement, and unemployment benefits.

Such survey-based comparisons, while suggestive, do not provide rigorous evidence of an effect of culture on preferences for government spending. In fact, demographic, geographic or institutional characteristics might be correlated with the language divide

[7] Switzerland has four official languages, German, French, Italian, and Romansh. German is spoken by 63.7% of the population, French by 20.4%, Italian by 6.5%, and Romansh by 0.5%.

Figure 2: Language regions and bilingual cantons in Switzerland



Note: Municipalities of the three bilingual cantons (Berne, Fribourg, and Valais) with a majority of German-speaking residents are shown in dark grey. French-speaking municipalities are in light grey. Cantonal borders are in black. We attribute each municipality to a language region according to the majority language spoken, calculated using data of the Swiss census 2000. Source: Swiss Federal Statistical Office.

and should thus be controlled for. To circumvent this problem, we take advantage of the fact that the French-German language border crosses three cantons, Berne, Fribourg, and Valais (see Figure 2). We can therefore compare preferences within the same institutional (cantonal) setting, and even directly at the language border, where demographic and topographic characteristics exhibit no discontinuities. [8]

As a measure of preferences, we use federal referendum outcomes at the municipality level. Switzerland is characterised by a high degree of direct democracy, with citizens voting regularly on a wide range of issues.[9] We select all federal referenda from 1981 to 2009 on subjects that were presented by the federal government as having an influence on the level of taxes. This includes all referenda on social insurance, and public budget issues such as old age pensions, health insurance, debt-reduction measures, and fiscal transfers

[8]Within the three bilingual cantons, the language border between the French and German regions is sharp. In fact, the percentage French (German) speaking residents jumps from 85% (9%) to 5% (90%) when crossing the language border. This border is historically determined and stable over time.

[9]For example, in the year 2009, there have been 8 federal referenda and a median of 4 cantonal referenda per canton.

Table 2: Federal referenda having influence on taxes

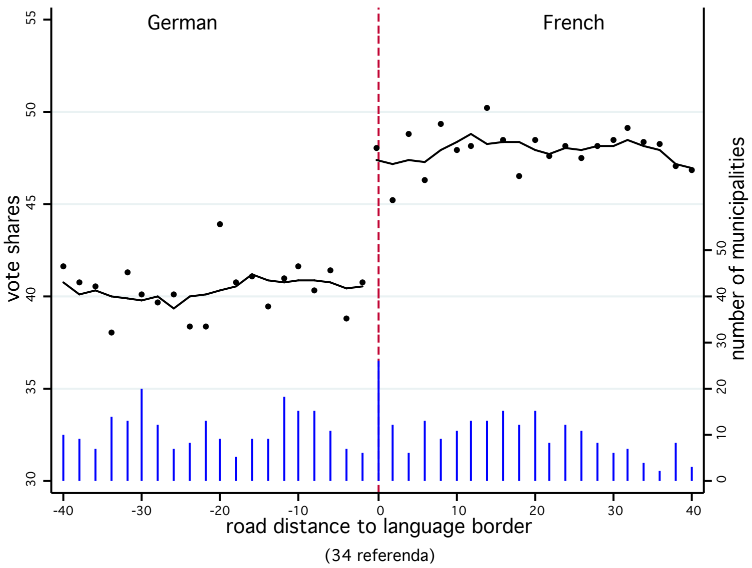
Referenda ID	Year	Subject	% Yes
A. Left-of-centre parties recommend "yes" and right-of-centre parties "no"			
323	1984	Maternity insurance	15.8
352	1988	Old-age insurance	35.1
373	1992	Health insurance	39.3
415	1994	Health insurance	51.8
416	1994	Health insurance	23.4
423	1995	Old-age and disability insurance	27.6
444	1998	Old-age insurance	41.5
458	1999	Maternity insurance	39.0
469	2000	Old-age insurance	39.5
470	2000	Old-age insurance	46.0
484	2001	Capital gains tax	34.1
489.2	2002	Old-age insurance	46.4
499	2003	Health insurance	27.1
500	2003	Disability rights	37.7
503	2003	Education subsidies	31.6
508	2004	Old-age and disability insurance	31.4
523	2006	Old-age insurance	41.7
527	2006	Family subsidies	68.0
528	2007	Health insurance	28.8
536	2008	Old-age insurance	41.4
B. Right-of-centre parties recommend "yes" and left-of-centre parties "no"			
328	1985	Education subsidies	47.6
398	1993	Unemployment insurance	70.4
437	1997	Unemployment insurance	49.2
439	1998	State budget balancing	70.7
451	1999	Home ownership	41.3
457	1999	Disability insurance	30.3
480	2001	Debt break	84.7
489.1	2002	Old-age insurance	46.4
492	2002	Unemployment insurance	56.1
507	2004	Old-age insurance	32.1
509	2004	Family and property taxation	34.1
514	2004	Fiscal transfers	64.4
531	2008	Business taxation	50.5
534	2008	Health insurance	30.5

Note: Federal referenda from 1981 to 2009 having an influence on taxes. Referenda were selected using the official documents by the federal governement, which are distributed to all citizens before the vote. Source: http://www.swissvotes.ch

among cantons. Of these referenda, we keep those for which left-of-centre and right-of-centre parties published opposite vote recommendations. Table 2 lists the 34 selected referenda, which account for 14% of all federal referenda between 1981 and 2009. We split these referenda into two groups, with the first group containing all referenda for which the left-of-center parties recommended a "yes" vote and the right-of-center parties a "no", and the second group containing referenda with the reverse political constellation. We construct a preference measure as the average of the share of "yes" votes for referenda in the first group and the share of "no" votes for referenda in the second group.

Figure 3 shows this municipality-level preference measure as a function of road distance to the language border. The language border (with distance 0) is defined as those

Figure 3: Voting preferences of French and German-speaking municipalities



Note: Municipal vote shares on federal referenda from 1981 to 2009 for which the referenda were presented by the Federal Council as involving tax issues (see list in Table 2). Points show the average of the share of "yes" for left-of-center votes and the share of "no" for right-of-center votes at municipal level in the three bilingual cantons (Berne, Fribourg, and Valais). Lines are 10 km moving averages weighted by the number of municipalities. Road distance is negatively coded for German-speaking municipalities and positively for French-speaking municipalities. Road distances from the on-line route planner search.ch.

French-speaking municipalities that share a common border with a German-speaking municipality. Distance for the remaining municipalities is then defined as road distance to the closest language border municipality. Distance is negatively coded for Swiss-German municipalities. Preferences show strong differences in average levels and a discrete jump at the language border. Voters in French-speaking municipalities show significantly stronger support for policies recommended by left-of-center parties. This evidence is stable over time (see Appendix Figure A.2) and in line with the stated preferences summarized in Table 1. In Section 3, we shall elaborate on this descriptive evidence and provide quantitative estimates of the implied differences in preferences accross the linguistic divide.

An interesting particularity of Switzerland is that inhabitants of municipalities can vote on municipal tax levels, either directly by attending the communal assembly (80% of municipalities) or indirectly through the election of representatives to municipal parliaments (see e.g. Brülhart and Jametti [2007] for more details). We thus expect French-speaking municipalities to set higher tax rates than German-speaking ones.

2.2 Taxation

The Swiss fiscal system is highly decentralized. The smallest political units are the 2,591 municipalities, with a median population of some 1,000 inhabitants and a maximum of 422,640 (city of Zurich). Municipalities independently manage and finance a number of public services, including schools, social services, energy supplies, and roads. On average, 50% of total municipal revenue come from own tax revenue, while 15% come from fiscal transfers. The remaining revenue is divided between user fees and other income. Among tax revenue, 69% are raised through resident-based income taxation, 9% from wealth taxation, 16% from corporate taxation, and the remaining 6% are composed of property and other taxes.[10]

Municipalities cannot determine their own tax schedules. Rather, the cantons decide on the progressivity of the cantonal tax schedule, as well as on exemptions and deductions. Municipalities can then only set a tax multiplier as a scalar shifter on the cantonal tax schedule. This tax multiplier applies to income and wealth taxation. Moreover, corporate taxation in the three bilingual cantons is closely linked to income tax schedules .[11] This implies that municipal tax policy is basically constrained to a single instrument, which in turn allows for perfect comparability within cantons.

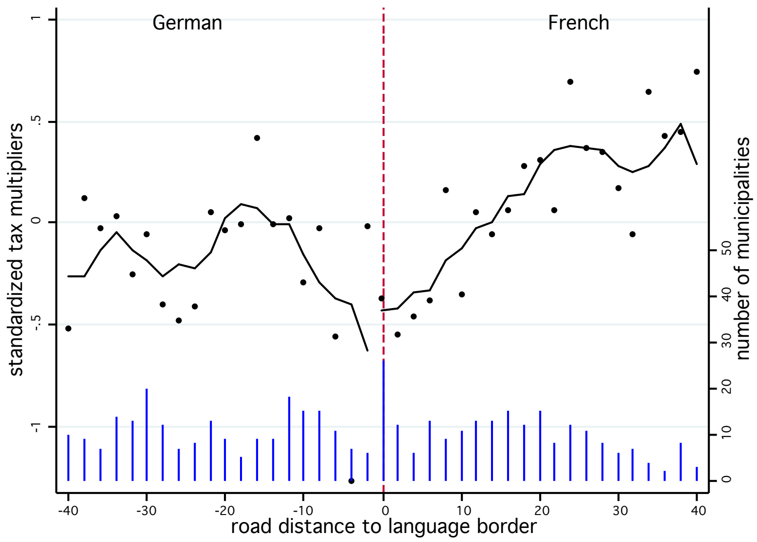
To ensure comparability across the three bilingual cantons, we standardize tax multipliers by deducting their mean and dividing by their standard deviation within each canton and year. Figure 4 plots average standardized municipal tax multipliers for the years 1980 to 2009 in the three bilingual cantons over the distance to the language border. Contrary to referendum outcomes, tax multipliers do not jump at the language border.[12] However, French-speaking municipalities located further away from the language border set higher tax rates than their German counterparts. It is this penomenon that we interpret as a manifestation of tax competition: French-speaking municipalities located at the language border would like to set higher tax rates according to their preferences. However, they are constrained by the threat of mobile residents relocating to low-tax municipalities on the

[10]Municipalities levy 31% of all income and wealth taxes in Switzerland. This is more than the Confederation (26%) and less than the cantons (43%).

[11]In the canton of Berne, both the income and the corporate tax share the same tax multiplier. In the canton of Fribourg, tax multipliers are not exactly the same but have more than 90% correlation, while in the canton of Valais, the corporate tax multiplier is constant across municipalities.

[12]As for preferences, the spatial pattern of tax multipliers is stable over time (see Appendix Figure A.2).

Figure 4: Municipal tax multipliers



Note: Points show average standardized municipal tax multipliers. Lines are 10 km moving averages weighted by the number of municipalities. Distance is negatively coded for German-speaking municipalities and positively for French-speaking municipalities. Source: Income tax multipliers from cantonal statistics (1980-2009) for cantons of Berne, Fribourg, and Valais. Road distances from the on-line route planner search.ch.

German-speaking side.

This constellation of measurable differences in preferences and perfectly comparable tax rates at the language border offers a unique setting for the identification of tax competition and its spatial reach. We shall compare tax differentials among municipalities directly at the language border, where preferences change discontinuously, and among counterfactual municipalities with the same differences in preferences but located further away from the border.

3 Baseline results

3.1 Descriptive statistics and sample selection

Our identification strategy requires that municipalities differ only with respect to preferences and distance to the language border. That is, we seek to compare municipalities on both sides of the language border that share the same characteristics, such as population, economic structure, and geographic features. We have therefore collected a wealth of data on of municipality characteristics, including population size and population characteristics (age structure, religion, income categories), economic activity (employment shares by sectors, economic center, urban area, tourism), and geographic attributes (altitude, area, lake shore).

Controlling for these covariates in a regression may rely too much on extrapolation if there is little overlap in municipality characteristics on both sides of the language border (see Imbens and Rubin [2010]). We therefore restrict our sample to the common support using a propensity score approach. We estimate for each municipality the predicted probability of being in the French-speaking region (propensity score) using all exogenous background characteristics. It has been shown by Rosenbaum and Rubin [1983] that observations with the same propensity score are indeed comparable. To achieve a common support in the two language regions, we drop all municipalities with a propensity score higher (lower) than the maximum (minimum) score in the other region. To be even more restrictive in the common support, we drop also all observations with a propensity score above 0.9 and below 0.1.[13]

We apply this procedure separately for municipalities at the language border and counterfactual municipalities further away from the border. We first define municipalities at the language border to be in a bandwidth from 0 to 20 kilometers and counterfactual municipalities from 21 to 40 kilometers.

Table 3 presents descriptive statistics for taxes, preferences, and background characteristics of municipalities. Column (1) shows means for all municipalities located within 40 kilometers from the language border. Columns (2)-(4) show differences in means between the French and the German language regions for all municipalities, those at the language border, and counterfactual municipalities. Columns (5)-(8) contain the same statistics for the trimmed sample, based on a propensity score estimated using only the exogenous background characteristics of panel B leaving aside the potentially endogenous migration-related characteristics in panel C. In fact, income and education structures of the population may be influenced by migration flows and be partly caused by tax policy. This implies a trade-off between controlling for endogenous covariates and possible omit-

[13] We implemented alternative specifications of the propensity score and the trimming procedure following Imbens and Rubin [2010]. Results are very similar across specifications.

Table 3: Descriptive statistics

	All municipalities				Trimmed sample			
	Mean	Difference French-German			Mean	Difference French-German		
	0-40 km	0-40 km	0-20 km	21-40 km	0-40 km	0-40 km	0-20 km	21-40 km
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
A. TAXES AND PREFERENCES								
Standardized tax multipliers	−0.07	0.19**	−0.02	0.51***	−0.04	0.19**	0.01	0.44***
Vote shares	44.13	7.63***	7.03***	8.20***	44.10	8.11***	7.80***	8.38***
B. BACKGROUND CHARACTERISTICS								
Population	1,682.12	−195.66	−221.96	−312.69	1,391.84	136.36	101.50	89.62
% Foreigners	6.38	3.03***	3.05***	2.53***	5.48	1.51***	0.96*	1.92***
% Young ($\leq$ 20)	27.39	0.67**	1.01***	0.33	27.60	0.61*	1.10***	0.12
% Old ($\geq$ 65)	14.05	−0.10	−0.17	0.35	14.13	−0.14	−0.18	0.16
% Primary sector	26.55	0.38	0.96	2.32	27.89	0.22	1.14	0.89
% Secondary sector	29.38	0.20	−1.25	1.04	29.21	−0.43	−1.08	−0.09
% Tertiary sector	44.07	−0.58	0.30	−3.36	42.90	0.21	−0.06	−0.81
Urban area	0.22	−0.01	0.02	−0.08*	0.18	−0.00	−0.01	−0.02
Center of urban area	0.02	0.01	0.01	−0.00	0.01	0.01	0.01	0.00
Tourist destination	0.03	0.02	0.03**	0.01	0.02	0.01	0.01	0.01
Lake	0.16	0.02	−0.04	0.04	0.16	0.01	−0.04	0.04
Altitude (m.a.s.l.)	659.22	121.03***	161.29***	91.39**	644.30	92.76***	121.87***	78.21**
Area (km^2)	12.07	4.84**	4.15*	6.86**	10.95	2.98**	2.21	4.44*
C. MIGRATION RELATED CHARACTERISTICS								
% Rich ($\geq$ CHF 75,000)	27.52	1.86***	1.34	0.89	27.59	2.24***	1.81*	1.59*
% Poor ($\leq$ CHF 15,000)	3.16	2.56***	3.19***	2.14*	2.40	1.27**	0.93**	2.04*
% High education (tertiary)	13.79	−0.99**	−0.16	−2.70***	13.60	−1.37***	−0.93	−2.33***
% Intermediate education	85.10	1.06**	0.24	2.71***	85.32	1.55***	1.11	2.49***
% No education	1.11	−0.07	−0.09	−0.02	1.07	−0.18**	−0.18*	−0.16
Unemployment rate	1.23	0.22***	0.19***	0.22**	1.15	0.11*	0.04	0.17*
Nb French speaking municipalities	211	211	130	81	173	173	97	75
Nb German speaking municipalities	214	214	98	116	186	186	87	99
Nb of years	30	30	30	30	30	30	30	30

Note: *** p<0.01, ** p<0.05, * p<0.10. Standard errors are clustered by municipality and year. % rich (poor) are defined as having net annual income over (below) CHF 75,000 (CHF 15,000). Source: averages from yearly data (2003-2007) from Federal income tax statistics published by the Swiss Federal Tax Administration. Urban area, center of urban area, tourist destination, lake are binary variables. Source: Swiss Federal Statistical Office. Other data from Swiss Federal Census (1980, 1990, 2000). Source: Swiss Federal Statistical Office. Trimmed sample: propensity score estimated using background characteristics from panel B. All municipalities with a propensity score $\notin (0.1, 0.9)$ and higher (lower) than the maximum (minimum) score in the other language region dropped.

ted variable bias. Our baseline results are based on the specification excluding migration related characteristics.[14]

Column (2) suggests statistically significant differences in taxes, preferences, but also some background characteristics across the language regions. Our identification of tax competition relies on the comparison of tax multipliers of municipalities at the language border (column (3)) and counterfactual municipalities (column (4)). Statistically significant differences in tax multipliers in counterfactual municipalities *but not at the language border* provide first evidence for tax competition, given that differences in preferences are always statistically significant. However, this could still reflect differences in background characteristics of municipalities rather than true causal evidence.

In columns (5)-(8), we therefore restrict our sample to the common support. This reduces the number of municipalities but achieves a better balancing of background characteristics. The only remaining statistically significant differences in background characteristics are economically negligible. Strikingly, the pattern of differences in taxes and preferences remains unaffected. To provide further causal evidence on the existence of tax competition, we investigate these differentials controlling for remaining differences in municipality characteristics.

3.2 Regression results

We now estimate the difference in tax rates between the two language regions separately for municipalities located at the language border (0-20 kilometers) and for counterfactual municipalities (21-40 kilometers), controlling for background characteristics using regression procedures in the full and in the trimmed sample. The estimation of propensity scores and tax differentials is then repeated for bandwidths of 15 and 10 kilometers. Table 4 presents differences in taxes and preferences across the language regions. Columns (1) and (2) show regression estimates using all municipalities, and columns (3) and (4) restrict the sample to the common support.[15]

[14]Results are also robust to the inclusion of migration related controls. See Appendix ??.

[15]A natural extension of regression on a trimmed sample would be to use matching on the propensity score. However, in our setting, this has two limitations: first, matching methods require a large number of observations; second, standard errors are biased because they do not account for the estimation of the propensity score in the first stage and the correlations within and across panels.

Table 4: French-German differentials in taxes and voting preferences

Dependent variables	All municipalities Taxes (1)	All municipalities Vote shares (2)	Trimmed sample Taxes (3)	Trimmed sample Vote shares (4)
		Panel A : Bandwidth of 20 km		
0-20 km	−0.131	0.573***	−0.101	0.561***
	(0.088)	(0.055)	(0.092)	(0.045)
No. of French municipalities	130	130	97	97
No. of German municipalities	98	98	87	87
21-40 km	0.406***	0.632***	0.446***	0.621***
	(0.107)	(0.060)	(0.114)	(0.063)
No. of French municipalities	81	81	75	75
No. of German municipalities	116	116	99	99
		Panel B : Bandwidth of 15 km		
0-15 km	−0.092	0.631***	−0.059	0.597***
	(0.101)	(0.054)	(0.111)	(0.051)
No. of French municipalities	96	96	62	62
No. of German municipalities	81	81	58	58
16-30 km	0.296***	0.578***	0.339***	0.552***
	(0.113)	(0.066)	(0.119)	(0.069)
No. of French municipalities	88	88	82	82
No. of German municipalities	75	75	73	73
31-45 km	0.391***	0.618***	0.487***	0.606***
	(0.140)	(0.080)	(0.148)	(0.081)
No. of French municipalities	33	33	27	27
No. of German municipalities	83	83	56	56
		Panel C : Bandwidth of 10 km		
0-10 km	−0.069	0.591***	−0.071	0.557***
	(0.142)	(0.064)	(0.153)	(0.071)
No. of French municipalities	66	66	41	41
No. of German municipalities	49	49	37	37
11-20 km	−0.246**	0.476***	−0.300**	0.473***
	(0.109)	(0.079)	(0.122)	(0.070)
No. of French municipalities	64	64	45	45
No. of German municipalities	49	49	40	40
21-30 km	0.549***	0.634***	0.617***	0.626***
	(0.138)	(0.084)	(0.145)	(0.090)
No. of French municipalities	54	54	51	51
No. of German municipalities	58	58	56	56
31-40 km	0.204	0.697***	0.231	0.672***
	(0.137)	(0.073)	(0.141)	(0.069)
No. of French municipalities	27	27	21	21
No. of German municipalities	58	58	40	40
No. of years	30	30	30	30

Note: Standard errors in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.10$. Dependent variables are standardized tax multipliers and standardized vote shares in support for left-of-center referenda. Common support: propensity score estimated using background characteristics from panel B in Table 3. All municipalities with a propensity score $\notin (0.1, 0.9)$ and higher (lower) than the maximum (minimum) score in the other language region dropped. Standard errors clustered by municipality and year.

Panel A of Table 4 presents our baseline results. Estimates for the full and the trimmed samples are very similar. Differences in vote shares between French and German-speaking municipalities are about 0.6 standard deviations, for both border and counterfactual municipalities, and always statistically significant. This effect is also economically large since it represents about 8 percentage points' difference in the support of left-of-center referenda (compared to a mean support of 44 percentage points).

If culture-specific preferences alone influence tax setting, we expect higher tax rates in French-speaking than German-speaking municipalities, for both border and counterfactual municipalities. Our results support this hypothesis for municipalities located further away from the language border, for which we find a statistically significant difference of 0.45 standard deviations in tax multipliers. This difference in taxes is also economically relevant. To illustrate this, we can compute the tax liability for a representative taxpayer, who is married and has a gross annual income of CHF 80,000 ($ 100,000), in the three bilingual cantons. Our estimates suggest that French-speaking taxpayers are willing to accept a 2.5% higher total annual tax liability (or about CHF 200).

At the language border, however, we do not find any statistically significant differences in taxes.[16] This implies the existence of tax competition, because we expect French-speaking municipalities located at the language border to limit their tax rates in order to retain mobile taxpayers from moving to the German side.[17]

In order to estimate the spatial reach of tax competition, we repeat the above analysis for smaller bandwidths. Panel B of Table 4 shows the results for bandwidths of 15 kilometers. Differences in preferences are very stable, while differences in taxes exhibit a smooth spatial gradient. Reducing bandwidths further to 10 kilometers, the general pattern is confirmed, that is, the tax differential is higher for municipalities located further away from the language border.

We propose a measure of the spatial reach of tax competition by combining results from panels A and B. Both panels show that tax differentials exhibit a smooth spatial gradient, suggesting a stronger constraint from tax competition for municipalities located closer to the language border. If we define the spatial reach of tax competition as the distance beyond which tax differentials become statistically significant, our results indicate a spatial reach of tax competition between 15 and 20 kilometers.

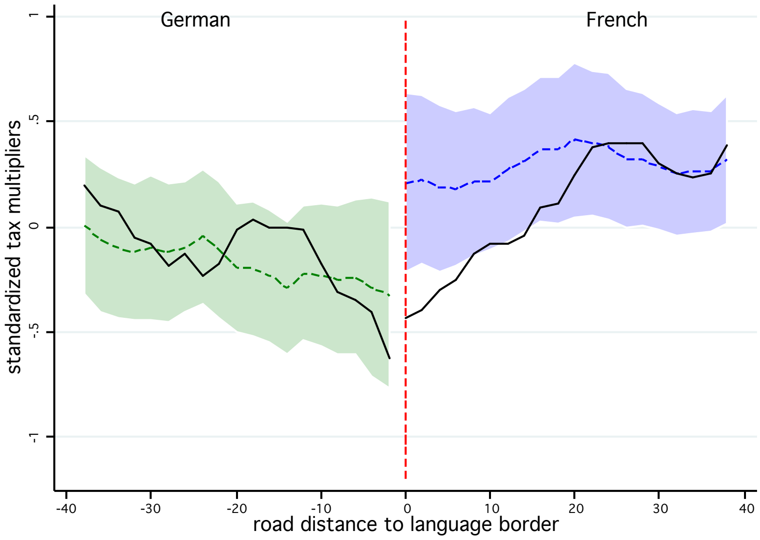
Figure 5 summarizes our findings graphically. We use counterfactual municipalities of one language region to predict the tax rates that would have been predicted for border municipalities within the same language region if there were no difference in preferences and only intraregional tax competition.[18] The graph sheds light on two important con-

[16]Note also that confidence intervals of coefficients on tax differentials at the language border and for counterfactual municipalities do not overlap.

[17]Note that if mobility costs were higher when moving to the other language region (because of cultural and language differences) than within the same region, we would expect a higher tax differential at the language border than with equal mobility costs everywhere. Finding no differential at the language border reinforce our result on the existence of tax competition.

[18]We predict tax multipliers in the French-speaking region on the base of the common support regression including only French-speaking municipalities located between 20 and 40 kilometers and vice versa for the

Figure 5: Predicted and actual tax multipliers



Note: Lines are 10 km moving averages of tax multipliers weighted by the number of observations. The dashed line in the French-speaking region represents predicted tax multipliers on the base of the common support regression including only French-speaking municipalities located between 20 and 40 kilometers. The dashed line in the German-speaking region are predicted tax multipliers estimated using German-speaking municipalities located between -40 and -20 kilometers. Shaded areas are 90% confidence intervals. Distance is negatively coded for German-speaking municipalities and positively for French-speaking municipalities. Source: Income tax multipliers from cantonal statistics (1980-2009) for cantons of Berne, Fribourg, and Valais. Road distances from the on-line route planner search.ch.

clusions. First, at the language border, we predict statistically significantly higher tax rates for French-speaking municipalities if they were not exposed to tax competition with German-speaking municipalities (dashed line) compared to observed tax rates. Second, the solid line turns statistically significantly different from the dashed line between 15 and 20 kilometers, which is consistent with our regression-based estimate of the spatial reach of tax competition.

4 Discussion

4.1 Moving and commuting

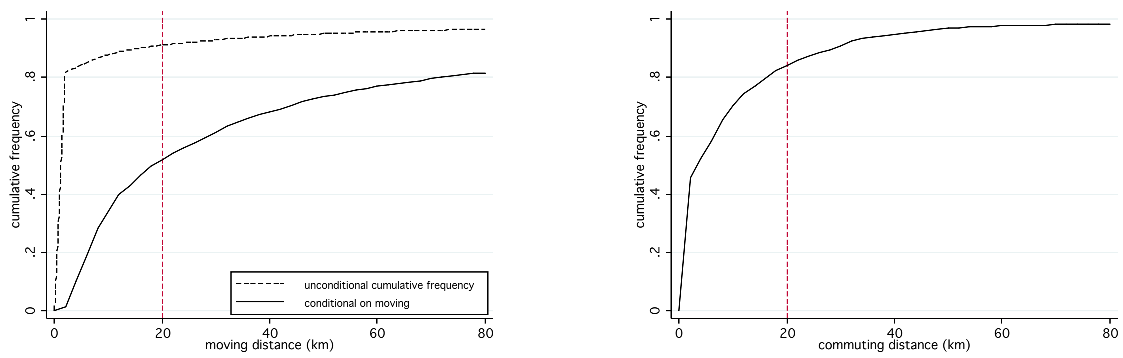
Mobility of taxpayers is a prerequisite for the existence of resource-flow income tax competition. Using individual data of the 2000 Federal Population Census covering all Swiss

German-speaking region.

Figure 6: Cumulative frequencies of distance of commuting and moving

Distance of moving
(across municipalities)

Distance of commuting
(within and across municipalities)



(a) (b)

Note: Figure 6(a): Road distance between the residence municipality in 1995 and 2000 for all individuals older than 15 residing in one of the three bilingual cantons in 2000. The dashed line refers to all individuals. The solid line refers to individuals that have moved across municipalities. Figure 6(b): Road distance of commuting for all individuals residing in one of the three bilingual cantons and working in Switzerland. Source: Federal Population Census 2000. Swiss Federal Statistical Office. Road distances from the on-line route planner search.ch. .

residents, we first investigate moving behavior in our three bilingual sample cantons. For each individual older than 15, we compute the road distance between their current municipality of residence and that of 1995. The dashed line in Figure 6(a) plots the cumulative frequency of moving distances. Some 80% of the population have either not moved, or moved only within their current municipality of residence. For the 20% of movers, the solid line plots the cumulative frequency of moving distances. About half of the movers stay within a radius of 20 kilometers of their former municipality of residence.

The willingness to commute is another important determinant of the existence of tax competition and its spatial reach. Recall that municipalities in Switzerland, when setting their tax multipliers, cannot target a specific income group but compete mostly for a heterogeneous pool of individuals choosing where to reside around a central labour market. Figure 6(b) plots the cumulative frequency of commuting distances for all employed individuals in the three bilingual cantons. More than 80% of individuals reside within a radius of 20 kilometers from their workplace. This prevalence of mostly local mobility is consistent with our interpretation of the results in terms of resource-flow tax competition and with our measure of its spatial reach f some 20 kilometers.

4.2 Yardstick competition

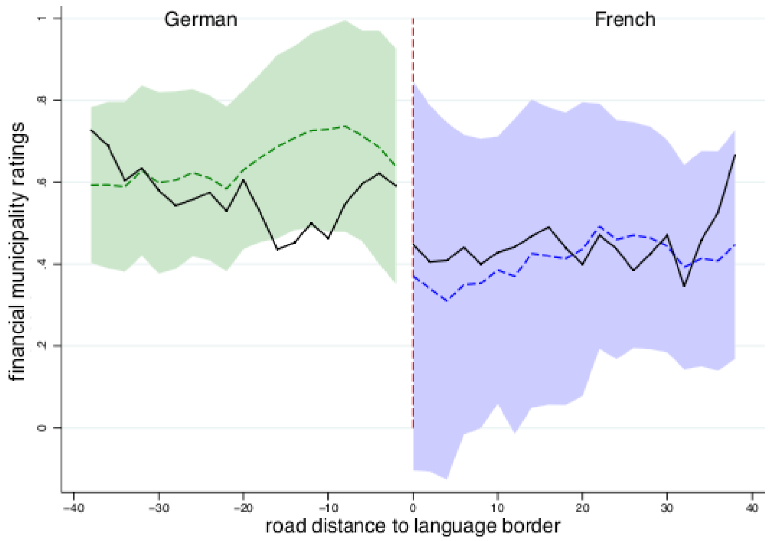
In a yardstick competition setting, voters evaluate the efficiency of their government by comparing the supply of publicly provided goods relative to the taxes paid in their jurisdiction against that ratio in neighboring jurisdictions (see e.g. Geys [2006], Revelli and Tovmo [2007]). With yardstick competition, this ratio, and thus potentially also local tax rates, are spatially correlated in equilibrium, as rent-seeking politicians are disciplined by the threat of non re-election.

To test the yardstick competition argument, we have collected data on financial ratings of municipalities in the three bilingual cantons, where municipalities are ranked on a scale from C to Aaa. These ratings, when purged from municipality background characteristics, can be used as a proxy for the efficiency of municipality governments. Figure 7 repeats the exercise presented in Figure 5 where the ratings have been transformed into a dummy variable and 1 denotes financial ratings better than the median (Aa+, the second of 16 ranks). This figure suggests that German-speaking municipalities are more efficiently run than the French-speaking ones. Furthermore, there is no clear spatial trend within the language regions. With yardstick competition, we would expect the French-speaking municipalities at the language border to have better ratings than those further away from the language border. Thus, yardstick competition seems not to be the cause of the convergence of tax rates at the language border.

4.3 Tax competition over high-income and wealthy taxpayers

Our results so far rely on the comparison across the language border of municipal tax multipliers in the three bilingual cantons. This sample offers the cleanest possible setting in terms of comparability of the tax variable, as the underlying cantonal tax schedule is held constant. We now extend our analysis to a complementary dataset including average tax rates on high-income and wealthy individuals for all municipalities in Switzerland. This allows us to concentrate on a presumably less local and possibly more intense area of strategic tax setting, namely inter-municipal and inter-cantonal tax competition. This extension comes at the cost of a somewhat reduced comparability of the relevant tax

Figure 7: Predicted and actual financial ratings



Note: Lines are 10 km moving averages of financial ratings weighted by the number of observations. The financial rating variable is a dummy for a rating better than the median. The dashed line in the French-speaking region represents predicted financial ratings on the base of the common support regression including only French-speaking municipalities located between 20 and 40 kilometres. The dashed line in the German-speaking region represents predicted financial ratings estimated using German-speaking municipalities located between -40 and -20 kilometres. Shaded areas are 90% confidence intervals. Distance is negatively coded for German-speaking municipalities and positively for French-speaking municipalities. Source: Financial ratings of municipalities of the cantons of Berne, Fribourg, and Valais for the year 2009 from fedafin AG . Road distances from the on-line route planner search.ch.

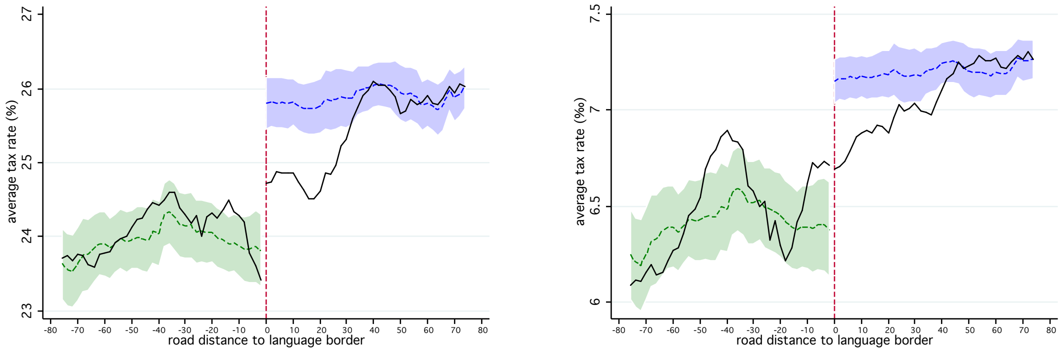
instruments. We now combine municipal and cantonal tax instruments, and do not control for all other policies and institutions that vary across cantons and may influence the location decision of rich taxpayers.

We have collected cantonal and municipal average tax rates for a non-married taxpayer with a gross annual income of CHF 500,000 and average tax rates for a married taxpayer with net wealth of CHF 5,000,000.[19] Using this dataset, we repeat the analysis of Section

[19]These categories corresponds to the penultimate income, respectively wealth category, for which we have data on average tax rates for the 813 largest municipalities in Switzerland. These rates are published annually by the Swiss Federal Tax Administration in *Charges fiscales en Suisse*. We compute the average tax rate for each of the about 2,591 municipalities as follows: We collect all municipal tax multipliers for the years 2005 to 2009. As these tax multipliers are the main determinant of differences in tax rates within a same canton, we can combine these two datasets by a regression procedure and interpolate the average tax rates for each municipality. There exist two other sources of variation in municipal average tax rates within cantons. First, in some cantons, school districts do not overlap with municipal borders and can levy their own taxes. Second, in some cantons, Catholic and Protestant churches can levy their own taxes on their members. These specificities create small prediction errors.

Figure 8: Predicted and actual average tax rates on high-income and wealthy taxpayers

gross annual income: CHF 500,000 (non-married taxpayer) | net wealth: CHF 5,000,000 (married taxpayer)



(a) (b)

Note: Lines are 10 km moving averages of average tax rates (cantonal and municipal tax rates) weighted by the number of observations. The dashed line in the French-speaking region represents predicted tax rates on the base of the common support regression including only French-speaking municipalities located between 40 and 80 kilometers. The dashed line in the German-speaking region represents predicted tax rates estimated using German-speaking municipalities located between -80 and -40 kilometers. Shaded areas are 90% confidence intervals. Distance is negatively coded for German-speaking municipalities and positively for French-speaking municipalities. Source: Average tax rates on income and wealth: own calculation based on cantonal statistics (2005-2009). Road distances from the on-line route planner search.ch. .

3.2 for bandwidths of 20 and 40 kilometers. We restrict the analysis to within 80 kilometers from the language border to keep the general context of tax competition across language regions.[20]

Figure 8 repeats the exercise presented in Figure 5. Municipalities located between 40 and 80 kilometers from the language border are used to predict average tax rates for municipalities located closer to the language border. The two graphs illustrate well the effect of tax competition in reducing tax differentials at the language border. Furthermore, they shed light on the spatial reach of tax competition over the most lucrative taxpayers, which is estimated at approximately 35 kilometers for income taxes and 45 kilometers for wealth taxes. This larger spatial reach makes sense, as high-income and wealthy taxpayers are reasonably characterized by the highest mobility among taxpayers.

[20]The maximum distance in the German (French) speaking part amounts to 228 (140) kilometers.

5 Conclusions

We propose a new quasi-experimental strategy to identify tax competition by exploiting systematic and measurable differences in preferences among spatially proximate local jurisdictions. These exogenous differences in preferences offer a way of determining the existence of tax competition and of estimating its spatial reach.

We develop a stylized tax competition model allowing for different preferences for a public good in neighboring jurisdictions and deduce from it our identification of tax competition. Applying this identification strategy to the Swiss language border, we show that preferences approximated by referenda outcomes differ persistently, discretely and statistically significantly between the French and the German-speaking regions of the three bilingual cantons. Voting patterns are invariant to distance from the language border. Second, we investigate the effect of preference differentials on local tax rates. We find an economically and statistically significant effect of culture on taxes: a 0.6 standard deviation higher support for left-of-center referenda is associated with about 0.45 standard deviation higher tax rates. Third, we identify tax competition by comparing the tax differential implied by the preference differential with the tax differential of municipalities located directly at the language border. Border municipalities are found to have the same differences in preferences as non-border municipalities, but the tax differential at the language border is zero. This is compelling evidence for the importance of tax competition.

Repeating the analysis across different distance bandwidths, we estimate the spatial reach of tax competition at about 20 kilometers. This is consistent with general moving and commuting patterns in Switzerland. Our result can be interpreted as a lower bound on the spatial reach of tax competition, as the underlying tax instrument is restricted to affect all elements of the tax base equally. Extending the analysis to inter-municipal and inter-cantonal tax competition targeted at very rich taxpayers, we consistently find a larger spatial reach of about 40 kilometers. This result suggests that the spatial reach of tax competition depends on the underlying tax instruments available to local jurisdictions. Limiting these instruments could be one option for policy makers concerned about the potential harms of tax competition. The link between the range of available tax instruments and the spatial reach of tax competition would appear to be a fruitful object of further empirical examination and will shed some light on the theoretical debate on preferential regimes (see Janeba and Peters [1999]; Keen [2001]).

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A Appendix

A.1 Model

We solve the model using the following utility functions for mobile and immobile workers coming from region A:

$$U_A^m = \alpha(1 - t_i),$$

$$U_A^{im} = (1 - t_A)^{1-\delta_A} \left(G(t_A, n_A)\right)^{\delta_A},$$

where $G(t_A, n_A) = t_A * n_A$.

Mobile workers take tax rates as given and choose where to live depending on their specific mobility cost. In equilibrium, the number of mobile workers in region A is given by

$$n_A^* = x\left(1 + \frac{\alpha(t_B - t_A)}{\bar{c}}\right).$$

Thus, the maximization problem of the representative immobile worker in region A is

$$\max_{t_A} \quad (1 - t_A)^{1-\delta_A} \left(t_A x \left(1 + \frac{\alpha(t_B - t_A)}{\bar{c}}\right)\right)^{\delta_A}$$

which leads to the following tax reaction function:[21]

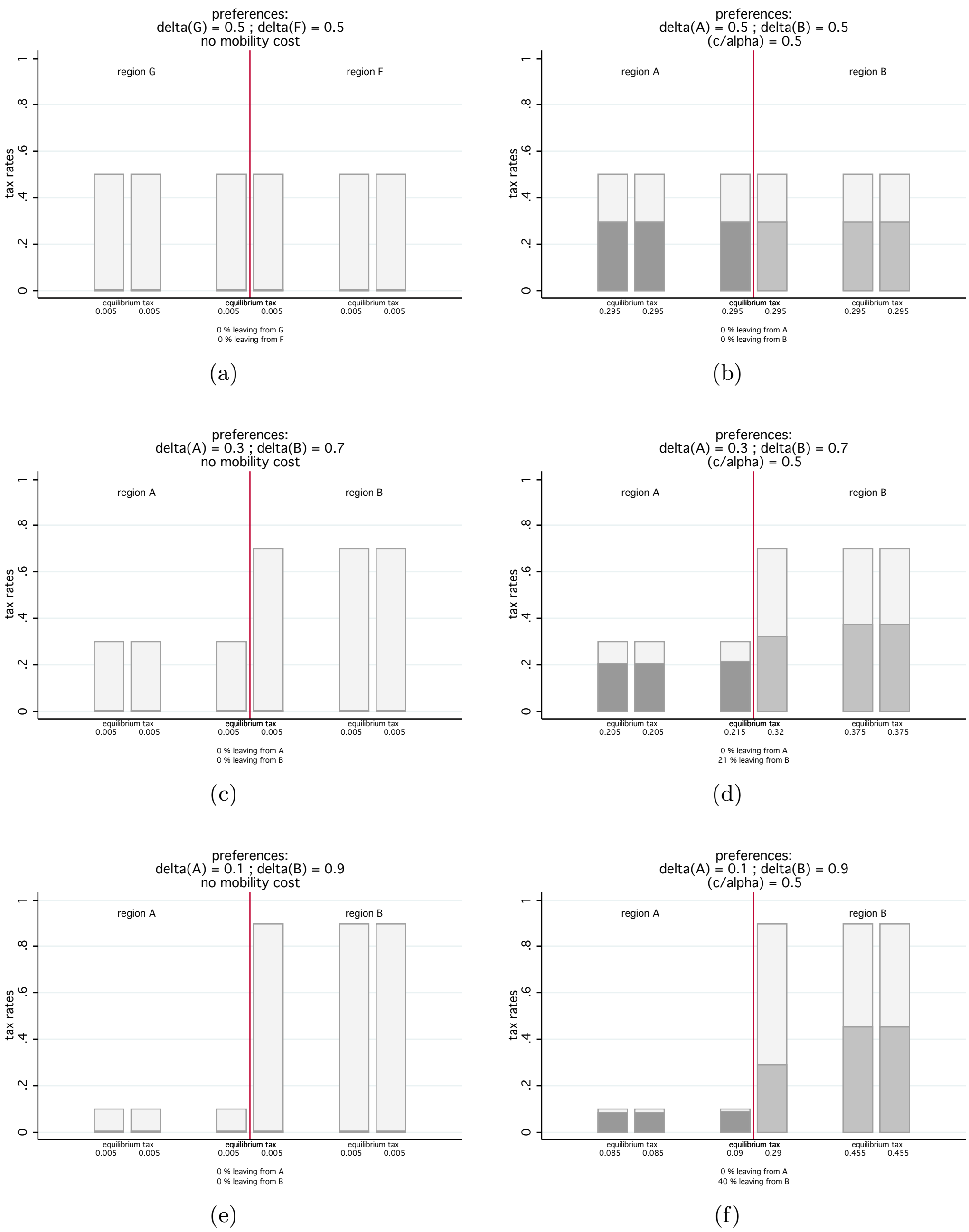
$$t_A(t_B) = \frac{2\delta_A + \frac{\bar{c}}{\alpha} + t_B - \sqrt{\left(\frac{\bar{c}}{\alpha} + t_B\right)^2 + 4\delta_A^2\left(1 - \frac{\bar{c}}{\alpha} - t_B\right)}}{2(1 + \delta_A)}.$$

One can show that $\frac{\partial t_A}{\partial t_B} > 0$ and $\frac{\partial t_A}{\partial(\frac{\bar{c}}{\alpha})} > 0$ as long as $\delta_A^2 < 1$, which is always the case as $\delta \in (0, 1)$. Similarly, $\frac{\partial t_A}{\partial \delta_A} > 0$ for all values of $\frac{\bar{c}}{\alpha} + t_B$.

Figure A.1 presents equilibrium tax rates for different preference parameters and ratio $\frac{\bar{c}}{\alpha}$.

[21] This model leads to a second possible tax reaction function of the form $t_A(t_B) = \frac{2\delta_A + \frac{\bar{c}}{\alpha} + t_B + \sqrt{\left(\frac{\bar{c}}{\alpha} + t_B\right)^2 + 4\delta_A^2\left(1 - \frac{\bar{c}}{\alpha} - t_b\right)}}{2(1+\delta_A)}$. We rule out this tax reaction function, as it does not lead to an equilibrium.

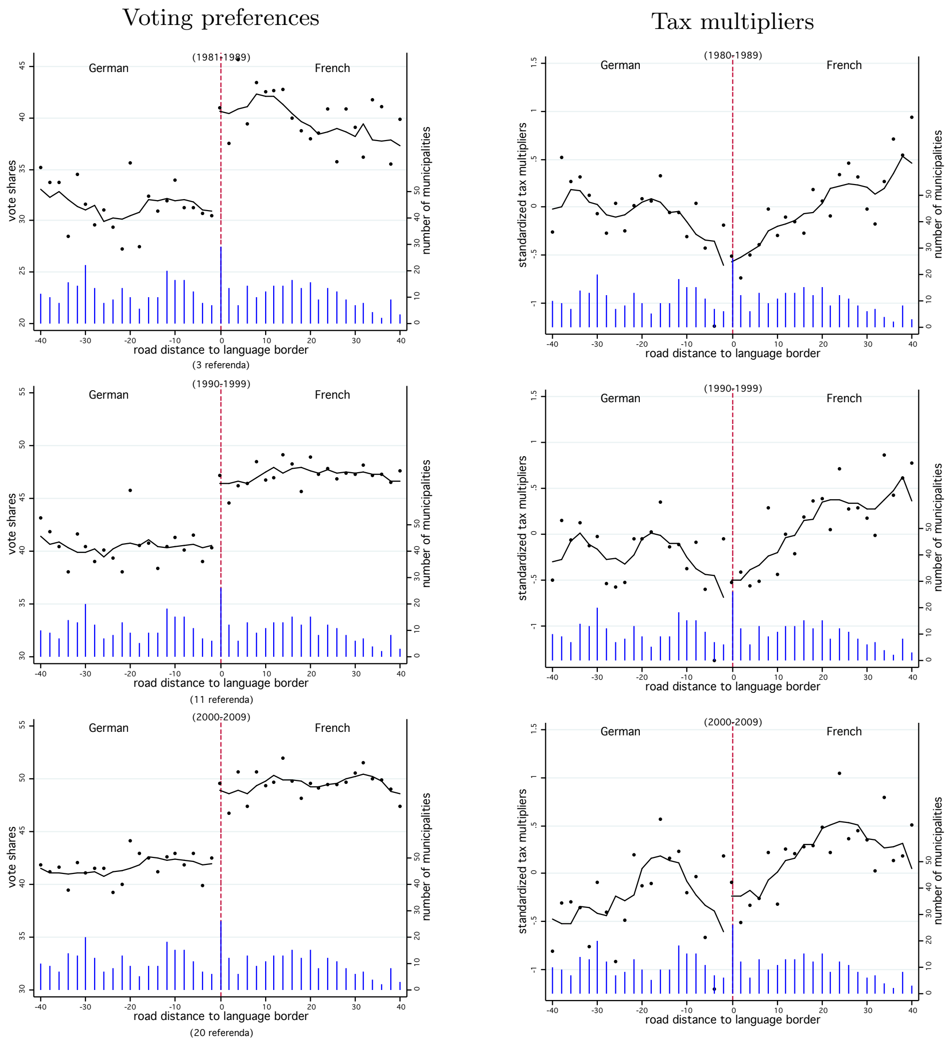
Figure A.1: Equilibrium tax rates for different preference parameters and mobility costs



Note: Pairs of bars represent two neighboring jurisdictions that can be located in the same cultural region, or one in region A and one in region B. The line indicates the region border. White bars represent tax rates without mobility. Dark grey and light grey bars are equilibrium tax rates with mobility. If equilibrium tax rates are the same, mobile workers do not move.

A.2 Voting preferences and tax multipliers for different time spans

Figure A.2: Voting preferences and tax multipliers for different time spans



Note: Municipal vote shares on federal referenda from 1981 to 2009 for which the referenda were presented by the Federal Council as involving tax issues (see list in Table 2). Points show the average of the share of "yes" for left-of-center votes and the share of "no" for right-of-center votes at municipal level in the three bilingual cantons (Berne, Fribourg, and Valais). Lines are 10 km moving averages weighted by the number of municipalities. Road distance is negatively coded for German-speaking municipalities and positively for French-speaking municipalities. Road distances from the on-line route planner search.ch.

Note: Points show average standardized municipal tax multipliers. Lines are 10 km moving averages weighted by the number of municipalities. Distance is negatively coded for German-speaking municipalities and positively for French-speaking municipalities. Source: Income tax multipliers from cantonal statistics for the cantons of Berne, Fribourg, and Valais. Road distances from the on-line route planner search.ch.