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ABSTRACT

The Effect of Agglomeration Size on Local Taxes*

Standard tax competition models predict a 'race-to-the-bottom' of corporate tax rates when firms are mobile. Recent theoretical literature has qualified this view by offering a theoretical explanation why this extreme prediction need not occur: central regions with large clusters of economic activity are able to set positive tax rates without fearing to lose firms to peripheral regions as the firms would forego `rents' from agglomeration economies. In this paper, we study whether local policy makers effectively tax such agglomeration rents. We test this with panel data from Swiss municipalities between 1985 and 2005. We find that large urban areas set indeed higher tax rates than small ones. This is consistent with the theoretical prediction. Within urban areas, however, municipal tax rates are unrelated to the size of economic activity in and around municipalities while they are positively related to the size of the political jurisdiction. We see this result as evidence that the standard tax competition model for asymmetric jurisdictions is at work in the competition of municipalities within an urban area. Both results are robust to controlling for reverse causality by using instrumental variables. Controlling for fixed effects in a 20 year panel is non-informative and neither supports nor contradicts these findings. As a robustness check we introduce an new measure of cluster intensity which considers the varying intensities in agglomeration economies across sectors.

JEL Classification: H32 and R3
Keywords: agglomeration, corporate taxes, local taxation and tax competition

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1 Introduction

Standard tax competition models predict a 'race-to-the-bottom' of corporate tax rates when firms are mobile. The new economic geography (NEG) literature has qualified this view by offering a theoretical explanation why this extreme prediction need not occur: central regions with large clusters of economic activity are able to set positive tax rates without fearing to lose firms to peripheral regions as the firms would forego 'rents' from agglomeration economies such as market access, supplier proximity or knowledge spillovers. In this paper, we study whether local policy makers effectively tax agglomeration rents, and whether this effect is strong enough to have a noticeable impact on the evolution of statutory corporate tax rates across Swiss urban areas and municipalities.

The NEG prediction can be tested by showing that small regions exhibit lower tax rates than bigger ones. Although this test seems straightforward to implement there is a series of challenges. First, the standard tax competition model with asymmetric jurisdiction size also predicts that small locations (tax havens) have lower tax rates than large ones, but the economic implications are very different. To separate the two predictions we make a clear difference between the political and the economic size of a location. To identify the two effects separately, we take advantage of the fact that small and medium sized municipalities can be found both in the centre and the periphery of an urban area. Second, unobserved and unobservable local characteristics could have an important effect on local tax rates. We therefore control for observable location characteristics in our *cross-section analysis*. Furthermore, we control for unobserved local characteristics by including municipality fixed effects in our *panel analysis*. Third, the size of local jurisdictions is likely affected by local tax rates and therefore endogenous. We instrument for location size with a set of variables based on 19th century population, initially available land reserves and initial sector composition.

A further empirical challenge arises from the elegant but unrealistic description of local jurisdictions in the theoretical models. The theoretical literature assumes that local jurisdictions are politically and economically independent from each other. In reality, countries are typically divided into economically fairly independent urban areas which are formed of a multitude of economically dependent and politically fairly independent municipalities. We develop two strategies to address this issue. First, we do an analysis at the *urban area level*, treating each urban area as an independent entity. In this approach, economic and political size of the local jurisdiction, i.e. the urban area, overlap. Second, we do a *municipality level* analysis. In this approach, the political and economic size of the local jurisdiction, i.e. the municipality, diverge. We therefore introduce two different measures for the economic size of the municipality: economic activity within the legal borders and the distance weighted size of economic activity within and around the municipality.

Another aspect typically ignored by the theoretical literature is the industry composition of agglomeration. Because different industries can exhibit different degrees of agglomeration economies, the industry composition at the local level could have an important effect on taxation. We therefore propose a new cluster intensity measure to deal with this problem.

We base our estimations on data for *Switzerland*. The Swiss federation consists of three government layers (federal, cantonal and municipal), with each jurisdictional level collecting a roughly similar share of total tax revenue. Cantons and municipalities enjoy vast autonomy in the determination of their tax rates, and, as a consequence, we observe large variations in tax burdens even within the small area covered by Switzerland. The Swiss fiscal system therefore provides a well suited laboratory in which to examine our research question.

The remainder of this paper is structured as follows. In section 2, we discuss the related theoretical and empirical literature. Section 3 explains our empirical strategy. In section 4, we describe data and variables used for the estimations. The results of the main analysis are reported in section 5. In section 6, we propose a new cluster measure and discuss the results using this alternative measure. Section 7 concludes.

2 Theoretical Background and Empirical Literature

The implications of agglomeration economies for strategic tax setting have been studied in a number of theoretical contributions, including Ludema and Wooton (2000), Kind et al. (2000), Andersson and Forslid (2003), Baldwin and Krugman (2004), and Borck and Pflüger (2006). See Baldwin et al. (2004, chapters 15 and 16) for a comprehensive overview of this often called New Economic Geography (NEG) literature. The key insight of this literature is that agglomeration forces make the world ‘lumpy’: when capital (or any other relevant production factor) is mobile and trade costs are sufficiently low, agglomeration forces lead to spatial concentrations of firms which cannot easily be dislodged by tax differentials. Ottaviano and van Ypersele (2005) have shown that in the presence of agglomeration economies tax competition can be second-best welfare-enhancing, as it may mitigate a tendency towards excessive spatial concentration of firms. In fact, agglomeration externalities create rents that can in principle be taxed by the jurisdiction hosting the agglomeration.

This prediction contrasts with results from the standard tax competition literature, where mobile factors such as capital lead to inefficiently low tax rates because of competition among local governments. The standard tax competition literature goes back to Oates (1972), who already describes how jurisdictions lower tax rates to attract business investment. The first formalised models were developed by Zodrow and Mieszkowski (1986) and Wilson (1986). These papers find that because of tax competition local governments set capital tax rates and the level of public spending inefficiently low.

In an extension to the standard tax competition literature, Bucovetsky (1986) and Wilson (1991) introduce asymmetric country size. They find that because the marginal product of capital is higher in the smaller country, the elasticity of capital with respect to the capital tax rate must be higher. This results in lower tax rates in the smaller country, which therefore will be a tax haven. Hence, both the New Economic Geography model and the tax haven model can predict a positive correlation between jurisdiction size and tax rates; though the economic mechanisms and implications are very different.

Brülhart, Jametti and Schmidheiny (2007) have studied whether the main mechanism behind the NEG prediction is at work, i.e. whether firms really are less sensitive to local taxes in the presence of agglomeration economies. Drawing on a firm-level dataset for Switzerland and employing fixed-effects count-data estimation techniques, we found that firm births on average react negatively to corporate tax burdens, but that the deterrent effect of taxes is weaker in sectors that are more spatially concentrated. Firms in sectors with an agglomeration intensity at the twentieth percentile of the sample distribution are up to 50 percent more responsive to a given difference in corporate tax burdens than firms in sectors with an agglomeration intensity at the eightieth percentile.

There is yet only preliminary direct evidence of the NEG prediction. Charlot and Paty (2007), Jofre-Montseny and Solé-Ollé (2009) and Koh and Riedel (2010) are the first attempts to directly test whether agglomeration rents are taxed, by showing that local taxes are positively correlated with local agglomeration economies. Charlot and Paty (2007) assess the effect of agglomeration (measured as market access) on local taxation. They use panel data for French municipalities and find a positive effect of market access on taxation, and mimic behaviour in tax setting across municipalities. Jofre-Montseny and Solé-Ollé (2009) focus on the effect of urbanisation economies, localisation economies and market potential on the Spanish municipal business tax rate. Using a cross-section of Spanish municipality level data, they find that all of the above factors have a positive effect on tax rates. Koh and Riedel (2010) determine the tax effect of urbanisation and localisation economies, and investigate whether differentiation from neighbouring economies has an effect on business tax rates. Using panel data for local business tax rates in Germany, they find a positive impact of agglomeration and differentiation on tax rates.

Our paper is complementary to these three studies and seeks to overcome their shortcomings in several dimensions. First, we analyse data for Switzerland which is the only country studied so far where local business taxes are substantial enough to plausibly matter for business location. Second, we study the evolution of local tax rates over a much longer time horizon (20 years) than previous research. Our paper has therefore the potential to cover substantial changes in the size of local jurisdictions. Third, we propose new and in our opinion more convincing instruments for the employment growth rate of locations. Fourth, we explicitly address and operationalise the important distinction between the political and economic size of local jurisdictions, which has been ignored in previous studies.

3 The econometric model

The theoretical literature elegantly assumes that local jurisdictions are politically and economically independent from each other. In reality, countries are typically divided into economically fairly independent urban areas which are formed of a multitude of politically fairly independent municipalities. We develop two strategies to address this issue. First, we do an analysis at the urban area level, treating each urban area as an independent entity. In this first approach, economic and political size of the local jurisdiction, i.e. the urban area, overlap. Second, we do a municipality level analysis. In this second approach, the political and economic size of the local jurisdiction, i.e. the municipality, diverge. We therefore introduce two different measures for the economic size of the municipality: economic activity within the legal borders and the distance weighted size of economic activity within and around the municipality. See the description of the corresponding variables in section 4.3 for the operationalisation of these two variables.

We estimate the following relationship at the *urban area level*:

$$Tax_a = \beta_0 + \beta_1 \log(Empl_a) + \beta_2 X_a + u_a \tag{1}$$

Where Tax_a is the average tax rate over the individual municipalities of the urban area a, location size $Empl_a$ is measured as total employment in the urban area and X_a is a vector of other characteristics describing the urban area.

We estimate the following relationship at the *municipality level*:

$$Tax_i = \beta_0 + \beta_1 \log(Empl_i^{muni}) + \beta_2 \log(Empl_i^{dist}) + \beta_3 X_i + u_i \tag{2}$$

where $Empl_i^{muni}$ is the location size within the legal borders of municipality i, $Empl_i^{dist}$ is the distance-weighted size of the economically relevant area in and around municipality i and X_i is a vector of control variables.

Although we use a wide range of control variables, it is still possible that there are unobserved and unobservable local characteristics with an important effect on taxation. We use the long difference (20 years) between 1985 and 2005 to control for omitted factors with a difference-in-difference strategy. In addition, we include time fixed effects to capture time trends in the data. In the urban area level analysis, we estimate the following panel data equation:

$$Tax_{at} = \beta_0 + \beta_1 \log(Empl_{at}) + \beta_3 X_{at} + \delta_t + c_a + u_{at} \tag{3}$$

where c_a are urban area fixed effects and δ_t time fixes effects. In the municipality level analysis, the estimated equation is

$$Tax_{it} = \beta_0 + \beta_1 \log(Empl_{it}^{muni}) + \beta_2 \log(Empl_{it}^{dist}) + \beta_3 X_{it} + \delta_t + c_i + u_{it} \tag{4}$$

where c_i are municipality fixed effects. As there are only two data waves, the fixed effects estimator will be identical to the estimation in first differences

$$\Delta Tax_{it} = \alpha + \beta_1 \Delta \log(Empl_{it}^{muni}) + \beta_2 \Delta \log(Empl_{it}^{dist}) + \beta_3 \Delta X_{it} + v_{it} \tag{5}$$

where $\Delta Tax_{it} = T_{it} - Tax_{i,t-1}$, $\Delta \log(Empl_{it}) = log(Empl_{it}/S_{i,t-1})$ and $v_{it} = \Delta u_{it}$.

We have to take into account that the size of local jurisdictions is likely endogenous. First, locations with low taxes are likely to attract – ceteris paribus – more firms and hence are larger then locations with high taxes. This leads to endogeneity from reversed causality. Second, there may be omitted variables that explain both tax rates and location size. We therefore estimate equations (1) to (5) using instrumental variables. See sections 4.5 and 4.6 for a description of the used instruments.

4 Data and Variables

We base our estimations on data for Switzerland. For a number of reasons, the Swiss fiscal system provides a well suited laboratory in which to examine our research question.

The Swiss federation consists of three government layers (federal, cantonal and municipal), with each jurisdictional level collecting a roughly similar share of total tax revenue. Cantons and municipalities enjoy vast autonomy in the determination of their tax rates, and, as a consequence, we observe large variations in tax burdens even within the small area covered by Switzerland. Cantons and municipalities collect around 65 percent of the corporate income and capital tax revenue, the remaining 35 percent being raised by the federal government. Profit taxes account for 85 percent of corporate tax receipts.

4.1 Geographical Definitions

Switzerland was divided into 3022 municipalities in the year 1985.[1] This number shrank to 2758 by the year 2005 due to mergers of small municipalities. We combine the municipality data with historic geographic coordinates to measure the distance between municipalities as described in section 4.3.[2]

The Swiss Federal Statistical Office identified 55 urban areas in the year 2000. Urban areas are defined similarly to metro- and micropolitan statistical areas (MSA) in the U.S. They include a densely populated central city and its adjacent municipalities with high commuting flows to the centre.[3] The largest urban area in the year 2000 is Zurich with a population of 1,080,728 living in 132 municipalities; the smallest is St. Moritz with a population of 15,757 living in 8 municipalities.[4] We use the definition for urban areas for year 2000 and corresponding list of municipalities throughout including for historical data from 1985 and 1850.

4.2 Local Business Taxes

We use data on corporate income taxes created by Brülhart and Jametti (2006) for the 1985 cross-section and by Bacher and Brülhart (2010) for the 2005 cross-section.[5] This data reports statutory tax rates for the 213 largest municipalities in 1985 and the 845 largest municipalities in 2005.

Our dependent variable is the local tax rate for firms. $ProfitTax_i$ is the corporate profit tax rate in location i as percentage of a firm's profit. We use the tax rate for a firm with median profits (9% of turnover in our sample). In the municipality level analysis, $ProfitTax_i$ is the tax rate in municipality i plus the respective cantonal tax rate. In the urban area level analysis, $ProfitTax_a$ is the employment-weighted average of the local

[1]Historical lists of Swiss municipalities are provided in an online tool by the Swiss Federal Statistical Office at `http://www.bfs.admin.ch/bfs/portal/de/index/infothek/nomenklaturen/blank/blank/gem_liste/02.html`.

[2]Geographic coordinates mark the centre of municipalities, typically the church tower or main square. Coordinates for 2005 are available online from the Federal Statistical Office at `http://www.bfs.admin.ch/bfs/portal/de/index/infothek/lexikon.html`; data for 1985 was directly provided by the Swiss Federal Statistical Office.

[3]The exact definition is given in Schuler, Joye, and Dessemontet (2005) , Eidgenössische Volkszählung 2000: Die Raumgliederungen der Schweiz. Swiss Federal Statistical Office, Neuenburg.

[4]The composition of urban areas in the year 2000 are available online from the Swiss Federal Statistical Office at `http://www.bfs.admin.ch/bfs/portal/de/index/regionen/11/geo/analyse_regionen/04.html`.

[5]These variables are based on statutory tax data from the official compendium of cantonal tax laws (Steuern der Schweiz, editions 2001- 2005), and on cantonal and municipal tax multipliers obtained from the 26 cantonal tax authorities by the authors.

tax rates $ProfitTax_i$ in all reported municipalities i that belong to urban area a.

Table 1 and 2 report descriptive statistics for the local tax burden for both municipalities and urban areas. The variance of the corporate tax burden is large: the combined municipal and cantonal profit tax rate was on average 17.7% across the 845 municipalities in 2005. The highest tax rate, at 23.4%, was more than double the lowest rate, at 11.5%. Aggregated to the urban area level, the average tax rate was 17.0% across 55 urban areas ranging from 12.9% to 23.1%. Decomposing the total variance into within and between variance in the 1985-2005 Panel shows that business tax rates vary almost as much over time as across locations.

4.3 Location Size

The main explanatory variable is the 'size' of the location. We measure the size of the location by its employment. Local employment figures are generated from firm-level data in the Swiss Business Census provided by the Swiss Federal Statistical Office.[6] This dataset contains information on location, sector of activity and number of employees for the universe of about 300,000 firms located across Switzerland in 1985 and 2005.

A main contribution of this paper is to make a clear distinction between the political and the economic definition of location size. The political definition refers to the legal borders of the local jurisdiction whereas the economic definition includes the relevant neighbouring jurisdictions. We use the following variables in the municipality level analysis:

$EmplMuni_i$ is the number of full-time jobs in municipality i. Part-time jobs are added as full-time equivalent. In the municipality level analysis, $EmplMuni_i$ counts the jobs within the legal borders of the municipality.

$EmplDist_i$ is the number of full-time jobs in the economically relevant area in and around municipality i. It is the sum of the municipality's own employment and the employment of all other Swiss municipalities weighted by the inverse distance:

$$EmplDist_i = \sum_{j=1}^{J} \frac{EmplMuni_j}{Dist_{ij}}$$

where $EmplMuni_i$ is employment in municipality i and J is the number of municipalities in the country. We include all of the roughly 3,000 municipalities in this calculation and not just the 845 for which tax data is available in 2005. $Dist_{ij}$ is the Euclidean distance between two municipalities i and i, and if $j \neq i$ is measured as:

$$Dist_{ij} = \sqrt{(x_i - x_j)^2 + (y_i - y_j)^2}$$

[6]Confidential access to the universe of the Swiss Business Census was granted by the Swiss Federal Statistical Office under contract 09325.

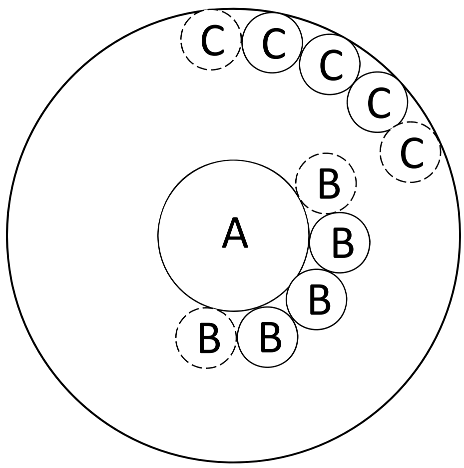

Figure 1: Urban area with large central municipality (A) and both small central (B) and small peripheral (C) municipalities.

where the x and y coordinates determine the geographical location of municipalities i and j. The so-called 'own distance' of municipality i is calculated as

$$Dist_{ii} = \frac{2}{3}\sqrt{\frac{AreaBuilt_i}{\pi}}$$

where $AreaBuilt_i$ is built-up land area in the municipality. The own distance is the average distance to the municipal centre assuming a circular municipality of the same size. The own distance acknowledges that firms are on average further away from each other in large municipalities than in small ones. It also guarantees that our variable $EmplDist_i$ is invariant to the units in which distance is measured.

Figure 1 illustrates how the different measures of location size differ for different types of municipalities. It shows a prototypical urban area consisting of a large central municipality (A) and both small central (B) and small peripheral (C) municipalities. The central municipality will have large values both for its own employment $EmplMuni$ as well as for the employment including its neighbours $EmplDist$. Small central municipalities have a low value for $EmplMuni$ but high values for $EmplDist$ because of their proximity to the centre. Small peripheral municipalities have low values for $EmplMuni$ as well as for $EmplDist$. In regressions including both variables, the identifying variation that allows to discriminate the effects of the two variables will stem from small and mid-size municipalities which can be found in the centre as well as the periphery of urban areas.

In the urban area level analysis, we make no distinction between political and economic definition. $EmplArea_a$ is the number of jobs in all municipalities i that belong to urban area a.

Tables 1 and 2 report descriptive statistics for the different measures of location size.

Location sizes measured by $EmplMuni_i$, $EmplDist_i$ or $EmplArea_a$ vary much across locations. Municipal employment ($EmplMuni$) ranges from 52 to 275,864 across the 845 municipalities in 2005; urban area employment ($EmplArea$) from 3,768 to 555,349. However, different locations are not growing at very different rates leading to within variances which are 8 to 18 times smaller than the corresponding between variances.

4.4 Further Location Characteristics

We also include the following three control variables:

$FrenchItalian_i$ and $FrenchItalian_a$ are dummy variables which equal 1 if the population in municipality i or, respectively, urban area a are on the majority French or Italian speaking. Historically, French and Italian speaking Swiss jurisdictions have higher tax rates than German speaking ones.[7]

$Centre_i$ is a dummy variable which equals 1 if municipality i is the central place of the urban area it belongs to. $CapitalCity_i$ is a dummy variable which equals 1 if municipality i is the capital of a canton. These variables capture the additional revenue needs of central places and capital cities, respectively.

4.5 Instruments for Cross-section Analysis

We seek to explain local tax rates with the size of the location. There is obvious concern about the exogeneity of this variable. First, locations with low taxes are likely to attract – ceteris paribus – more firms and hence are larger than locations with high taxes. This leads to endogeneity from reversed causality. Second, there may be omitted variables that explain both tax rates and location size. Our proposed instrumental variables mainly seek to eliminate the bias from reversed causality.

In the 2005 cross-sectional analysis, we use population figures from 1850, the first Census after the founding of modern Switzerland, as instruments. Historical population figures for 1850 are from the Swiss Federal Statistical Office.[8]

The variable $PopMuni_{i,1850}$ is the population in municipality i in 1850. The variable $PopDist_{i,1850}$ is defined analogously to $EmplDist_i$. It is the sum of the municipality's

[7]Crivelli, Filippini and Mosca (2006) document higher public health spending in French speaking cantons. Eugster and Parchet (2011) use a regression discontinuity approach to show that the French culture causes higher tax rates and public expenditure in Swiss municipalities around the language border.

[8]We obtained the data through its (now decommissioned) online platform "Statweb". Historical population figures are reported for present-day municipalities taking into account potential mergers and split-ups of municipalities.

own population and the distance-weighted population of all other municipalities:

$$PopDist_{i,1850} = \sum_{j=1}^{J} \frac{PopMuni_{j,1850}}{Dist_{ij}}$$

where $Dist_{ij}$ is the Euclidean distance between municipalities i and j. This calculation is based on all of the roughly 3,000 Swiss municipalities. As instrument in the urban area level analysis, $PopArea_{a,1850}$ sums over all municipalities i that belong to urban area a as defined in 2000.

Descriptive statistics for all instruments are also reported in Tables 1 and 2. Municipal population ($PopMuni$) in 1850 ranged from 56 to 41,585 across the 845 municipalities included in the analysis. Urban area population ($PopArea$) in 1850 ranged from 1,568 to 181,147 across the 55 urban areas. The employment size of municipalities in present-day Switzerland is very strongly correlated to the historical population figures 150 years ago: the correlation between 1850 population and 2005 employment is 0.98 across the 55 urban areas and 0.88 across the 845 municipalites. Historical population figures obviously rule out reverse causality and easily fulfill the requirement of instrument relevance.

4.6 Instruments for Panel Data Analysis

In the 1985-2005 panel data analysis, fixed effects will take care of a large part of potential omitted variables. However, there remains the concern about reversed causality. Locations with less increase (or even a decrease) in tax rates will – ceteris paribus – attract more firms and hence exhibit higher employment growth. We therefore instrument employment growth from 1985 to 2005. We propose two sets of variables as instruments:

$LandReserve_i$ is the fraction of land that has not been built-up by 1985 and could potentially be used for buildings in the subsequent 20 years.[9] It is calculated as

$$LandReserve_i = 1 - \frac{AreaBuilt_i}{AreaTotal_i}$$

where $AreaBuilt_i$ is the land area used for housing, businesses and traffic; $AreaTotal_i$ is the total land area excluding rivers, lakes, mountains, etc. Our definition is entirely based on the physical characteristics of the location and ignores zoning restrictions. We think that 1985 zoning restrictions were not binding over the 20 subsequent years as they could be relaxed by the political economy in locations with strong demand for land. We expect that this variable is positively correlated with future growth in locations close to the centre of urban areas where space constraints are most severe. Land reserves in 1985

[9]Land use for 2005 is from the Federal Statistical Office, Arealstatistik der Schweiz 2004/09. Historical data for the period 1979/1985 using historical definitions of municipalities were directly provided by the Swiss Federal Statistical Office.

differ dramatically across the 207 municipalities included in the panel analysis: they range from almost entirely built-up municipalities with land reserves of 2.4% to almost empty municipalities with 97% of land which can be potentially built-up.

In the urban area level analysis, $LandReserveCentre_i$ is the land reserve in the central municipality of the urban area. We expect that limited growth potential in the central municipality hampers the growth of the whole urban area.

$PredEmpl_i$ is the predicted employment in location i based on its initial 1985 sector composition and the sectoral growth rates from 1985 to 2005 in Germany[10]. The calculation assumes that employment in each sector grows at a sector-specific rate $Growth_{s,1985-2005}$ which is independent of the location. We use the growth rate in Germany, $Growth^D_{s,1985-2005}$, as an exogenous measure of sector-specific growth:

$$PredEmplMuni_{i,2005} = \sum_{s=1}^{S} EmplMuni_{is,1985} \cdot (1 + Growth^D_{s,1985-2005})$$

where $EmplMuni_{is,1985}$ is employment in location i and sector s in 1985 and $Growth^D_{s,1985-2005}$ is the discrete growth rate of employment is sector s in Germany between 1985 and 2005. We expect higher growth potential in locations with a large initial share of employment in sectors that turned out to grow fast over the subsequent 20 years. Our predicted employment is independent of the actual employment growth in Swiss municipalities and sectors over the period 1985-2005 hence ruling out reversed causality. The mean of $PredEmplMuni$ as well as overall, within and between variance are similar to the realised values in $EmplMuni$.

$PredEmplDist_{i,2005}$ is the predicted employment in the economically relevant area in and around municipality i. This is analogously defined to $EmplDist_i$. We calculate this measure by summing over the location's own predicted employment and the distance-weighted predicted employment of all other municipalities:

$$PredEmplDist_i = \sum_{j=1}^{J} \frac{PredEmplMuni_j}{Dist_{ij}}$$

where $Dist_{ij}$ is the Euclidean distance between municipalities i and j.

In the urban area level analysis, $PredEmplArea_a$ is the sum of $PredEmplMuni_i$ over all municipalities i that belong to the corresponding urban area a.

In the municipality level analysis, we also use the geographic location within the urban area as instrument. $DistCentre_i$ is the distance of each municipality to the centre of the urban area. Municipalities that do not belong to any urban area are assigned the distance to the nearest urban area centre.

[10]Sector level data for the German economy are from the EU KLEMS Growth and Productivity Centre (2008)

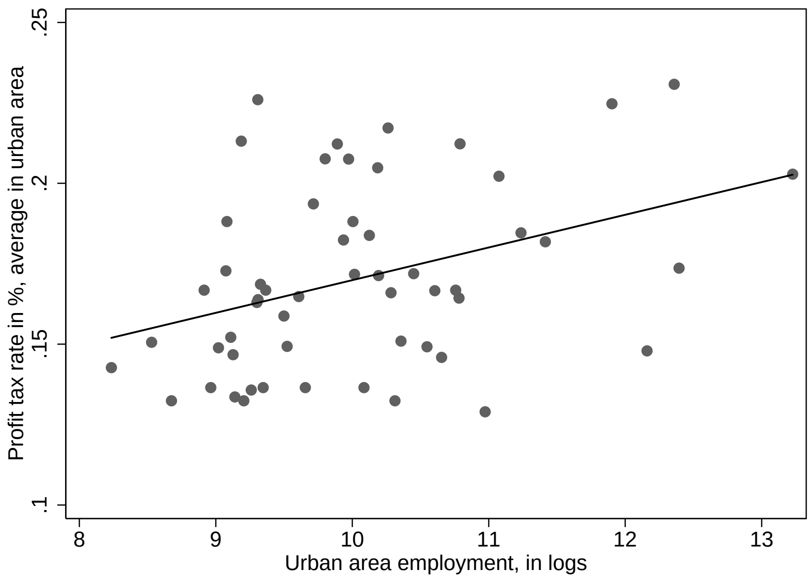

Figure 2: Profit tax rates and employment across 55 urban areas in 2005.

5 Results

We analyse the data on two different levels of aggregation. In the urban area level analysis, data on tax rates and location size are aggregated to the level of urban areas. In the municipality level analysis, tax rates of individual municipalities and their size are used. Section 3 discusses these two approaches.

5.1 Urban Area Level Results

Cross-section results of the urban area level analysis for the year 2005 are reported in Table 3. Column [1] shows the result of a regression of profit tax rates ($ProfitTax_i$) on the log of total urban area employment ($EmplArea_i$) across 55 Swiss urban areas. The tax rates are based on the 553 largest municipalities in the country. The estimated effect of employment is positive and highly significant ($t = 2.93$). The point estimate of 0.0102 means that a doubling in the size of the urban area leads to an increase in tax rates of $\log(2) \cdot 0.0102 = 0.7\%$ points. This is a substantial effect given that tax rates are on average 17% and that the largest urban area is 150 times larger than the smallest urban area (see Table 1). Figure 2 visualizes this relationship. Column [2] controls the relationship for different cultural background as measured with the dummy variable $FrenchItalian$. The control variable is highly significant and positive but leaves the effect of the urban area size practically unchanged.

The above reported effects are likely biased as our explanatory variable location size is not exogenous. Low tax rates attract more businesses leading to larger location size in the long run. This leads to a reverse causality problem in our estimation of equation (1). We therefore estimate the relationship using the population in 1850 ($PopArea_{i,1850}$) as instrument. See Section 4.5 for a detailed description and motivation of the instruments used. Column [3] in Table 3 reports the instrumental variables (IV) estimates. Table A1 in the appendix shows the corresponding first stage estimates. Our instrument is very strong with a first stage F-Test on the excluded instrument of 222.[11] The 2nd stage results reveal a substantially increased point estimate for the effect of location size. This increase goes in the expected direction as the reverse causality running from taxes to location size would have predicted a *negative* relationship between local taxes and location size. The point estimate of 0.0128 is still significant on the 1% level and means that a doubling in the size of the urban area leads to an increase in tax rates of $\log(2) \cdot 0.0128 = 0.9\%$ points.

The significantly positive relationship reported in Table 3 could be confounded with other factors that differ across urban areas. We seek to control for such omitted factors with a difference-in-difference strategy using the long (20 years) difference between 1985 to 2005. Table 4 reports random effects (RE) and fixed effects estimations for the 1985-2005 Panel with two waves. Note that tax rates in the panel estimates are based on fewer municipalities as tax rates in 1985 are only reported for 179 municipalities that belong to urban areas. The pooled estimation with random effects in column [1] reiterates the findings from the 2005 cross-section in Table 1. However, random effects do *not* yet control for unobserved urban area characteristics. We therefore estimate equation (3) using fixed effects (FE), i.e. we control for all time-invariant characteristics of the urban areas. The fixed effects (FE) estimator is equivalent to the first difference estimator (FD) which regresses 20-year changes in tax rates on the growth rate of local employment. Even controlling for urban area fixed effects, we find a positive but insignificant effect. Note, however, that despite the 20 year lag, the within-variance of $\log(EmplArea)$ is 18 times smaller than the between variance. This reflects the enormous stability of the Swiss urban system. It is therefore not unexpected that we do not find a significant effect with so little identifying variation. The large confidence bounds include the significant results from the 2005 cross-section and do not contradict them.

In the last column [3] of Table 4 we seek to control for the potential reverse causality of tax rates and size with instrumental variables. As described in section 4.6, our two instruments are land reserves in the centre municipality in 1985 ($LandReserveCentre$) and 2005 employment predicted from the 1985 sector composition ($PredEmplArea$). Our

[11] We use robust tests throughout as we have no reason to assume that our error term is homoscedastic. While it is straightforward to calculate robust test statistics to test for weak instruments, there are no corresponding critical values for robust tests. The currently best practice is to compare robust test statistics to critical values developed by Stock and Yogo (2005) under homoscedasticity.

instruments are individually and jointly highly significant in the first stage (see Table A1 in the appendix). Not unexpectedly with a sample size of 53, the F-statistic of 6.88 reveals that our instruments are nevertheless rather weak. The estimated confidence bounds of the parameter is again non-informative: while we cannot detect a significant relationship we can also not rule out the results from the cross-section.

5.2 Municipality Level Results

The results for the 2005 cross-section of the municipality level analysis are given in Table 5. Column [1] reports the results from a regression of the local profit tax rate on local employment within municipal borders ($EmplMuni$) across 845 Swiss municipalities. The estimated effect is virtually zero and not significant. Column [2] regresses local taxes on employment in and around the municipality ($EmplDist$). The estimated effect is now positive and highly significant. Column [3] includes both measures of location size. See section 4.3 for a description of the two measures and the identifying differences. The estimated effects are almost identical to the bivariate results in columns [1] and [2]. The point estimate of $EmplDist$ is highly significant ($t = 3.28$) and almost perfectly matches our findings in the urban area level analysis in Table 3, column [1]. Column [4] includes in addition dummy variables for whether the municipality belongs to the French or Italian speaking part of Switzerland ($FrenchItalian$), whether it is the central place of the urban area ($Centre$) and whether it is a cantonal capital city ($CapitalCity$). Controlling for these additional variables, the effect of urban area size is reinforced while the effect of jurisdictional size remains zero.

As in the previous section, we are concerned about bias from reverse causality in columns [1] to [4]. We therefore instrument both the political size of the location ($EmplMuni$) and its economic size ($EmplDist$). We use historical population figures from 1850 ($PopMuni_{1850}$ and $PopDist_{1850}$) as instruments as described in section 4.5. Column [5] reports the instrumental variables (IV) estimates. First stage results are reported in Table A2 in the appendix. The two instruments are highly significant predictors for the corresponding employment variable. The joint F-test for weak instruments which jointly tests both first stage regressions is 49 and shows that the instruments are very strong.[12] The IV point estimate for the effect of $EmplMuni$ is now positive and significant while the effect of $EmplDist$ is almost halved compared to column [4]. This change of the parameters between OLS and IV goes in the expected direction as the reverse

[12]We use the Kleibergen-Paap (2006) rank F-Test. This F-statistic is a generalisation of the Cragg-Donald (1993) statistic that allows for heteroscedastic errors. While it is straightforward to calculate the test statistics, there are no corresponding critical values. The currently best practice is to compare robust test statistics to critical values developed for the Cragg-Donald statistic by Stock and Yogo (2005).

causality would predict a negative relationship between local taxes and jurisdiction size. However, the effect of the economically relevant area *EmplDist* is still much larger (2.5 times) than the effect of the jurisdiction size.

Columns [6] to [10] in Table 5 include a fixed effect for each urban area.[13] This analysis relies fully on the variation of location sizes *within* urban areas and ignores the differences *across* urban areas. Including urban area fixed effects fundamentally changes our results: both jurisdiction (*EmplMuni*) and area size (*EmplDist*) have no significant effect in any of the specifications in columns [6] to [9]. This is not the consequence of a lack of identifying variation as the confidence bounds are small and ruling out effects of the magnitude reported in column [1] to [4]. The significantly positive effects in columns [1] to [4] are therefore entirely driven by differences across urban areas as documented in the urban area level analysis in section 5.1.

Column [10] in Table 5 includes urban area fixed effects as well as instrumental variables. The results of the two first stage regressions are reported in Table A2. As in column [5], 1850 population for jurisdiction ($PopMuni_{1850}$) and area size ($PopDist_{1850}$) are significant predictors for 2005 employment and pass the test against weak instruments (Kleibergen-Paap F = 21). Also as in column [5], controlling for reverse causality mainly affects the effect of jurisdictions size (*EmplMuni*). This effect is now positive and significant while the effect of the area size (*EmplDist*) remains close to zero and insignificant. So *within* urban areas, it is the political size of the municipality that affects local tax rates while the economic size does not matter: small municipalities set lower taxes than large ones whether they are in the centre of the economic activity of the urban area or at its periphery. We see this result as evidence, that the tax haven mechanism rather than the New Economic Geography (NEG) mechanism is at work in the competition of municipalities within a given urban area.

Table 6 report the results using a panel with 1985 and 2005 data. Column [1] estimates the pooled 1985 and 2005 cross-sections with random effects and reiterates the findings from Table 5, columns [1] to [4]. Column [2] controls for municipality fixed effects, i.e. for all time-invariant characteristics including urban area fixed effects. This fixed effects (FE) estimator is equivalent to the first difference estimator (FD) which regresses 20-year changes in tax rates on the growth rate of local employment. As in the urban area level analysis, there is very little time variation that we can exploit and the large confidence intervals neither detect significant effects nor rule out effects as estimated in the cross-section. Column [3] additionally includes year specific urban area effects leading to negative though insignificant size effects.

[13] Municipalities not belonging to an urban area were assigned to the urban area whose central place is closest to them.

Column [4] in Table 6 tackles the potential reversed causality of changes in tax rates on employment growth by instrumenting both employment growth of the jurisdiction and of the urban area. See section 4.6 for a description of the instruments used. Most of our 5 instruments are highly significant in both first stage regressions (see Table A2 in the appendix) though the joint analysis of both equations with the Kleibergen-Paap (2006) F-statistics shows that the instruments are rather weak. The estimates in column [4] are therefore at best indicative.

Summing up the cross-section results in Table 3 and 5, we find that municipalities in large urban areas set higher tax rates than municipalities in small urban areas. This is consistent with the New Economic Geography (NEG) prediction whereby agglomeration rents are taxed in the competition among urban areas. Within urban areas, however, the size of the economically relevant area in and around a municipality is unrelated to its tax level while the size within its political borders is positively related. This result is robust to controlling for reverse causality by using instrumental variables. We see this result as evidence, that the tax haven mechanism rather than the NEG mechanism is at work in the competition of municipalities within an urban area. Controlling for fixed effects in the panel analysis of Tables 4 and 6 is non-informative and neither supports nor contradicts these findings.

6 Alternative Cluster Measures

The New Economic Geography (NEG) literature typically considers only urbanisation economies, and neglects varying intensities in agglomeration economies across sectors. So far we have followed this simplification in our empirical analysis in section 5. In this section we construct a cluster intensity measure which takes into account the structure of the economy at the local level. We also include two well-known measures of sectoral composition of the local economy: specialisation and diversification.

6.1 Cluster intensity

Different industrial sectors exhibit in the real world different degrees of agglomeration rents. In our setting, local jurisdiction can not exploit this heterogeneity as statutory tax rates apply identically to all sectors. Local jurisdictions can potentially tax agglomeration rents if three conditions are met: (1) it hosts an industrial cluster of a sector, (2) this sector is an important fraction of the local economy and (3) this sector is characterised by important agglomeration economies. This applies for example to the watch-making industry, an industry characterised by high agglomeration economies which satisfies condition (3). Consider Le Locle, a rural town in the Jura. Le Locle hosts one of the largest concentrations of watch manufacturers in Switzerland, accounting for the majority of local employment (over 45% in 2005). Now consider Geneva, the 2nd largest city in Switzerland. Geneva hosts another main cluster of the watch-making industry, yet it does not account for a significant part of the local economy (only 1.5% of local employment in 2005), and therefore does not satisfy condition (2) above.

We propose the following index to measure the importance of industrial clusters in the local economy:

$$ClusterIntensity_i = \sum_{s=1}^{S} \frac{EmplMuni_{is}}{Empl_s} \cdot \frac{EmplMuni_{is}}{EmplMuni_i} \cdot \gamma_s$$

where $Empl_s$ is total employment in sector s. $EmplMuni_{is}/Empl_s$ is the fraction of employment in sector s located in municipality i; a high number indicates that the municipality hosts an important industrial cluster. The second multiplier $EmplMuni_{is}/Empl_i$ is the fraction of employment in municipality i belonging to sector s; a high number indicating that the sector is important for the local economy. The third multiplier γ_s is a measure of the agglomeration economies in sector s.

To measure agglomeration economies we use the Ellison and Glaeser (1997) index[14]:

$$\gamma_s = \frac{\frac{\sum_i (z_{is} - x_i)^2}{1 - \sum_i x_i^2} - H_s}{1 - H_s}$$

where $z_{is} = EmplMuni_{is}/Empl_s$ and $x_i = EmplMuni_i/Empl_{tot}$, $Empl_{tot}$ denoting total national employment. H_s is an index measuring the concentration of an industry as $H_s = \sum_k^K \psi_k^2$, where ψ_k is the share of each plant in industry employment, and K the total number of industry plants. The Ellison and Glaeser (1997) index is constructed to take into account the possibility of industry agglomeration by pure chance, unrelated to any agglomeration economies.

6.2 Specialisation and Diversification

Two important factors characterising the economic activity of a municipality are the degree to which they are specialised and diversified. We use in our analysis the specialisation and diversification indices employed by Duranton and Puga (2000).

As a specialisation measure we use employment in the most important industry s of municipality i

$$Specialisation_i = \max_s \left(\frac{EmplMuni_{is}}{EmplMuni_i} \right)$$

[14] Duranton and Overman (2005) propose an alternative index which avoids the border problem of the Ellison-Glaeser index. Unfortunately, we cannot use this index as we lack information on the exact geographic location of firms in our data.

where $EmplMuni_{is}$ is the number of employees in municipality i working in sector s and $EmplMuni_i$ is as defined above. This index measures the importance of the largest sector in a municipality, and allows for a comparison across municipalities.

As a *diversity* measure we use the inverse of the Hirschman-Herfindahl index,

$$Diversification_i = \frac{1}{\sum_s \left(\frac{EmplMuni_{is}}{EmplMuni_i}\right)^2}$$

This index increases with increasing diversity of the local economy, equalling 1 if the activity of a sector is entirely concentrated in one municipality.

Note that using these specifications, diversification and specialisation are not exactly opposites. A municipality with one very important sector but many less important ones can be both specialised and diversified.

6.3 Results

Table 7 reports the results using the three alternative measures, cluster intensity, specialisation and diversification.

Table 7 column [1] shows the urban area level analysis for the 2005 cross-section. Our new measure $ClusterIntensity$ turns out positive and highly significant. This means that urban areas with important clusters of concentrated sectors rise higher business taxes than others. However, the effect is rather small: a one-standard deviation increase in $ClusterIntensity$ leads to a $0.0006 \cdot 8.9593 = .5\%$ points increase in tax rates. $Specialisation$ is insignificant while $Diversification$ is also positively related to tax rates. Column [2] uses the 1985 to 2005 panel and includes urban area fixed effects. The effect of our measure is now negative though not significantly so.

Table 7 column [3] shows the municipality level analysis for the 2005 cross-section. All three measures are significantly and positively related to local tax rates. The effects are smaller that in the urban area level analysis. Column [4] also uses the 2005 cross-section but adds urban area fixed effects, i.e. only exploits the within urban area variation. The effect of our new measure $ClusterIntensity$ remains positive and significant though it is not substantial any more: a one-standard deviation increase in $ClusterIntensity$ leads to a $0.00063 \cdot 0.5916 = .04\%$ points increase in tax rates.

Table 7 column [5] shows the municipality level analysis for the 1985 to 2005 panel. Column [6] adds urban area-year fixed effects. This turns the effect of $ClusterIntensity$ significantly negative but it remains economically small. The negative effect likely stems from inverse causality when tax cuts attract new clusters. Unfortunately, our instruments used in Section 5 are not credible to instrument our alternative measures. The results in this section are therefore at best indicative.

7 Conclusion

In this paper we study whether local policy makers effectively tax agglomeration rents, as predicted by the New Economic Geography (NEG) literature. To test this mechanism we use data from a panel of Swiss municipalities. We face several challenges bridging the gap between theoretical model and empirical evaluation. First, the standard tax competition model with asymmetric jurisdiction size also predicts that small locations (tax havens) have lower tax rates than large ones, but the economic implications are very different. To separate the two effects we make a clear difference between the political and economic size of a location by developing a measure for each definition of size. We find that large urban areas exhibit higher tax rates than small ones. This is consistent with the NEG prediction whereby agglomeration rents are taxed in the competition among urban areas. Within urban areas, however, the size of the economically relevant area in and around a municipality is unrelated to its tax level while the size within its political borders is positively related. We see this result as evidence, that the tax haven mechanism rather than the NEG mechanism is at work in the competition of municipalities within an urban area. Second, there could be important unobserved and unobservable local characteristics. We address this problem by including municipality fixed effects to control for omitted variables. Despite the 20 year lag in the data there is very little time variation we can exploit, and the large confidence intervals neither detect significant effects nor rule out the positive effects estimated in the cross-section. Third, the size of local jurisdictions is likely affected by local tax rates and therefore endogenous. We instrument 2005 employment with 1850 population figures and 1985 to 2005 employment growth with a set of variables based on initially available land reserves and initial sector composition. Our instruments turn out to be very strong for the cross-section analysis but rather weak for the panel analysis. Our cross-section results are robust to controlling for reverse causality. As a robustness check we introduce a new measure of cluster intensity which considers the varying intensities in agglomeration economies across sectors.

References

[1] Andersson, F. and R. Forslid (2003). Tax competition and economic geography. Journal of Public Economic Theory, 5(2)-279-303.

[2] Bacher H.U. and M. Brülhart (2010), Progressive Taxes and Firm Births. Mimeo. University of Lausanne.

[3] Baldwin, R., R. Forslid, P. Martin, G. Ottaviano, and F. Robert-Nicoud (2003). Economic Geography & Public Policy. Princeton University Press.

[4] Baldwin, R. and P. Krugman (2004). Agglomeration, integration and tax harmonisation. European Economic Review, 48,1-23.

[5] Borck, R. and M. Pflüger (2006). Agglomeration and tax competition. European Economic Review, 50,647-668.

[6] Brülhart M. and M. Jametti (2006). Vertical versus horizontal tax externalities: an empirical test. Journal of Public Economics, 90(10-11), 2027 2062.

[7] Brülhart, M., M. Jametti and K. Schmidheiny (2007). Do Agglomeration Economies Reduce the Sensitivity of Firm Location to Local Taxes? CEPR Discussion Paper 6606.

[8] Bucovetsky, S. (1991). Asymetric tax competition. Journal of Urban Economics, 30, 167-181.

[9] Charlot, S. and S. Paty (2007). Market access effect and local tax setting: evidence from French panel data. Journal of Economic Geography, 7, 247-263.

[10] Cragg, J. G. and S. G. Donald (1993). Testing identifiability and specification in instrumental variable models. Econometric Theory, 9(2), 222-240.

[11] Crivelli, L., Filippini, M. and Mosca, I. (2006). Federalism and regional health care expenditures: an empirical analysis for the Swiss cantons. Health Economics 15(5): 535-541.

[12] Duranton, G. and D. Puga (2000). Diversity and specialisation in cities: Why, where and when does it matter? Urban Studies, 37(3), 533-555.

[13] Duranton, G. and H. Overman (2005). Testing for Localisation using Micro-Geographic Data. Review of Economic Studies, 72(4), 1077-1106.

[14] Eugster Beatrix and Raphael Parchet (2011). Culture and Taxes: Towards Identifying Tax Competition. Mimeo, University of Lausanne.

[15] Ellison, G. and E. L. Glaeser (1997). Geographic concentration in the U.S. manufacturing industry: A dartboard approach. Journal of Political Economy, 105(5), 889-927.

[16] Groningen Growth and Development Centre (2008). EU KLEMS Growth and Productivity Accounts. www.euklems.net.

[17] Jofre-Monseny, J. and A. Sole-Olle (2009). Is agglomeration taxable? Mimeo, Universitat de Barcelona, IEB.

[18] Kind, H. J., K. H. Midelfart Knarvik, and G. Schjelderup (2000). Competing for capital in a 'lumpy' world. Journal of Public Economics, 78, 253-274.

[19] Kleibergen, F. and R. Paap (2006). Generalized reduced rank tests using the singular value decomposition. Journal of Econometrics, 133(1), 97-126.

[20] Koh, H.-J. and N. Riedel (2010). Do governments tax agglomeration rents? Oxford University Centre for Business Taxation WP 10/04.

[21] Ludema, R. D. and I. Wooton (2000). Economic geography and the Fiscal effects of regional integration. Journal of International Economics, 52, 331-357.

[22] Oates, W. E. (1972). Fiscal Federalism. Harcourt Brace Jovanovich, New York, New York.

[23] Ottaviano, G. and T. van Ypersele (2005). Market size and tax competition. Journal of International Economics, 67, 25-46.

[24] Stock, J.H. and Yogo, M. (2005). Testing for Weak Instruments in Linear IV Regression. In: D.W.K. Andrews and J.H. Stock (Eds). Identification and Inference for Econometric Models: Essays in Honor of Thomas Rothenberg. Cambridge University Press, 80-108.

[25] Wilson, J. D. (1986). A theory of interregional tax competition. Journal of Urban Economics, 19, 296-315.

[26] Wilson, J. D. (1991). Tax competition with interregional differences in factor endowments. Regional Science and Urban Economics, 21, 423-451.

[27] Zodrow, G. R. and P. Mieszkowski (1986). Pigou, Tiebout, property taxation, and the underprovision of local public goods. Journal of Urban Economics, 19, 356-370.

Table 1: Descriptive Statistics, Urban Area Level

	2005 Cross-section		1985-2005 Panel	
	Mean	Std. Dev.	Mean	Std. Dev.[1]
ProfitTax [2]	0.170	0.028	0.163	0.028 *(o)*
				0.023 *(b)*
				0.016 *(w)*
Log(*EmplArea*)[3]	10.04	1.04	10.05	1.04 *(o)*
				1.05 *(b)*
				0.06 *(w)*
Log(*PredEmplArea*)			10.10	1.06 *(o)*
				1.06 *(b)*
				0.08 *(w)*
ClusterIntensity	0.00028	0.00060	0.00036	0.00094 *(o)*
				0.00088 *(b)*
				0.00033 *(w)*
Specialisation	0.1391	0.0559	0.1460	0.0571 *(o)*
				0.0529 *(b)*
				0.0223 *(w)*
Diversification	15.45	3.42	15.18	3.44 *(o)*
				3.20 *(b)*
				1.29 *(w)*
FrenchItalian	0.33	0.47	0.34	0.48 *(o)*
Log($PopArea_{1850}$)	9.34	0.98		
N Urban Areas	55		53	
N Municipalities	553		179	
Waves	1		2	

[1] Standard deviation. (o) = overall, (b)=between, (w)=within.

[2] Corporate profit tax rate, sum of municipal and cantonal tax, 9% profit level, employment-weighted average across municipalities. Tax rates are based on sample of largest municipalities (N municipalities) within the urban area.

[3] Employment is based on all municipalities within the urban area.

Table 2: Descriptive Statistics, Municipality Level

	2005 Cross-section		1985-2005 Panel	
Estimator[1]	Mean	Std. Dev.	Mean	Std. Dev.[1]
ProfitTax	0.177	0.028	0.165	0.028 *(o)*
				0.021 *(b)*
				0.019 *(w)*
Log(*EmplMuni*)[2]	7.25	1.07	8.56	0.90 *(o)*
				0.90 *(b)*
				0.12 *(w)*
log(*EmplDist*)[3]	10.98	0.32	11.10	0.33 *(o)*
				0.33 *(b)*
				0.03 *(w)*
Log(*PredEmplMuni*)			8.60	0.92 *(o)*
				0.91 *(b)*
				0.08 *(w)*
Log(*PredEmplDist*)			11.16	0.34 *(o)*
				0.33 *(b)*
				0.08 *(w)*
ClusterIntensity	0.000071	0.000625	0.000369	0.003921 *(o)*
				0.003311 *(b)*
				0.002106 *(w)*
Specialisation	0.2411	0.1108	0.1967	0.0927 *(o)*
				0.0830 *(b)*
				0.0415 *(w)*
Diversification	9.60	3.37	11.85	3.45 *(o)*
				3.15 *(b)*
				1.42 *(w)*
French/Italian	0.269	0.444	0.237	0.426 *(o)*
Centre	0.065	0.247	0.256	0.437 *(o)*
CapitalCity	0.031	0.173	0.126	0.332 *(o)*
Log($PopMuni_{1850}$)	7.013	0.862		
Log($PopDist_{1850}$)	10.640	0.257		
$LandReserve_{1985}$			0.680	0.210 *(o)*
DistCentre			6.467	6.445 *(o)*
N Urban Areas	55		53	
N Municipalities	845		207	
Waves	1		2	

[1] Standard deviation. (o) = overall, (b)=between, (w)=within.

[2] Employment in municipality.

[3] Sum of employment in municipality and neighboring municipalities weighted by inverse distance.

Table 3: Urban Area Level, 2005 Cross-section

Estimator[1]	OLS	OLS	IV
	[1]	[2]	[3]
Log(*EmplArea*)	0.0102***	0.0098***	0.0128***
	(0.0035)	(0.0033)	(0.0031)
FrenchItalian		0.0167**	0.0164**
		(0.0074)	(0.0083)
Constant	0.0683*	0.0663*	0.0361
	(0.0350)	(0.0337)	(0.0304)
Number of Instruments[2]			1
Weak Instrument F-Test[3]			221.9
R-squared	0.1394	0.2167	0.2044
N Urban Areas	55	55	55
N Municipalities	553	553	553

Dependent Variable: Corporate profit tax rate, sum of municipal and cantonal tax, 9% profit level, employment-weighted average across municipalities. Tax rates are based on sample of largest municipalities (N municipalities) within the urban area; employment is based on all municipalities within the urban area. Standard errors in parentheses, heteroskedasticity-robust . Coefficient significant at * $p<0.10$, ** $p<0.05$, *** $p<0.01$.

[1] OLS: ordinarly least squares, IV: instrumental variables.
[2] Instrument is log(population in 1850). First stage regression results in Appendix Table A1.
[3] Robust F-statistic on excluded instruments.

Table 4: Urban Area Level, Panel Analysis 1985-2005

Estimator[1]	RE	FE/FD	FD-IV
	[1]	[2]	[3]
Log(*EmplArea*)	0.0058***	0.0035	0.0371
	(0.0023)	(0.0330)	(0.0928)
FrenchItalian	0.0157**		
	(0.0069)		
Constant	0.0903***		
	(0.0234)		
Year fixed effects	yes	yes	yes
Urban area fixed effects		yes	yes
Number of Instruments[2]			2
Weak Instrument F-Test[3]			6.88
R-squared[4]		0.3292	
N	106	106	106
N Urban Areas	53	53	53
N Municipalities	179	179	179

Dep. Variable: Corporate profit tax rate, sum of municipal and cantonal tax, 9% profit level, employed-weighted average across municipalities. Tax rates are based on sample of largest municipalities (N municipalities) within the urban area; employment is based on all municipalities within the urban area. Standard errors in parentheses, clustered for urban areas (except IV). Coefficient significant at * p<0.10, ** p<0.05, *** p<0.01.

[1] RE: random effects, FE: fixed effects, FD: first difference, IV: instrumental variables.

[2] Instruments are based on 1985 land reserves and industry mix. First stage regression results in Appendix Table A1.

[3] Robust F-Statistic on excluded instruments.

[4] Within-R2.

Table 5: Municipality Level, 2005 Cross-section

						Urban Area Fixed Effects				
Estimator[1]	OLS	OLS	OLS	OLS	IV	LSDV	LSDV	LSDV	LSDV	IVDV
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]
log(*EmplMuni*)[2]	0.0008		-0.0002	-0.0002	0.0072**	0.0003		0.0003	0.0007	0.0052***
	(0.0010)		(0.0010)	(0.0010)	(0.0031)	(0.0004)		(0.0005)	(0.0006)	(0.0020)
log(*EmplDist*)[3]		0.0107***	0.0109***	0.0325***	0.0178***		0.0013	0.0000	0.0008	0.0023
		(0.0032)	(0.0033)	(0.0028)	(0.0040)		(0.0043)	(0.0054)	(0.0052)	(0.0079)
FrenchItalian				0.0354***	0.0318***				0.0081*	0.0091**
				(0.0023)	(0.0028)				(0.0043)	(0.0040)
Centre				-0.0093**	-0.0227***				-0.0036	-0.0126**
				(0.0045)	(0.0071)				(0.0023)	(0.0049)
CapitalCity				-0.0035	-0.0101				0.0012	-0.0051
				(0.0055)	(0.0067)				(0.0025)	(0.0037)
Constant	0.1707***	0.0588	0.0581	-0.1874***	-0.077	0.1744***	0.1626***	0.1746***	0.1611***	0.1455
	(0.0073)	(0.0359)	(0.0358)	(0.0291)	(0.0492)	(0.0026)	(0.0474)	(0.0571)	(0.0548)	(0.0907)
Number of Instruments[4]					2					2
Weak Instrument Test[5]					49.4					20.7
R-squared	0.001	0.015	0.015	0.267	0.214	0.755	0.755	0.755	0.757	0.738
N Municipalities	845	845	845	845	845	845	845	845	845	845
N Urban Areas	55	55	55	55	55	55	55	55	55	55

Dep. Variable: Corporate profit tax rate, sum of municipal and cantonal tax rate, 9% profit level. Standard errors in parentheses, heteroscedasticity-robust, clustered by urban areas for LSDV and IVDV models. Coefficient significant at * p<0.10, ** p<0.05, *** p<0.01.

[1] OLS: ordinarly least squares, IV: Instrumental variables, LSDV: least squares dummy variables, IVDV: Instrumental variables dummy variables.

[2] Employment in municipality.

[3] Sum of employment in municipality and neighbouring municipalities weighted by inverse distance.

[4] Instrumented are log(employment) for both the jurisdiction and the urban area. Instruments are log of municipality population in 1850 and log municipality population in 1850 with distance weighted neighbours. First stage regression results in Appendix Table A2.

[5] Kleibergen-Paap rank F-statistic.

Table 6: Municipality Level, Panel Analysis 1985-2005

Estimator[1]	RE	FE/FD	FE/FD	FD-IV
	[1]	[2]	[3]	[4]
log(*EmplMuni*)[2]	0.0017	0.0145	-0.0038	0.002
	(0.0021)	(0.0125)	(0.0064)	(0.0135)
log(*EmplDist*)[3]	0.0114**	0.0282	-0.0267	-0.0337
	(0.0048)	(0.0801)	(0.0387)	(0.0580)
FrenchItalian	0.0226***			
	(0.0037)			
Centre	-0.0062			
	(0.0042)			
CapitalCity	-0.0035			
	(0.0055)			
Year fixed effects	yes	yes	yes	yes
Municipality fixed effects		yes	yes	yes
Urban area x year effects			yes	yes
Instruments[4]				5
Weak Instrument Test[5]				3.06
N	414	414	392	
N Municipalities	207	207	196	196
N Urban Areas[6]	53	53	42	42

Dep. Variable: Corporate profit tax rate, sum of municipal and cantonal tax, 9% profit level. Standard errors in parentheses, heteroscedasticity-robust, clustered by municipality. Coefficients significant at * p<0.10, ** p<0.05, *** p<0.01.

[1]RE: random effects, FE: fixed effects, FD: first difference, IV: instrumental variables. FE and FD yield identical estimates.

[2] Employment in municipality.

[3] Sum of employment in municipality and neighbouring municipalities weighted by inverse distance.

[4] Instruments are based on 1985 land reserves and industry mix. First stage regression results in Appendix Table A2.

[5] Kleibergen-Paap rank F-statistic.

[6] Data from 11 urban areas is dropped in specifications with urban area effects (columns [3] and [4]) as only one municipality per year is observed.

Table 7: Alternative Cluster Measures

	Urban Area Level		Municipality Level			
	2005	1985-2005	2005 Cross-section		1985-2005 Panel	
Estimator[1]	OLS	FE	OLS	LSDV	FE	FE-LSDV
	[1]	[2]	[3]	[4]	[5]	[6]
ClusterIntensity	8.9593***	-4.9499	2.4357***	0.5916***	-0.8805***	-0.2494**
	(3.0098)	(3.4681)	(0.6977)	(0.1764)	(0.2723)	(0.1095)
Specialisation	0.1224	-0.0872	0.0380**	0.0127	0.0566	0.0329
	(0.1041)	(0.1664)	(0.0175)	(0.0083)	(0.0543)	(0.0232)
Diversification	0.0047**	-0.0021	0.0020***	0.0005	0.0009	0.0011*
	(0.0018)	(0.0025)	(0.0006)	(0.0003)	(0.0014)	(0.0006)
FrenchItalian	0.0240***		0.0243***	(0.0157)		
	(0.0085)		(0.0025)	(0.0103)		
Centre			-0.0132***	-0.0032		
			(0.0044)	(0.0024)		
CapitalCity			0.0011	0.002		
			(0.0055)	(0.0024)		
Constant	0.0702		0.1428***	0.1652***		
	(0.0426)		(0.0094)	(0.0054)		
Urban area fixed effects		yes		yes		
Municipality fixed effects					yes	yes
Year fixed effects		yes			yes	
Urban area x year effects						yes
R-squared	0.27	0.35	0.15	0.76	0.48	0.92
N Municipalities	553	179	845	845	207	196
N Urban Areas	55	53	55	55	53	42

Dep. Variable: Corporate profit tax rate, sum of municipal and cantonal tax, 9% profit level. Standard errors in parentheses, heteroscedasticity-robust. Coefficients significant at * p<0.10, ** p<0.05, *** p<0.01.

[1]OLS: ordinarly least squares, FE: fixed effects, LSDV: least squares dummy variables.

Table A1: First Stage Results for Urban Area Level

	2005 Cross-section	1985-2005 Panel
2nd Stage	Tab 3, col [3]	Tab 4, col [3]
Dependent Variable	log(*EmplArea*)	Δlog(*EmplArea*)
Log(*PopArea* $_{1850}$)	0.9779***	
	(0.0656)	
FrenchItalian	0.0817	
	(0.1037)	
Δlog(*PredEmplArea*)[1]		0.7263***
		(0.1959)
LandReserveCentre $_{1985}$		0.1017**
		(0.0479)
Constant	0.8801	-0.1217**
	(0.6369)	(0.0477)
Weak Instrument Test[2]	221.9	6.88
R-squared	0.85	0.14
N Urban Areas	55	53
N Municipalities	553	176

Heteroskedasticity robust standard errors in parentheses. Coefficient significant at * p<0.10, ** p<0.05, *** p<0.01.

[1] Employment growth predicted from 1985 sector composition and 1985-2005 sector growth in Germany.

[2] Robust F-Statistic on excluded instruments.

Table A2: First Stage Results for Municipality Level

	2005 Coss-section				1985-2005 Panel	
2nd Stage	Tab 5, col [5]	Tab 5, col [5]	Tab 5, col [10]	Tab 5, col [10]	Tab 6, col [4]	Tab 6, col [4]
Dep. Variable	log(*EmplMuni*)	log(*EmplDist*)	log(*EmplMuni*)	log(*EmplDist*)	Δlog(*EmplMuni*)	Δlog(*EmplDist*)
Log($PopMuni_{1850}$)	0.3902***	-0.0940***	0.4946***	-0.0517***		
	(0.0397)	(0.0096)	(0.0440)	(0.0092)		
Log($PopDist_{1850}$)	0.1234	1.1871***	0.5543	1.3841***		
	(0.1480)	(0.0281)	(0.7434)	(0.1569)		
FrenchItalian	0.1088	0.0969***	-0.0302	-0.0107		
	(0.0856)	(0.0202)	(0.2150)	(0.0251)		
Centre	1.5588***	0.1567***	1.5575***	0.1748***		
	(0.0841)	(0.0272)	(0.0904)	(0.0160)		
CapitalCity	0.7773***	0.1795***	0.5742***	0.0884**		
	(0.1457)	(0.0526)	(0.1342)	(0.0376)		
ΔLog(PredEmplMuni)[1,2]					0.0071	-0.1209**
					(0.2386)	(0.0479)
ΔLog(PredEmplDist)[1,3]					-0.5697	0.4638
					(1.0974)	(0.3238)
$LandReserve_{1985}$					0.4007***	0.0648***
					(0.1328)	(0.0199)
DistCentre					0.0155	0.0089***
					(0.0143)	(0.0021)
$LandReserve_{1985}$ x *DistCentre*					-0.0252	-0.0097***
					(0.0180)	(0.0026)
Constant	3.0470*	-1.0342***	-2.6304	-3.4704**	-0.0451	-0.0471
	(1.5675)	(0.3031)	(8.1647)	(1.6902)	(0.2561)	(0.0556)
F-Test excluded instruments	51.3	918.5	65.4	46.4	2.82	9.27
Weak Instrument Test[2]	49.4		20.7		3.06	
R-squared	0.403	0.700	0.499	0.909	0.398	0.591
N Municipalities	845	845	845	845	196	196
N Urban Areas	55	55	55	55	42	42

Standard errors in parentheses, heteroskedasticity-robust. Coefficient significant at * p<0.10, ** p<0.05, *** p<0.01.

[1] Employment growth predicted from 1985 sector composition and 1985-2005 sector growth in Germany.

[2] Employment in municipality.

[3] Sum of employment in municipality and neighboring municipalities weighted by inverse distance.

[2] Kleibergen-Paap rank F-statistic.