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DO AGGLOMERATION ECONOMIES REDUCE THE SENSITIVITY OF FIRM LOCATION TO TAX DIFFERENTIALS?*

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Recent theoretical work in economic geography has shown that agglomeration forces can mitigate 'race-to-the-bottom' tax competition, by partly or fully offsetting firms' sensitivity to tax differentials. We test this proposition using data on firm births across Swiss municipalities. We find that corporate taxes deter firm births less in more spatially concentrated sectors. Firms in sectors with an agglomeration intensity in the top quintile are less than half as responsive to differences in corporate tax burdens as firms in sectors with an agglomeration intensity in the bottom quintile. Hence, agglomeration economies do appear to attenuate the impact of tax differentials on firms' location choices.

According to the standard model of tax competition, increasing the mobility of firms induces a race to the bottom in corporate tax rates.[1] Recent theoretical work has fundamentally questioned the relevance of this scenario. In most 'new economic geography' models, the strength of spatial agglomeration forces rises as economies become more integrated. As a result, the scope for attracting firms through fiscal inducements could in fact shrink as technological and administrative obstacles to firm mobility are reduced. The existence of agglomeration forces could thus allow governments to continue to tax corporate income even after capital has in principle become highly mobile.

We provide an empirical assessment of the hypothesis that agglomeration forces can offset differences in corporate taxes as a determinant of firm location. Estimating location choice models for firm start-ups across Swiss municipalities, we find that high corporate taxes are indeed a deterrent to firm location but that this deterrent effect is weaker in sectors that are more spatially clustered. Hence, agglomeration economies – be they due to externalities or to spatially concentrated endowments – can constrain

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[1] For a comprehensive review of this literature, see Wilson (1999).

the ability (and incentive) of jurisdictions to compete for firms via strategically low tax rates.

Our regression specifications are derived from firm-level profit functions in a location choice model. The distinctive feature of our empirical model is an interaction term between local corporate tax rates and a measure of sector-level agglomeration. Positive estimated coefficients on this interaction term imply that location choices of firms in more agglomerated sectors are less sensitive to tax differences across potential locations. Local tax rates may, however, be endogenous with respect to firms' location choices. Our strategy is fourfold: we focus on the interaction term (which is less likely to be affected by endogeneity bias than the main effect of taxes), we use sector-level counts of *new* firms as the dependent variable (as new firms are less likely to have influenced pre-existing tax rates than incumbent firms), we exploit a setting in which municipal corporate taxes apply identically to firms across all sectors (such that taxes are not tailored to individual firms or sectors) and we instrument both tax rates and agglomeration measures. Finally, in order to minimise the risk of omitted-variable bias, we control for unobserved sector and location characteristics via sector and location fixed effects.

Our estimates suggest that firms in sectors with an agglomeration intensity in the top quintile of the sample distribution are less than half as responsive to a given difference in corporate tax burdens as firms in sectors with an agglomeration intensity in the bottom quintile.

We proceed as follows. Section 1 provides a brief review of the relevant literature. Section 2 presents the model we estimate. Our empirical setting and data set are described in Section 3. Estimation results are reported in Section 4 and Section 5 concludes.

1. Literature Background

The implications of agglomeration economies for strategic tax setting among jurisdictions that compete for mobile tax bases have been studied in a number of theoretical contributions, including Kind *et al.* (2000), Ludema and Wooton (2000), Andersson and Forslid (2003), Baldwin and Krugman (2004), Borck and Pflüger (2006) and Baldwin and Okubo (2009).[2] 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 that cannot be dislodged by tax differentials. In fact, agglomeration externalities create rents that can in principle be taxed by the jurisdiction that hosts the agglomeration.

New economic geography models can also accommodate configurations, where agglomeration economies in fact *add* to the sensitivity of firm location to tax differentials because one firm's location choice can trigger further inflows and thus the formation of a new cluster. In such knife-edge configurations, agglomeration economies exacerbate the intensity of tax competition (Baldwin *et al.*, 2003, result 15.8; Konrad and Kovenock, 2009). We abstract from these theoretically conceivable but practically rather less likely situations to focus on configurations featuring established agglomerations. This is where

[2] See Baldwin *et al.* (2003), ch. 15, 16) for an overview.

the new economic geography implies qualitatively novel predictions for tax policy. The models typically feature a single increasing-returns sector, the intensity of whose agglomeration forces varies (mostly non-monotonically) with trade costs. Where agglomeration forces are strongest (i.e. at intermediate trade costs), the probability that the increasing-returns sector completely agglomerates in one region is highest and the sensitivity to tax differentials is smallest.[3] The greater is a sector's observed spatial concentration, the larger, on average, are the underlying agglomeration economies and the lower should be the sector's locational sensitivity to tax differentials.[4]

Empirically, there is considerable evidence to show that firm location is sensitive to differences in corporate taxes, across a range of methodological approaches.[5] Since Carlton (1983), it has become standard practice to estimate corporate location choices through the conditional-logit model, which is formally derived from a representative firm's stochastic profit function.[6] Papke (1991) suggested that location choice could alternatively be represented by a region-level count model, such that estimation is based on maximum likelihood with an assumed Poisson distribution.[7] The Poisson model was shown by Guimaraes *et al.* (2003) to imply identical coefficient estimates to those of the conditional-logit model with grouped data and group-specific fixed effects. One can therefore estimate the conditional-logit model via Poisson, taking sectors as the grouping variable.

Devereux *et al.* (2007) have previously explored the impact of agglomeration economies on the sensitivity to local fiscal incentives of firms' location choices.[8] They have estimated a conditional-logit model of plant location in Great Britain, including an interaction term of region-level fiscal incentives with the stock of pre-existing same-sector plants in the relevant region, and they found that fiscal incentives have a greater impact on attracting plants to regions with larger stocks of existing plants. As fiscal incentives in British regions are negotiated individually for each proposed new establishment, unobserved plant-level features might affect both the probability of a plant receiving a grant in a particular area and the probability of it locating in that area. Since statutory corporate taxes of Swiss regions are neither firm nor sector specific, our empirical setting does not present the estimation challenge affecting an analysis of the same question based on British regional grants.

[3] More precisely, in the standard 'core-periphery' model the range of tax differentials that will not dislodge a given spatial allocation of firms is largest where agglomeration forces are strongest.

[4] Burbidge and Cuff (2005) and Fernandez (2005) have studied tax competition in models featuring increasing returns to scale that are external to firms, with firms operating under perfect competition. In these models, individual firm mobility is not constrained by agglomeration economies and governments may compete even more vigorously to attract firms than in the standard tax competition model. Krogstrup (2008) shows that for tax competition to be intensified, external agglomeration economies must be relatively weak, in the sense that they are outweighed by dispersion forces that stabilise the overall spatial allocation of activity. Our working hypothesis is that agglomeration economies are sufficiently internalised by firms to affect firms' locational sensitivity to tax differentials.

[5] See, e.g. Hines (1999) for a survey, and De Mooij and Ederveen (2003) for a meta-analysis.

[6] Recent applications include Guimaraes *et al.* (2000), Figueiredo *et al.* (2002), Crozet *et al.* (2004), Head and Mayer (2004), Devereux *et al.* (2007) and Strauss-Kahn and Vives (2009).

[7] Count models of firm location have subsequently been estimated by List (2001), Guimaraes *et al.* (2003) and Holl (2004).

[8] In a related strand of recent research, Charlot and Paty (2007), Jofre-Monseny and Solé-Ollé (2010, 2012), Koh and Riedel (2010), Jofre-Monseny (forthcoming) and Lüthi and Schmidheiny (2011)) have found that local tax rates are positively correlated with measures of local agglomeration.

As an additional methodological innovation, we focus on the interaction of taxes with a *sector*-specific measure of agglomeration, in order to capture the essence of the new economic geography insight on tax competition. Devereux *et al.* (2007), using a *location*-specific measure, show that it may be cheaper to attract a new plant to an existing cluster than to a peripheral location. This is an important and evidently policy-relevant result, but not what the theory necessarily predicts when the economy is in spatial equilibrium. In an interior spatial equilibrium with no relocation costs, expected profits at the locus of agglomeration (the 'central' location) and at the periphery are equalised. Whether a given change in fiscal inducements is then more effective at attracting firms to a central or to a peripheral location is indeterminate, as it depends on the functional form of the relationship between real returns and industry shares across locations. In the simulations reported by Borck and Pflüger (2006, figure 5), a given fiscal inducement will in fact attract a larger number of firms if offered at the peripheral location than if offered at the central location. As long as taxes vary within the bounds beyond which they would trigger discrete ('catastrophic') relocations of mobile sectors, the theory consistently suggests that stronger sector-level agglomeration forces imply a lower sensitivity of firm location to tax differentials.[9] This specification furthermore allows us to control for sector and location fixed effects throughout, thus considerably alleviating concerns about omitted-variable bias.

2. The Empirical Model

2.1. *Theory: Footloose and Latent Startups*

At the most general level, there are two approaches to modelling the location of new firms. One approach is to consider an investor who has resolved to set up a firm somewhere among a given set of locations and then decides which location to pick. We refer to this as the 'footloose-startup' model. The other approach is to assume that potential entrepreneurs are spatially immobile and continuously decide whether or not to set up a firm.[10] We refer to this approach as the 'latent-startup' model. To the empirical researcher, these two approaches are equivalent in two essential respects: the decision to set up a firm at a particular location is based in both cases on expected profits, and in both cases expected profits are best modelled as a combination of deterministic components and a stochastic term.

We posit a general profit function for a *footloose-startup* decision problem, where a firm belonging to sector i has decided to set up a new plant f and now considers which location j to choose:

$$\pi_{fij} = U_{ij} + \varepsilon_{fij} = \alpha_1 T_j + \alpha_2 A_i + \alpha_3 T_j A_i + \boldsymbol{\beta}' \boldsymbol{x}_{ij} + \varepsilon_{fij}. \tag{1}$$

[9] In 'core-periphery' models, which, in the absence of taxes, accommodate only perfectly agglomerated or perfectly dispersed spatial allocations of the mobile sector, marginal variations in relative tax burdens imply marginal reallocations of that sector among locations in the dispersed equilibrium but have no effect on sectoral location in the agglomerated equilibrium (Baldwin *et al.*, 2003). In models that accommodate partially agglomerated configurations even in the absence of taxes, more strongly agglomerated equilibria imply lower elasticities of firm counts relative to tax differentials (Borck and Pflüger, 2006).

[10] See Becker and Henderson (2000) and Figueiredo *et al.* (2002).

U_{ij} summarises the deterministic part of the model that is common to firms of a particular sector and location; T_j represents the relevant corporate tax burden at location j; A_i represents the strength of agglomeration economies in sector i; $\mathbf{x}_{ij}$ is a vector of other variables that determine a firm's profits in sector i at location j (such as factor prices, proximity to markets etc.); α_1, α_2, α_3 and $\boldsymbol{\beta}$ are coefficients to be estimated; and ε_{fij} is a stochastic error term. A sector's propensity to agglomerate, A_i, may be determined by pecuniary and/or technological spillovers, or it may be due to the spatial concentration of immobile resources that are important to the sector.

Our interest is in the parameter α_3: while we expect the attractiveness of a location j to fall in the level of its corporate tax burden, implying that α_1 should be negative, this sensitivity should be weaker in sectors that are subject to strong agglomeration forces. A positive α_3 would therefore confirm the result of the economic geography literature that agglomeration forces can offset industries' sensitivity to tax differentials.[11]

If we treat the location decision problem as one of random profit maximisation, firm f will pick location m if $\pi_{fim} > \pi_{fij}\ \forall\ j, j \neq m$. As shown by McFadden (1974), the assumption that ε_{fij} has an extreme-value type 1 distribution yields a simple expression for the probability of choosing location m: $p_{fim} = \mathrm{e}^{U_{fim}}(\sum_j \mathrm{e}^{U_{fij}})^{-1}$. If we define a dummy variable d_{fij} that equals one if firm f chooses location j and zero otherwise, the log likelihood of the conditional-logit model becomes: $\ln L_{\mathrm{CL}} = \sum_f \sum_i \sum_j d_{fij} \ln p_{ij} = \sum_i \sum_j n_{ij} \ln p_{ij}$, where n_{ij} represents the number of firms in sector i that choose location j.

Guimaraes *et al.* (2003) have shown that the same log likelihood, up to a constant, obtains if one assumes n_{ij} to be independently Poisson distributed. Thus, parameter estimates obtained from a Poisson count regression of n_{ij} on all region specific and region sector-specific regressors plus a set of sector fixed effects are identical to those obtained from conditional-logit estimation. We can therefore rewrite the random profit model (1) equivalently as follows:

$$\mathrm{E}(n_{ij}) = \lambda_{ij} = \exp(\alpha_1 T_j + \alpha_3 T_j A_i + \boldsymbol{\beta}' \mathbf{x}_{ij} + \boldsymbol{\gamma}' \mathbf{d}_i), \tag{2}$$

where n_{ij} follows a Poisson distribution and $\mathbf{d}_i$ is a set of sector dummies. The inclusion of sector dummies forces the control matrix $\mathbf{x}_{ij}$ to consist exclusively of variables that vary across locations. The main effect of A_i, α_2, is absorbed into the sector fixed effects.

The *latent-startup* model assumes that every location hosts a certain number of immobile actual and potential new firms ('entrepreneurs') per sector. At every point in time, each potential entrepreneur computes the net present value (NPV) from becoming active and uses this to decide whether or not to start an actual firm. This yields, for every location-sector pair, a supply and demand curve for new firms in birth-NPV space. The supply curve, which rises in NPV, depends primarily on the size of a location's pool of potential entrants. The demand curve traces how the NPV per firm

[11] In the online Technical Appendix, we present an empirical model that is formally derived from spatial demand and supply conditions. In that model, the interaction between municipal taxes and sector agglomeration economies is not introduced by assumption but implied by considering agglomeration economies in the production function.

changes as more firms become active in the same sector and location, and its position depends on variables such as local factor costs and local product demand. Total births are then determined by the intersection of these demand and supply schedules. Becker and Henderson (2000) show that, conditional on standard regularity conditions, this model leads directly to the Poisson specification (2). By employing Poisson estimation, we can therefore accommodate both the footloose- and the latent-startup models – a considerable advantage given that it would be impossible based on available information to judge which of the two models represents a better approximation of the actual data-generating process.

2.2. *Estimation Issues*

2.2.1. *Unobserved location-specific effects*

Firms' choices may in part be driven by location-specific variables that are unobserved by the econometrician, such as the bureaucratic costs of registering new firms or availability of specialised labour. Omission of these variables would lead to biased parameter estimates on the included regressors. Furthermore, if such unobserved location-specific factors are spatially autocorrelated, the 'independence of irrelevant alternatives' (IIA) assumption underlying the conditional-logit approach is violated. We therefore include location fixed effects that control for all unobserved location-specific characteristics. Our baseline model (1) then becomes:

$$\pi_{ij} = \alpha_3 T_j A_i + \boldsymbol{\beta}'\mathbf{z}_{ij} + \boldsymbol{\gamma}'\mathbf{d}_i + \boldsymbol{\delta}'\mathbf{g}_j, \tag{3}$$

where $\mathbf{g}_j$ is a set of location dummies. The vector of controls $\mathbf{z}_{ij}$ contains the subset of elements of $\mathbf{x}_{ij}$ that vary by location and industry. This approach does not allow us to identify coefficients on purely location-specific characteristics such as T_j. Since we are mainly interested in the interaction effect α_3 but may also wish to know the main effect of taxes α_1, we shall estimate both specifications (2) and (3).

2.2.2. *Identification and inference*

In the aggregate, local corporate tax rates and sector agglomeration patterns are both cause and consequence of firms' location choices. The local stock of firms influences local tax rates through the local tax base or the political process of local tax setting; sector-level agglomeration indices are by construction the result of existing firms' location choices.

One element of our strategy for mitigating simultaneity bias is to focus on location choices of *new* firms. It is important to note in this context that the local jurisdictions of our data are legally bound to set identical statutory taxes across all sectors (see Section 3.1), and that we consider disaggregated sectors (see Section 3.2). This allows us to treat tax rates as exogenous not only from the viewpoint of an individual firm, but also from that of a cohort of new firms in a particular sector and location.

'Mechanical' reverse causation from location choices to agglomeration measures is ruled out, since our agglomeration indices are computed over pre-existing stocks of firms. Furthermore, given the narrow definition of sectors we shall work with, we also feel confident in abstracting from the possibility that the intensity of spatial concentration could be influenced by the level and spatial distribution of corporate tax burdens.[12]

These considerations notwithstanding, endogeneity of T_j and A_i may still be an issue, because, at steady state, firm birth rates are a function of firm stocks and because by considering the full set of sectors, aggregate reverse causality from firms to taxes may still matter. It is important therefore to note that our regressor of central interest is the interaction of these two variables, for which it is difficult to conceive of an endogeneity problem.

Nonetheless, we shall estimate instrumental-variables versions of all our specifications, by instrumenting corporate tax rates with electoral vote shares lagged by two decades and by instrumenting the Swiss agglomeration measures with their British counterparts.

We report Eicker–Huber–White robust standard errors in all Tables. We do not report clustered standard errors, as the variables of central interest vary at the location-sector level, which is the level of individual observations. This approach also corrects the standard errors for potential overdispersion when estimating Poisson models.

2.2.3. *Functional form*

As evident in (2), the standard location choice model suggests a log-linear relationship between the expected number of firms in location j and industry i and the relevant explanatory variables. The key feature of log-linearity is that the explanatory variables affect the number of firms multiplicatively. Our log-linear specification with two-way fixed effects (3) can be reformulated as follows:

$$\mathrm{E}\left(n_{ij}\right) = \exp(T_j A_j)^{\alpha_3} (\tilde{\gamma}_1)^{d_1} (\tilde{\gamma}_2)^{d_2} \ldots (\tilde{\delta}_1)^{g_1} (\tilde{\delta}_2)^{g_2} \ldots, \tag{4}$$

where $\tilde{\gamma}_i = \exp(\gamma_i)$ and $\tilde{\delta}_j = \exp(\delta_j)$.

The fixed effects are our main control variables and it is important that they be modelled as multiplicative. The industry fixed effects have to absorb, among other factors, size differences across sectors, which are largely driven by the vagaries of statistical classification. In our data, aggregate industry sizes vary by a factor of 1,000, ranging from 146 to 152,000 workers. The location fixed effects control for, among other factors, differences in the total size of locations, which are largely driven by historically determined jurisdictional borders. In our data, jurisdiction sizes vary by a factor of 300, ranging from 952 to 293,708 workers. A linear regression specification with additive fixed effects implies the same absolute industry fixed effect for small and large locations and the same absolute location fixed effect for small and large industries. A linear specification thus risks predicting implausibly large firm counts in small locations but large industries and in small industries but large locations. Multiplicative fixed effects are not subject to this problem.

Multiplicative effects can be estimated by using (2) or (3) as the basis for a Poisson/conditional-logit regression model. Alternatively, we can estimate those models with OLS after log-transforming the dependent variable. Unlike the Poisson model,

[12] For models of endogenous agglomeration, driven in part by taxation patterns, see e.g. Ottaviano and van Ypersele (2005) and Haufler and Wooton (2010).

however, the log transformation has the disadvantage of dropping all observations with zero firm births. We estimate and compare both specifications.

We also estimate fully linear specifications. This approach allows us to use instrumental variables, while including location-industry observations with zero firm counts. First, we report linear models with the count of new firms as dependent variable. However, because of the obviously misspecified additive functional form of the two main control variables, the industry and the location fixed effects, we consider these fully linear results to be indicative at best. Second, we use firm entry rates rather than absolute numbers as the dependent variable (see Section 3). Here, the two fixed effects do not need to control for sector and location size; their obviously misspecified additive functional form should pose a less severe problem. However, even with rescaling for size by defining the dependent variable as entry rates, the independent variables should appear multiplicatively. We therefore consider this specification a robustness test for our main results.

3. The Empirical Setting

3.1. *Local Taxation in Switzerland*

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 almost complete 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% of the total tax revenue raised on corporate income and capital, the remaining 35% being raised by the federal government. Profit taxes account for 85% of corporate tax receipts. The variance of corporate tax burdens is large. Figure 1 illustrates this point for consolidated cantonal-plus-municipal corporate income taxes on profits of an average-sized firm with a 9% return on capital: the highest tax rate, at 17.6%, is more than three times higher than the lowest rate, at 5.5%.

Another convenient feature of our empirical setting is that corporate taxation is not negotiated with individual firms or sectors but based on legally binding statutory rates that depend solely on firms' observed profitability and capital. The definitions of these tax bases have been harmonised countrywide by a federal law that has been in force since 1993 and that foresees no firm-specific or sector-specific regimes except for some clauses to avoid double taxation of holding companies.[13]

[13] The official title of the law is 'Bundesgesetz über die Harmonisierung der direkten Steuern der Kantone und Gemeinden', adopted by the federal parliament on 14 December 1990. Special tax treatment applies to farming but we omit agricultural activities in our estimations. For firms with operations in several cantons, the exemption principle holds. Double-taxation agreements define the allocation of profits using formula apportionment, mostly based on wage bills, capital or sales; see Feld and Kirchgässner (2003, ch. 135) for an illustrative example. The exemption principle combined with formula apportionment provides an incentive for firms to respond to tax differentials via physical location choices rather than through creative accounting.

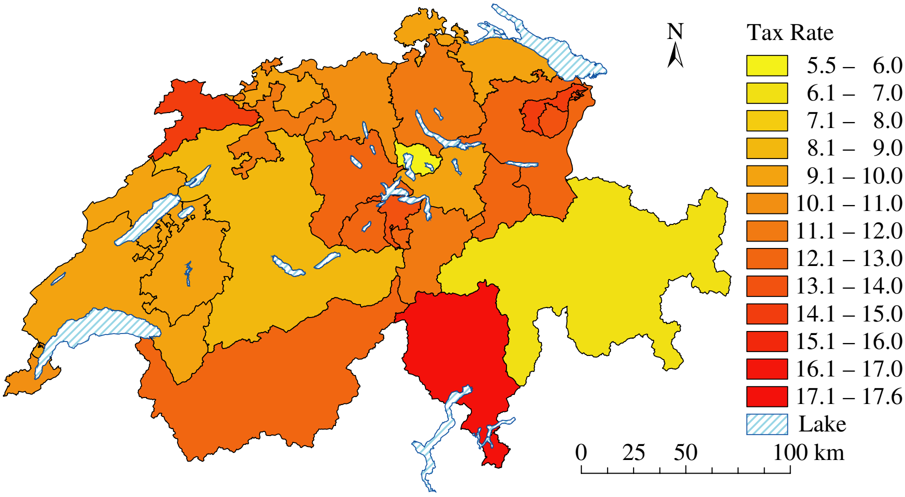

Fig. 1. *Corporate Income Tax Rates Across Swiss Cantons*
Notes. Cantonal and municipal statutory corporate income (profit) tax rates on a representative firm with 9% return on capital. Cantonal averages over all of the cantons' sample municipalities in 1998.

The sole exception to equal treatment across firms and sectors is that some firms can be offered tax rebates for a maximum of 10 years after setting up a new operation. No systematic data are made available for cantonal and municipal exemptions granted, but available evidence suggests that they affect less than 4% of new firms.[14] Furthermore, as tax holidays at the federal level are contingent on exemptions granted at the cantonal level, cantons and municipalities have a strong incentive to grant exemptions more generously if concurrent tax exemptions are granted by the federal government. Since the eligibility for federal tax holidays is restricted to certain legally defined 'lagging' regions, this is differenced out in our baseline specification with location fixed effects. Sector-specific taxation exists at the federal level (for value-added tax, excise taxes and import duties) but all cantonal and municipal taxes imply identical treatment across sectors.

3.2. *Data Sources*

We draw on data from three main sources. First, the Swiss Federal Statistical Office has collected information on every newly created firm annually since 1999.[15] The main use of this data set is as the source of new firm counts per municipality and economic sector (n_{ij}), our dependent variable. We use data for the years 1999–2002. The database also

[14] According to published government replies to parliamentary questions in the cantons of St. Gallen and Lucerne, 59 and 35 temporary tax exemption agreements were granted respectively by these two cantons over our sample period 1999–2002. Relative to the number of firms created in those cantons and years, this represents 3.8% and 3.6% respectively. These percentages must be considered upper bounds, as some exemptions are granted to existing firms that undertake significant restructuring projects.
[15] The statistical office's title for this project is 'Unternehmensdemografie' (UDEMO).

offers information on the municipality in which the new firm is located and on the firm's main sector of activity by three-digit sector of the European NACE classification.[16] The data set records as new firms all market-oriented business entities that have been founded in the year concerned and are operating for at least 20 hours per week. New entities created by mergers, takeovers or breakups are not counted, nor are new establishments by existing firms. A foreign firm's first Swiss branch, however, counts as a new firm. Observed firm births undoubtedly represent a mixture of births through resident entrepreneurs best modelled by the latent-startup approach and of births by non-resident (Swiss or foreign) investors best modelled by the footloose-startup approach.

Our second data source is the multi-annual census of all firms located in Switzerland, also carried out by the Federal Statistical Office.[17] The census records establishments (of which there can be several per firm) and attributes them to a NACE sector according to their self-declared principal activity. We use data for the survey of 1998, containing information on location, sector of activity and employment, to construct our agglomeration variable.

The census data show that we work with a narrow sector definition: the average share of a three-digit sector in terms of both employment and firm stocks across our sample municipalities is 0.48%. Municipalities dominated by one or a small number of sectors are exceedingly rare. Cases in which a sector accounts for more than 10% of the municipal firm count represent a mere 0.26% of observations.

Finally, we have assembled a municipality-level data set on local taxes and other control variables measured in 1998 and 2001 from a variety of sources.[18] We use these data for our measures of corporate and personal income tax burdens, factor prices, public expenditure and proximity to markets. The data cover the 213 largest municipalities. The mean population of our sample municipalities is 17,367, for a mean total area of 20.2 km^2.[19]

3.3. *Variables Used*

3.3.1. *Dependent variable*

We run all of our regressions for counts of *new firms* born over the period 1999–2002. The average number of new firms (n_{ij}) per location and three-digit industry is 0.93, with a nationwide sample total of 26,233 new firms over our four-year sample period.

As an alternative dependent variable, we use *entry rates* defined as *new firms* scaled relative to the predicted stock of pre-existing firms per municipality and sector. We calculate *entry rates* as follows:

[16] We retain only activities that pertain to the private sector. Furthermore, sectors for which no firm births are observed are dropped from the data set. This leaves us with 132 three-digit sectors.

[17] The statistical office's title for this project is 'Betriebszählung' (BZ).

[18] For a detailed description of the data on municipal taxes and other municipal attributes, see Brülhart and Jametti (2006).

[19] Due to the small size of our sample jurisdictions, we feel confident in abstracting from within-jurisdictional heterogeneity. Duranton *et al.* (2011) provide a careful treatment of this issue based on data for English Local Authorities (which, on average, cover areas that are 18 times larger than our Swiss sample municipalities).

$$Entry\ rate = \frac{new\ firms_{ij}}{(firms_i \times firms_j)/firms_{tot}}, \tag{5}$$

where *new firms*$_{ij}$ is the number of new firms in sector i and location j created between 1999 and 2002, *firms*$_i$ is the stock of firms in sector i in 1998, *firms*$_j$ is the stock of firms in location j in 1998 and *firms*$_{tot}$ is total stock of firms in 1998. The denominator is the predicted stock of firms in sector i and location j assuming that all locations have the same-sector composition. This definition thus controls for differences in the size of both sectors and locations. Alternatively, we could have scaled by *firms*$_{ij}$. Our choice has the advantage that we do not lose sector-location observations with zero firm stocks in 1998 and it is considerably less prone to reverse causality.

Summary statistics for the dependent and independent variables are shown in Table 1.

3.3.2. *Explanatory variables*

Location-sector-specific variables Our main explanatory variable in the two-way fixed-effects model (3) is the interaction of the local corporate tax rate (T_j) and sectoral agglomeration economies (A_i), with $\mathbf{d}_i$ denoting sector fixed effects and $\mathbf{g}_j$ taking the form of municipality fixed effects. Except where stated otherwise, our explanatory variables are observed for two years, 1998 and 2001 and we use the average value.

Our measure of T_j, *tax*, is defined as the municipal-plus-cantonal average corporate income tax rate on a firm with median profitability.[20]

Agglomeration economies are not directly observable. In equilibrium, however, sectors subject to strong agglomeration economies will be more spatially concentrated than sectors subject to weak agglomeration economies (or to net dispersion economies). Hence, we compute spatial concentration indices using the definition proposed by Ellison and Glaeser (1997), EG index, which controls for differences in firm numbers across sectors in quantifying the extent of geographic clustering. We compute the interaction between the tax variable and the *EG index* after mean-differencing the *EG index*. With this standardisation, the interaction term has a mean of zero, which allows us to interpret the estimated coefficient on the tax variable in the one-way fixed-effects specification (2) as the effect of taxes for a sector with average spatial concentration.

We consider the inclusion of a number of control variables ($\mathbf{x}_{ij}$). For the reasons explained in Section 2.2.3, it can be important that we control for the size of sector-location cells, particularly in fully linear specifications. We do this by including the 1998 *stock of firms* in the relevant sector and municipality. Given the potential endogeneity of this variable, we also systematically explore the robustness of our results to its exclusion.

In order to allow for cost factors affecting firm profits, we control for the prices of labour and of real estate, while assuming that the price of capital is equalised across Swiss municipalities. *Wage* reports average monthly wages per sector and region in the

[20] According to Swiss federal tax statistics, our sample median firm reported a return on own capital of some 9%.

Table 1

Descriptive Statistics

	Varies by	Mean	Sandard deviation	Min.	Mun./sector with min.	Max.	Mun./sector with max.
New firms†	mun., sector	0.925	7.86	0	*several*	694	Zurich, legal and management consultancy services
Entry rate†	mun., sector	0.152	0.76	0	*several*	25.04	Zollikofen, car manufacturing
Tax (avg. corporate income tax rate on median firm)‡	mun.	10.720	2.12	5.34	Freienbach	15.84	Giubiasco
EG index	sector	0.013	0.02	−0.04	production of paints & printing inks	0.17	accessory services for transport
Wage§	mun., sector	5.600	0.77	3.38	*several*	7.77	*several*
Property price¶	mun.	1.803	0.29	1.11	Le Locle	2.68	Zollikon
Income tax rate‡	mun.	6.632	1.39	2.73	*several*	9.38	*several*
Public expenditure††	mun.	14.278	2.56	10.18	Wettingen	21.02	Basel, Riehen
Stock of firms‡‡	mun., sector	5.859	36.26	0	*several*	2372	Zürich, other retail business
Market potential§§	mun.	1.140	0.63	0.28	Bex	4.39	Ecublens
Distance to highway¶¶	mun.	4.349	6.53	0.03	Morges	59.92	St. Moritz
Assisted municipality	mun.	0.249	0.43	0	*several*	1	*several*
Population†††	mun.	17.361	31.365	4.055	Sainte-Croix	351.838	Zurich
Vote share of left-wing parties in 1983‡	mun.	3.360	4.00	0	*several*	17.97	Carouge
British EG index	sector	−0.057	0.76	−0.69	Production of musical instruments	6.01	Production of ceramics

Notes. NACE three-digit sector level; data for 1998 unless stated otherwise; 28,116 observations. †Over period 1999–2002, ‡in %, §in 2000 in thousand Swiss francs, ¶in 2002, ††per capita in thousand Swiss francs, ‡‡in 1998, §§based on 1992 municipal incomes in million CHF, ¶¶in kilometres, †††in thousand.

year 2000, while *property price* stands for the municipality-specific average rental price per square metre of a representative residential unit in the year 2002.[21] We interact both these price variables with the *EG index*, as we may expect equivalent effects of agglomeration economies for the importance of factor prices to those we hypothesise for local tax rates: the stronger are sector-specific agglomeration economies, the less sensitive firms' location decisions should be, other things equal, to differentials in factor prices across municipalities.

As instruments for the tax variable, we use the municipality-level share of votes cast for left-wing parties in the 1983 federal election. This measure turns out to correlate strongly with observed tax rates in 1998 but cannot be suspected of being influenced by firm births in our sample period. For the Swiss *EG index*, we use as an instrument the corresponding British EG indices, computed using firm-level data for England, Scotland and Wales in 2005 (Simpson, 2007).

Location-specific variables In the one-way fixed-effects model (2), we can identify the effects of purely location-specific controls. We include the following variables. *Income tax rate* represents the canton-averaged statutory cantonal-plus-municipal personal income tax rate for a median-income representative household. We choose this measure, which is invariant across municipalities within each canton, because distances within cantons are sufficiently small to allow easy commuting among municipalities. Hence, income taxes in the particular municipalities where firms are located would not be the relevant measure. Similarly, we control for *public expenditure*, computed as canton-averaged municipal-plus-cantonal expenditures on the main spending items from the viewpoint of private-sector firms: education, public safety and transport. Again, selecting only municipality-specific expenditure would not represent the relevant variable, as Swiss municipalities are sufficiently small for a large share of commuting to take place between rather than within municipalities. The main demand-side control variable is *market potential*, which, for each municipality, is defined as the inversely distance-weighted average income across all Swiss municipalities.[22] As a simple complementary measure, we also include *distance to highway*, the road distance to the nearest access point to the highway network. This variable, unlike *market potential*, has the advantage of measuring accessibility without implying that the relevant economic space ends at the national border. We furthermore include a dummy variable for *assisted municipalities*, which are defined as lying within a region identified by federal law as eligible for temporary tax exemptions for newly created firms (see Section 3.1). Finally, we control for the log of *population*, for consistent estimation given unequally sized locations. Summary statistics on these variables are provided in Table 1.

[21] *Wage* is available from the Swiss national statistical office at a level of sectoral aggregation corresponding roughly to one-digit NACE, and at the level of regions comprising several cantons ('Grossregionen'). It is thus assumed that relative wages are constant across subsectors and within regions. *Property price* is available from the consultancy firm Wüest & Partner. Since commercial property prices are not collected at a sufficient level of detail for our purpose, we employ prices of residential property as the best approximation. It is assumed that relative wages and property prices did not vary significantly over our sample period.

[22] Municipal incomes are estimates reported by the Swiss federal statistical office for 1992, the latest available year.

4. Results

4.1. *Some Preliminary Illustrations*

Before reporting econometric estimates, we provide a graphical illustration of our central result. Figures 2 and 4 show maps of the geographic distribution of establishments in two sectors: software development and consulting (NACE 722) and watches and clocks (NACE 335). The former sector is relatively dispersed, with an *EG index* in

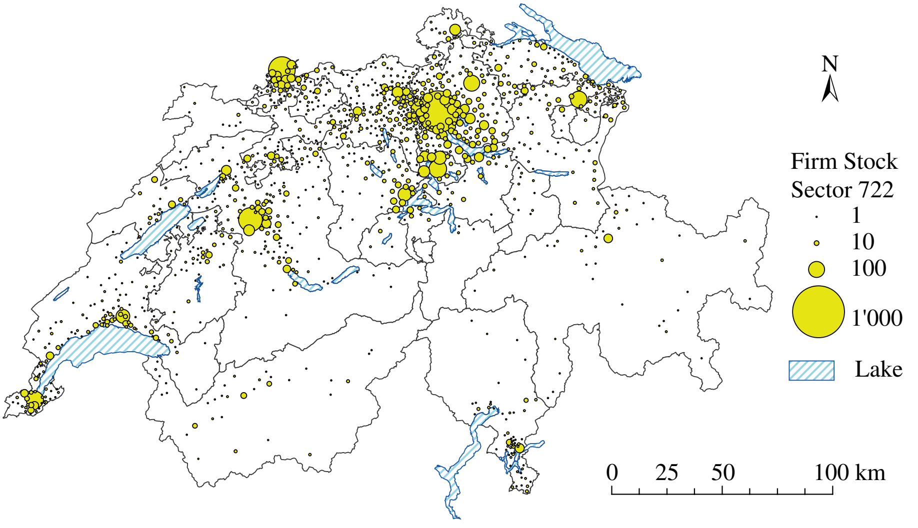

Fig. 2. *Software Development and Consulting, Distribution of Firms in* 1998
Notes. NACE sector 722; EG index = 0.001.

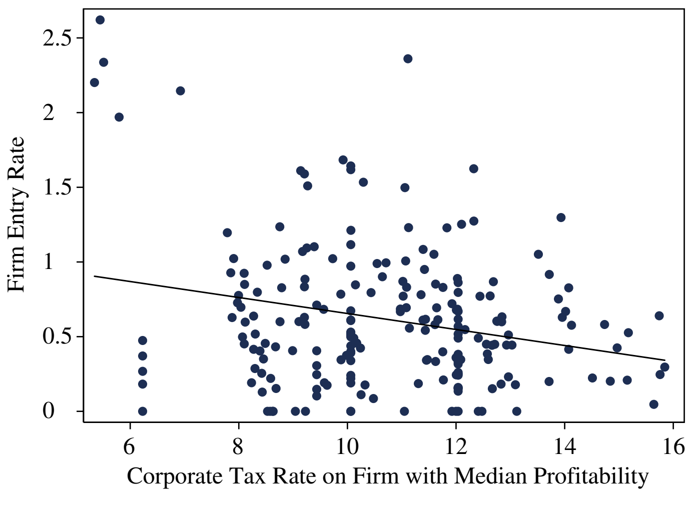

Fig. 3. *Software Development and Consulting, Taxes and Entry Rates of New Firms in* 1999–2002
Notes. Slope = −0.053; t-stat = −3.57; R^2 = 0.057.

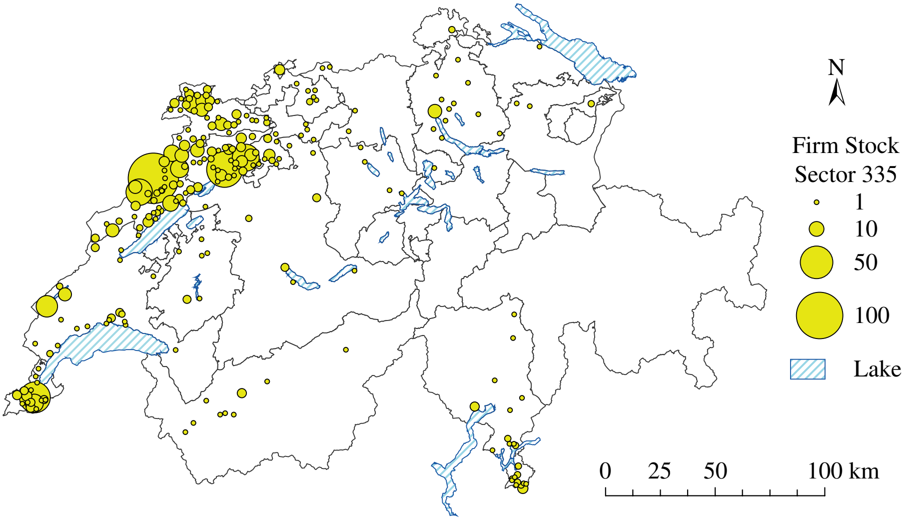

Fig. 4. *Watches and Clocks, Distribution of Firms in* 1998
Notes. NACE sector 335; EG index = 0.042.

the lowest quintile. Conversely, the latter sector serves as an example of a highly agglomerated industry, with an *EG index* in the top quintile. The corresponding Figures 3 and 5 plot *entry rates* against the corporate income tax rate. We observe that the relationship between taxes and firm births is negative and statistically significant for software development and consulting. This relationship turns statistically insignificantly positive for the strongly clustered watch-making industry. The two examples illustrate our main point: the more spatially concentrated a sector, the less firm births in that sector are deterred by high local corporate taxes (or attracted by low taxes).

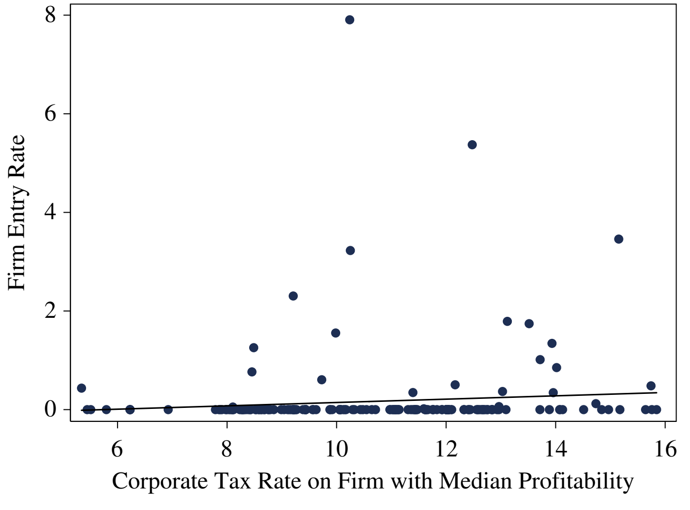

Fig. 5. *Watches and Clocks, Taxes and Entry Rates of New Firms in* 1999–2002
Notes. Slope = 0.034; t-stat = 1.35; R^2 = 0.009.

4.2. *Linear Models*

We begin by estimating the simplest possible (i.e. linear) version of the two-way fixed-effects model (3). These results are shown in columns 1–6 of Table 2. We report estimates with and without instrumenting the local tax rate, T_j, and the agglomeration measure, A_i and with and without including sector municipality-varying controls. First-stage regressions associated with the IV estimates are given in Table A1 in the Appendix. Statistical tests for instrument strength are satisfactory. When we include no controls, OLS yields no statistically significant estimates of α_3 and instrumenting even yields, implausibly, a (borderline) statistically significantly negative coefficient estimate. These findings are hardly surprising, as the absence of any scaling control implies a glaring omitted-variable problem. When we control for the 1998 local stock of same-sector firms on its own or in conjunction with the three other explanatory variables that vary across both panel dimensions, our estimated values of the interaction effect α_3 are consistently and statistically significantly positive, in line with our central hypothesis.

The non-instrumented point estimates (columns 1–3) are considerably smaller than the instrumented ones (columns 4–6). However, moving from OLS to IV raises the estimated standard errors as well as the coefficients, such that the OLS estimates are in fact contained within the 95% confidence intervals of their IV counterparts. Non-instrumented estimates can thus be interpreted as conservative.

In columns 7–8 of Table 2 we scale the dependent variable directly by defining it as the municipality sector-specific *entry rate*. Here too, we find consistently positive values for the interaction coefficient α_3 but these specifications turn out to be imprecisely estimated. A significantly positive coefficient on *wage* and a significantly negative coefficient on *wage* × *EG index* suggest that these models may be misspecified. Indeed, whilst we consider it reassuring to find the expected positive interaction effects even in the simple linear versions of our model, we prefer non-linear specifications for the reasons discussed in Section 2.2.3.

4.3. *Non-linear Models*

In columns 1–3 of Table 3, we continue to apply the OLS estimator but log-transform the dependent variable as implied by (2). This transformation eliminates all observations with zero recorded firm births, thus shrinking our sample substantially. Nonetheless, the results again support our central hypothesis: coefficients on the interaction term between taxes and agglomeration intensities are positive and statistically significant throughout.

We note also that the stock of existing firms, our sector-municipality scaling variable, has a considerably stronger impact in the fully linear models of Table 2 than in the log-linear regression runs shown in Table 3. This confirms the empirical relevance of the standard model of location choice, according to which the location and sector fixed effects should enter multiplicatively.

Columns 4–6 of Table 3 present Poisson estimates of the two-way fixed-effects model (3). As discussed in Section 2.1, these estimates offer a formal link to the theoretical profit function of entering firms. Again, we obtain positive coefficients on the interaction term throughout and find these coefficients to be statistically significant

Table 2

Linear Models

	Dep. var. =new firms per municipality and sector						Dep. var.=entry rate per municipality and sector			
	OLS			2SLS			OLS		2SLS	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Tax × EG index	0.003	0.713*	0.710*	−6.806*	6.774**	5.390*	0.034	0.057	0.061	0.029
	(0.468)	(0.389)	(0.399)	(3.669)	(3.371)	(2.777)	(0.083)	(0.082)	(0.396)	(0.375)
Wage			0.124			0.131		0.020		0.028*
			(0.084)			(0.086)		(0.014)		(0.016)
Wage × EG index			−0.229			0.075		−0.757**		−1.096
			(1.412)			(4.883)		(0.323)		(0.932)
Property price × EG index			0.529			28.025*		0.406		2.775**
			(4.411)			(14.798)		(0.644)		(1.397)
Stock of firms		0.178***	0.178***		0.178***	0.178***				
		(0.028)	(0.028)		(0.028)	(0.028)				
Sector fixed effects	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Municipality fixed effects	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
R^2	0.19	0.69	0.69	0.18	0.69	0.69	0.05	0.05	0.05	0.05
Weak instrument test				172.03†	171.80†	73.14‡			172.03†	73.3‡

Notes. *p < 0.1. **p < 0.05. ***p < 0.01. 28,116 observations, 132 sectors. Robust standard errors in parentheses. 2SLS: *Tax* instrumented by 1983 vote share of left-wing parties, *EG index* instrumented with British EG index. †Robust F-statistic on excluded instruments. ‡Kleibergen and Paap (2006) rank F-statistic for stationary data.

Table 3

Non-Linear Models

	Dep. var. = log of new firms per municipality and sector			Dep. var. = new firms per municipality and sector		
	OLS			Poisson		
	(1)	(2)	(3)	(4)	(5)	(6)
Tax × EG index	0.354*	0.414**	0.426**	0.845	0.887*	1.583***
	(0.200)	(0.198)	(0.206)	(0.535)	(0.530)	(0.517)
Wage			−0.004			0.011
			(0.034)			(0.058)
Wage × EG index			−1.098			−0.981
			(1.035)			(2.166)
Property price × EG index			−0.334			20.938***
			(1.668)			(3.508)
Stock of firms		0.003***	0.003***		0.0002***	0.0002***
		(0.001)	(0.001)		(0.0001)	(0.0001)
Sector fixed effects	yes	yes	yes	yes	yes	yes
Municipality fixed effects	yes	yes	yes	yes	yes	yes
Number of observations	5,969	5,969	5,969	28,116	28,116	28,116
Log likelihood	−5,136	−4,775	−4,775	−16,838	−16,793	−16,715
R^2	0.62	0.66	0.66			

Notes. *p < 0.1. **p < 0.05. ***p < 0.01. 132 sectors; robust standard errors in parentheses.

once we control for the available sector-location varying controls. This estimator does not allow us to instrument potentially endogenous regressors. In view of our findings based on linear regression, we therefore consider the Poisson coefficients as conservative estimates of α_3.

In Table 4, we report linear (OLS and IV) and Poisson estimates of the one-way fixed-effects model (2). By dropping municipality fixed effects, we can identify coefficients on purely location-specific variables, albeit at the cost of risking estimation bias from remaining unobserved location-specific effects. In order to minimise that risk, we include our full set of controls. It is reassuring that the estimated coefficients on these variables largely conform with expectations and are robust across estimation methods.[23] Our principal interest here concerns the main effect of the tax variable, α_1. Since we mean-difference the EG *index* for the construction of the interaction terms in the one-way fixed-effects specifications, this coefficient measures the impact of taxes for a sector with average agglomeration intensity. To be plausible, the estimated value of α_1 should be negative. This is what we find: α_1 is estimated to be negative across the three specifications, and it is statistically significant in the OLS and Poisson estimation runs.

[23] We note in particular the expected negative signs on *wage* and positive signs on *wage* × [*EG index* − mean(EG*index*)], in contrast to most of the two-way fixed-effects specifications shown in Tables 2 and 3. The only unexpected result is the estimated coefficient on *property price*, which is statistically significantly positive. The most plausible explanation for this result is that *property price* correlates with unobserved location-specific features that are attractive to new firms and to some extent capitalised in property prices. We interpret this result as suggesting omitted variables at the municipality level, which supports the inclusion of location fixed effects as our baseline specification.

Table 4

Models Without Location Fixed Effects

	Dep. var. = number of new firms per municipality and sector		
	OLS	2SLS	Poisson
	(1)	(2)	(3)
Tax	−0.043**	−0.011	−0.031**
	(0.017)	(0.018)	(0.015)
Tax × [EG index − mean(EG index)]	0.713*	5.454*	1.735**
	(0.401)	(2.849)	(0.817)
Wage	−0.128**	−0.313***	−0.478***
	(0.064)	(0.119)	(0.066)
Wage × [EG index − mean(EG index)]	0.690	0.424	1.949
	(1.559)	(5.279)	(2.652)
Property price	0.181*	−1.247*	0.351***
	(0.106)	(0.688)	(0.081)
Property price × [EG index − mean(EG index)]	−0.275	28.752*	17.174***
	(4.373)	(14.872)	(3.719)
Stock of firms	0.179***	0.178***	0.0001**
	(0.027)	(0.027)	(0.0001)
Income tax rate	−0.108***	−0.652***	−0.199***
	(0.025)	(0.244)	(0.021)
Public expenditure	0.003	0.037	−0.017***
	(0.008)	(0.038)	(0.006)
Market potential	0.118***	0.230***	0.281***
	(0.041)	(0.072)	(0.032)
Distance to highway	−0.008*	0.007	−0.008***
	(0.004)	(0.006)	(0.003)
Assisted municipalities	0.020	0.039	0.044
	(0.049)	(0.061)	(0.038)
log population	−0.164	−0.018	1.021***
	(0.271)	(0.276)	(0.015)
Sector fixed effects	yes	yes	yes
Municipality fixed effects	no	no	no
R^2	0.69	0.69	
Kleibergen–Paap rank statistic		33.04	
log likelihood			−18,102

Notes. *p < 0.1. **p < 0.05. ***p < 0.01. 28,116 observations, 132 sectors; robust standard errors in parentheses.

Most importantly, the coefficient on the interaction term, α_3, is again found to be consistently and significantly positive.

In summary, our estimations confirm the hypothesis we seek to test: location choices of firms in more spatially concentrated sectors are less sensitive to tax differentials.[24]

[24] We have performed a large number of robustness checks not reported here but available on request. First, in order to take account of the progressivity in some corporate tax schedules, we computed an alternative measure of *tax* as the revenue-weighted average across several representative profitability levels of consolidated municipal and cantonal profit as well as capital taxes. Second, we replaced the *income tax* by (*i*) the municipal median-income tax rate, (*ii*) the canton-mean maximum (i.e. high-income) tax rate and (*iii*) inversely distance-weighted averages of municipal tax rates. Third, we used broader measures of public expenditure. Fourth, we excluded the assisted municipalities. Fifth, we replaced counts of new firms by counts of new jobs as the dependent variable. Sixth, we took four-digit industries instead of three-digit industries. Seventh, we used an inversely distance-weighted average of same-sector firms instead of just the municipality's own stock of existing same-sector firms as an alternative control. We found our central result to be largely insensitive to these variations. See also the complementary estimations reported in the online Technical Appendix to this article.

4.4. *Quantitative Interpretation*

4.4.1. *Linear model*

In Figure 6, we illustrate the effect of a unit change in the tax rate on the predicted number of new firms, based on the OLS estimates reported in column 1 of Table 4.

Let us return to the two illustrative sectors of Section 4.1. The software sector (NACE 722) is relatively dispersed, with an *EG index* of 0.002 lying at the lowest quintile of our sample distribution. As can easily be seen in Figure 6, our estimates imply that for a sector with this agglomeration intensity, a 1%-point decrease in the tax rate will raise the predicted number of new firms in the relevant municipality by 0.051. The sample average number of new firms by municipality and sector is 0.925, and the sample average of the tax rate is 10.7% (see Table 1). Hence, our OLS estimates imply an approximate tax elasticity of −0.59 for the software sector.

As an example for a relatively agglomerated sector, we again take the watch-making industry (NACE 335), whose *EG index* of 0.042 falls within the top quintile of the sample distribution. The OLS estimates imply that a 1%-point decrease in the tax will raise the predicted number of watch-making firms in the tax-cutting municipality by 0.023, yielding an approximate tax elasticity of −0.27.

Hence, while a 1%-point reduction in the tax rate is predicted to attract 0.051 additional software firms, it will attract only 0.023 additional watch-making firms. Expressed differently, moving from a dispersed sector (in the bottom agglomeration-intensity quintile) to a clustered sector (in the top agglomeration-intensity quintile) reduces the tax sensitivity of firms' location choices by over one-half.

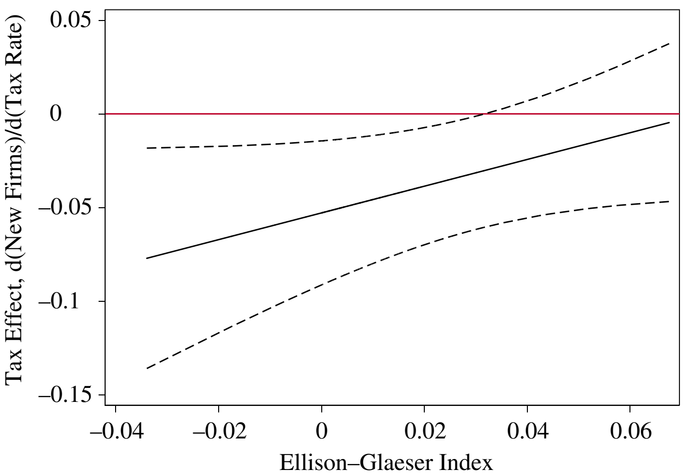

Fig. 6. *Implied Tax Effect (OLS Estimates)*

Notes. The graph shows the effect of a percentage-point increase in a location's tax rate on the number of new firms in a sector of a certain agglomeration intensity that locates there. The underlying computations are based on the coefficients and standard errors reported in Table 4, column 1. Dashed lines represent 95% confidence intervals.

4.4.2. *Non-linear model*

Unlike linear regression coefficients, Poisson parameter estimates cannot be interpreted as marginal effects. However, in their conditional-logit interpretation, the parameters can serve to predict the probability that a firm from sector i chooses location j: $P_{ij} = e^{U_{ij}}/\sum_k e^{U_{ik}}$. Marginal effects are obtained by differentiating this expression. Thus, the impact of a marginal increase in taxes in location j on the probability that a sector-i firm picks location j is given by

$$\partial P_{ij}/\partial T_j = (\alpha_1 + \alpha_3 A_i)\, P_{ij}(1 - P_{ij}) \tag{6}$$

in model (1). Conditional-logit marginal effects represent the lower bound of implied responses, with the marginal effects implied by the Poisson model representing the upper bound (Schmidheiny and Brülhart, 2011). Our computed quantitative effects can therefore be considered conservative.

Poisson marginal effects depend on all estimated parameters and all variables, through their dependence on P_{ij}. They therefore differ across locations and sectors. To compute meaningful marginal effects, we average all variables that vary across sectors except for the *EG index*, in order to isolate the interdependence of the tax effect with agglomeration economies from other cross-sectoral differences. We then visualise the marginal effects for a representative municipality (Montreux).[25]

Figure 7 shows the effect of a unit change in the tax rate as a function of the agglomeration index, based on the parameter estimates shown in Table 4, column 3. It is again easy to see that the tax effect is strongest and statistically significant in sectors with small values of the *EG index*. In more agglomerated sectors, the impact of taxes shrinks and finally even turns (insignificantly) positive.

We return to our two illustrative sectors. For the software sector, our estimated marginal effect of the median-firm corporate tax rate is −0.00017 and statistically significantly different from zero. Hence, the probability that a new software firm locates in Montreux would increase by 0.017% points if Montreux were to lower its tax rate by 1% point. This seemingly small effect needs to be compared to the choice probability (P_{ij}), which is 0.35% for that municipality and sector. Hence, a 1%-point reduction in the tax rate will raise the predicted number of new software firms in this municipality by 5%. The implied elasticity for the software sector in Montreux is −0.62 and thus very similar to the linear results.

Our estimated marginal tax effect for the watch-making sector is positive, at 0.00008. This means that the probability that a new watch manufacturer locates in Montreux would decrease by 0.008% points if Montreux were to lower its tax rate by 1% point. The implied elasticity for the watch-making sector in Montreux is +0.26. As can be gleaned from Figure 7, however, with an *EG index* of 0.042, the implied tax effect on the location choices of watch-making firms is not statistically significant. Watch making thus belongs to the sectors for which both our linear and non-linear estimates suggest that agglomeration economies are so strong that we can no longer identify statistically significant location effects of corporate taxes.

[25] Montreux is a representative municipality in the sense that it is close to the sample average in terms of both market access and population size.

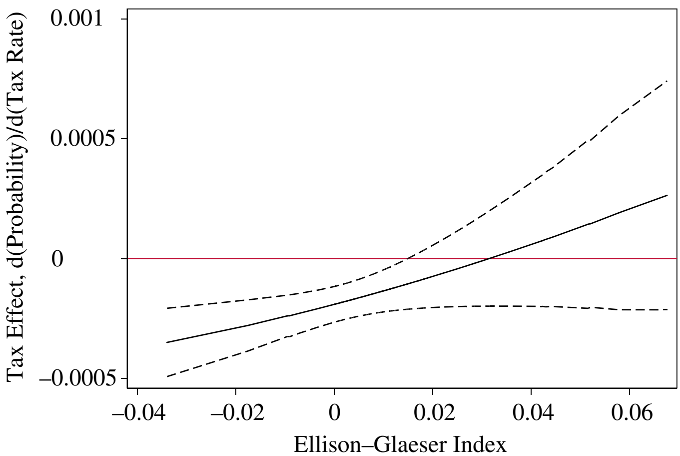

Fig. 7. *Implied Tax Effect (Poisson Estimates)*

Notes. The graph shows the effect of a percentage-point increase in a locations tax rate on the probability that a representative new firm locates there (4). The effect is shown for the municipality of Montreux and calculated assuming 1998 average (across sectors) municipality characteristics, except for the degree of agglomeration which varies as in the data. The underlying computations are based on the coefficients and standard errors reported in Table 4, column 3. Dashed lines represent 95% confidence intervals computed through the delta method.

5. Conclusions

Drawing on a firm-level data set for Switzerland and employing fixed-effects linear and count-data estimation techniques, we find 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 within the fifth quintile of the sample distribution are less than half as responsive to a given difference in corporate tax burdens as firms in sectors with an agglomeration intensity within the twentieth percentile. This finding supports the validity of recent theoretical results suggesting that agglomeration economies can reduce the importance of tax differentials for firms' location choices and thereby lessen the intensity of corporate tax competition.

In a sense, this research constitutes but the first step in a full evaluation of the prediction that agglomeration forces mitigate 'race-to-the-bottom' tax competition. Although tax competition is often at its fiercest when targeted at new firms, it could be useful to explore how tax differentials affect not just births but the entire life cycle of firms, including expansions, contractions and deaths. In future work it will furthermore be interesting to study whether policy makers recognise the differential impact of fiscal inducements across sectors and effectively seek to tax agglomeration rents, and whether this effect is strong enough to have a noticeable impact on the evolution of statutory corporate tax burdens. Finally, it would be interesting to distinguish between, on the one hand, spatial concentrations due to exogenously given endowments and, on the other hand, agglomeration of essentially footloose firms attracted to each other by various types of externalities. In theory, the latter type of agglomeration force can, depending on parameter values, intensify tax competition rather than mitigating it.

Appendix A. First-stage Regressions, Linear Model

Table A1

First-Stage Regressions, Linear Model

Dep. var. in second stage	Tax = avg. corporate income tax rate on median firm				
Dep. var.	Tax × EG index	Tax × EG index	Tax × EG index	Wage × EG index	Prop. price × EG index
Model in Table 2	(4)	(5)	(6)	(6)	(6)
Vote share × UK EG index	0.003***	0.003***	0.003***	0.0001**	0.00002
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Wage			0.005*	0.007***	−0.002***
			(0.003)	(0.001)	(0.000)
Wage × UK EG index			0.008***	0.013***	0.000
			(0.002)	(0.000)	(0.000)
Property price × UK EG index			−0.032***	−0.003***	0.012***
			(0.003)	(0.001)	(0.000)
Stock of firms		−0.000002	−0.00001	−0.0000003	−0.000003***
		(0.000004)	(0.000004)	(0.000001)	(0.000001)
Sector fixed effects	yes	yes	yes	yes	yes
Municipality fixed effects	yes	yes	yes	yes	yes
R^2	0.96	0.96	0.96	0.99	0.98
Weak Instrument Test	172.03†	171.80†		73.14‡	

Notes. *p < 0.1. **p < 0.05. ***p < 0.01. 28,116 observations; robust standard errors in parentheses. †Robust F-statistic on excluded instruments. ‡Kleibergen and Paap (2006) rank F-statistic for stationary data.

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Appendix A. Specific Model for Footloose Startups.
Fig. A1. Tax-Versus-Agglomeration Effect in the Specific Model.
Table A1. Specific Model, Sector Fixed Effects, Statutory Tax Rates.
Table A2. Specific Model, Sector Fixed Effects, Sector-Level Coefficients, Statutory Tax Rates.
Table A3. Specific Model, Sector and Location Fixed Effects.
Table A4. Specific Model, Sector Fixed Effects, Tax Index.

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