Does local taxation affect business' decisions?*

Gilles Duranton‡
London School of Economics

Laurent Gobillon§
Institut National d'Etudes Démographiques

Henry G. Overman¶
London School of Economics

7 March 2005

Preliminary: please do not quote without permission.

ABSTRACT: We use plant level data for UK manufacturing establishments to study the impact of local taxation on employment growth. Our empirical strategy pairs establishments across jurisdictional boundaries and uses difference-in-difference methods to estimate the impact of taxation. Our methodology improves on existing work as it corrects for both unobserved establishment heterogeneity and for unobserved local effects. Our initial results suggest that local taxation has a negative impact on employment growth.

Key words: Local taxation, Difference in difference estimation.
JEL classification: H22, H71, R38.

*Thanks to Helen Simpson and to seminar and conferences participants at a CEPR network meeting in Venice and an applied economic geography conference in Hamburg. Financial support from the Economic and Social Research Council (ESRC Grant R000239878) and the Leverhulme Trust is also gratefully acknowledged. This paper uses data that are Crown Copyright and reproduced with the permission of the HMSO Controller and the Queen's Printer for Scotland. However, the use of these data does not imply ONS endorsement of either the interpretation or the analysis in this paper.

‡Department of Geography and Environment, London School of Economics, Houghton Street, London WC2A 2AE, United Kingdom. Also affiliated with the Centre for Economic Policy Research, and the Centre for Economic Performance at the London School of Economics, g.duranton@lse.ac.uk, http://cep.lse.ac.uk/~duranton.

§Institut National d'Etudes Démographiques, 133, bd Davout 75980 Paris Cédex 20 France. laurent.gobillon@ined.fr, http://laurent.gobillon.free.fr/.

¶Department of Geography and Environment, London School of Economics, Houghton Street, London WC2A 2AE, United Kingdom. Also affiliated with the Centre for Economic Policy Research, and the Centre for Economic Performance at the London School of Economics, h.g.overman@lse.ac.uk, http://cep.lse.ac.uk/~overman.

1. Introduction

Issues surrounding the impact of local taxation are a key concern of a wide range of economic literatures. We can identify three questions that emerge from this literature. First, all else equal, how elastic are location decisions with respect to tax differences across jurisdictions? This question has been the particular focus of the 'race to the bottom' literature where competition between jurisdictions for a mobile tax base, leads to mobile factors paying a sub-optimally small tax burden. (Gordon, 1983; Zodrow and Mieszkowski, 1986; Wilson, 1986; Wildasin, 1988). More recent theoretical contributions have suggested that allowing for agglomeration may prevent this race to the bottom (Baldwin, Forslid, Martin, Ottaviano, and Robert-Nicoud, 2004). Empirical evidence, however, is limited and the actual impacts remain an open question. The second set of questions relates to what is done with the tax proceeds. In particular, in the area of public finance, inter-jurisdictional competition helps achieve the efficient provision of local public goods (Tiebout, 1956). The third set of questions revolves around the incidence of taxation and what exactly is being taxed. This has been a particular focus in urban economics, where capitalisation of local taxes has important implications for the possibility of efficient taxation of land rents.

This paper is concerned with providing some empirical evidence on these issues by looking at the impact of local taxation on the location and growth of firms. Our particular institutional context allows us to abstract from the second set of questions about how money is spent and instead focus on the impact and incidence of taxation.

Ours is clearly not the first paper to consider this issue. Bartik (1991) summarises the results from the earlier literature. Evidence from the 1960s and 1970s suggested there was no effect of taxes on firm location decisions. Bartik's own work focusing on data from the 1980s suggested that there was a negative relationship and a number of subsequent papers have confirmed that general finding. Much of this work, however, used fairly large spatial units (mostly US states). More recent work has started to move towards smaller spatial units with similar results. See, for example, Guimaraes, Figueiredo, and Woodward (2004) work using data for US counties.

The existing literature, however, has failed to satisfactorily resolve three main problems when attempting to assess this impact. First, firms are faced with a choice of a large number of heterogenous locations when deciding where and how to produce. Second, firms themselves are also heterogenous. Third, details of the tax system matter and some aspects of the tax system may be endogenous to firm production and location decisions. This paper attempts to deal with all three of these problems.

The rest of the paper is structured as follows. In section 2 we outline our methodology and relate it to the existing literature. Section 3 briefly outlines our data while section 4 presents our findings on the impact of local taxation. Section 5 concludes.

2. Methodology

A. *Heterogenous locations*

When locating, establishments[1] are faced with a large number of heterogenous sites. Once located, site specific variables may then impact on production decisions. A wide variety of factors will affect both the attractiveness of particular sites and the success of establishments once they have chosen their site. For example, the attractiveness of a site may depend on access to the road network while changes to that network may affect the performance of establishments at that site. In this version of the paper we are predominantly concerned with the impact of local taxation on establishment employment and so our focus will be on the latter effect, i.e. the impact of site characteristics on performance. Given that there is site heterogeneity, assessing the impact of local taxation will require us to control for a variety of fixed and time-varying site characteristics. Some of these site characteristics may be observable, but many are likely to be unobservable.

Of course, unobserved site characteristics are not a problem if these unobserved characteristics are uncorrelated with included explanatory variables. Unfortunately, this is unlikely to be the case. The most natural assumption is that many of these unobserved characteristics will vary smoothly across space. That means neighbouring sites are likely to have similar values of these unobserved characteristics. As sites within jurisdictions also face the same tax rates, this means that these unobserved characteristics are very likely to be highly correlated with the very variable in which we are interested. In addition, unobserved site characteristics are also potentially correlated with time varying establishment characteristics. For both these reasons, dealing with these unobservable site characteristics is the first key step in developing a methodology to assess the impact of local taxation. The novelty in our approach is to accept that unobserved site characteristics are likely to be highly spatially correlated and to use this fact to our advantage. Using ideas from Holmes (1998) we identify establishments that are close to one another, but on different sides of jurisdictional boundaries. These establishments will have very similar unobserved site characteristics, but will face different tax rates. We look at the extent to which differences in employment growth between these pairs of establishments can be explained by different local tax rates. This spatial differencing allows us to control for unobserved site characteristics. Note, that this approach has the added attraction that these unobserved characteristics may be both fixed and time-varying.

The existing literature, albeit mainly focused on establishment location rather than performance, has tackled this issue in a number of ways. One possibility is to assume that the unobservable effects are common across sites within jurisdictions and to include dummy variables to condition out these effects. These jurisdictional dummies should pick up any unobserved, time-invariant fixed-effects common to all establishments in the jurisdiction. Clearly this approach rules out the use of simple cross section data. It has also proved difficult to implement in situations with a large number of jurisdictions, because the non-linear models (e.g. conditional logit) that are popular in this literature do not allow one to difference out the large number of dummy variables before estimation. Finally, and most importantly, this approach cannot capture variations in site

[1] We use the terms plant and establishment interchangeably.

characteristics that occur within jurisdictions as well as the fact that these unobserved effects may vary over time. Our methodology allows us to deal with both these issues.

One possible solution to the problem of the large number of dummy variables and the issue of time-varying unobserved effects is to opt for a nested approach with the inclusion of dummies at higher spatial scales. It is unclear how one would motivate such an approach for establishment performance, but it may be more natural for location decisions, particularly when we can think of such decisions as a two step procedure. For example, firms first decide which country then decide which region and we assume that the important unobserved effects occur at the country level. The impact of local taxation is then identified from both cross sectional and time series variation. Head and Mayer (2004) for example adopt such an approach in their study of Japanese FDI in to EU countries. This approach has the added advantage that it does not need to rely on the assumption of the independence of irrelevant alternatives. This assumption is key to the implementation of conditional logit models and is clearly problematic in the current situation given that unobserved site characteristics are likely to be correlated across space. Unfortunately, this nested approach allows for time-varying effects at the expense of ignoring smaller scale variation in unobserved characteristics. Again, our methodology allows us to deal with this issue.

B. ***Heterogenous establishments***

Our approach to dealing with the existence of heterogenous establishments is more standard. Because we have a panel of establishment level data, we are able to control for observed time-varying characteristics of establishments as well as condition out time-invariant establishment specific effects through the inclusion of an establishment level fixed-effect. Note that the inclusion of establishment level fixed effects should also control for unobserved time-invariant site specific effects (if firms do not move) leaving our spatial differencing to control for unobserved time-*varying* site specific effects. Although there is nothing particularly innovative in the method we use to deal with establishment heterogeneity, panel data techniques are not widely used in the existing literature on the impact of local taxation.

C. ***The taxation system and the endogeneity of taxes***

Taxation systems vary across a wide number of dimensions. For example, what exactly is taxed and who pays the tax? In addition, the impact of taxation can depend on frictions elsewhere in the economy (e.g. the length of time for which businesses sign rental contracts).. To address these problems and to isolate the effects of changing tax *rates* calls for a focus on tax systems that have very similar rules across jurisdictions, so the only source of variation is the tax rate itself. The UK rates system that we use in this paper is one such system. We note, in passing, that given current data on cross-country tax systems, controlling for cross-country differences in those systems presents a major problem for the literature looking to assess the impact of tax rates on international location decisions.

The other issue that we need to confront is the endogeneity of tax rates to employment and location decisions. To do this, we intend, in future versions of the paper, to instrument using a range of local political variables.

D. ***A model of the employment impact of local taxation***

To make this discussion concrete, we consider the impact of local taxation on establishment employment decisions (the main focus of the remainder of the paper). Take location as given.[2] The establishment occupies one of many sites indexed by $z(i)$. The local jurisdiction that sets the tax for this establishment clearly depends on the site occupied, and is indexed as $a(i)$.

Establishments use capital (K) and labour (L) to produce a final good. We assume that the price of the final good (p) is common across all jurisdictions, the cost of capital ($r_{a(i)}$) may vary across jurisdictions, while the wage rate (w_i)is establishment specific. We allow the cost of capital to vary at the jurisdictional level because, in the particular context we consider, it is most natural to model business rates as a tax on capital. Establishment specific wages allow for differences across jurisdictions (including the degree of labour market monopoly power enjoyed by establishments), but may also capture composition effects at the establishment level. Ignoring time subscripts for simplicity, the establishments profit maximisation problem can be written as:

$$Max_{L,K}\Pi_i = pA_iF(L_i,K_i) - w_iL_i - r_{a(i)}K_i \tag{1}$$

where F is the production function and A_i is an establishment specific productivity effect. Under standard regularity conditions, a sufficient condition for profit maximisation is that the following first order conditions hold:

$$\frac{\partial \Pi_i}{\partial L_i} = pA_i\frac{\partial F(L_i,K_i)}{\partial L_i} - w_i = 0 \tag{2}$$

$$\frac{\partial \Pi_i}{\partial K_i} = pA_i\frac{\partial F(L_i,K_i)}{\partial K_i} - r_{a(i)} = 0 \tag{3}$$

Again, using standard, regularity conditions and focusing only on labour demand we have

$$L = g(\overset{+}{A_i}, \overset{-}{w_z}, \overset{?}{r_a}) \tag{4}$$

where g is some (possibly non-linear) function and the expected signs of the cross-partial derivatives are indicated above each variable.

As we stated above, in the UK context , which we consider in detail in the remainder of the paper, we will model business rates as a tax on capital which changes $r_{a(i)}$, the cost of capital in jurisdiction $a(i)$. Clearly, this simple model misses some important aspects of the impact of local tax rates. However, it will be easier to discuss the implications for our estimates once we have outlined our empirical specification and so we postpone discussion until after the next sub-section.

[2]Allowing establishments to chose location involves a simple extension. The problem can be solved backward through a two-stage maximisation. In the first step establishments chose capital and labour to maximize profit at each location. In the second step they maximize with respect to location.

E. ***Econometric specification: Spatial and time-differencing***

Denote by e_{it} the employment of establishment i at time t. As can be seen from equation (4), employment will depend on the establishment's productivity effect, the wage rate and the local cost of capital. Let us consider each of these in turn. We will assume that the productivity effect has both a location and establishment specific component. We assume that the location specific component can be split in to two effects that occur at two different spatial scales. The first is a fixed-effect at the jurisdictional level. For establishment i located in jurisdiction $a(i)$, this jurisdiction effect is $\gamma_{a(i)}$. The second local effect is time-varying and is specific to the site that the establishment occupies. This site specific effect is denoted $\theta_{z(i)t}$. We assume that, independent from these location effects, the establishment also experiences an establishment specific productivity effect that is captured by a time-invariant establishment fixed-effect μ_i. We also allow for other observable time varying establishment variables, X_{it} to impact on employment. For the moment, the only variable that we include in X_{it} is the wage faced by the establishment, but later work will allow for additional factors. Finally the establishment faces a local cost of capital $r_{a(i)}$. We assume that the cost of capital at time t, r_t, is constant everywhere except for the fact that it is subject to a locally varying tax applied at business rate $b_{a(i)t}$. Thus, $r_{a(i)t} = b_{a(i)t} + r_t$. Assuming that the relationship is log-linear[3]:

$$e_{it} = \alpha r_{a(i)t} + \beta X_{it} + \mu_i + \gamma_{a(i)} + \theta_{z(i)t} + \epsilon_{it} \tag{5}$$

where α captures the effect of local taxation on employment and β is a vector of parameters that capture the effect of time-varying establishment specific observable variables. Notice that estimating this equation directly using OLS and ignoring the unobservable effects will give inconsistent estimators of the effect of both α and β. To get consistent estimators we need to eliminate the unobservable establishment and jurisdictional effects. To do this, we first difference with respect to time.[4] Denoting Δ_t as the first difference operator with respect to time, this gives us:

$$\Delta_t e_{it} = \alpha \Delta_t r_{a(i)t} + \beta \Delta_t X_{it} + \Delta_t \theta_{z(i)t} + \Delta_t \epsilon_{it} \tag{6}$$

where we have used the fact that $\Delta_t \mu_i = \Delta_t \gamma_{a(i)} = 0$. Now, define $\tilde{e}_{it} \equiv \Delta_t e_{it}$ and similarly for all other variables and we can rewrite equation (6) as:

$$\tilde{e}_{it} = \alpha \tilde{r}_{a(i)t} + \beta \tilde{X}_{it} + \tilde{\theta}_{z(i)t} + \tilde{\epsilon}_{it} \tag{7}$$

Note that we still cannot get consistent estimators of α and β from this equation if changes in the unobserved site specific variables $\tilde{\theta}_{z(i)t}$ are correlated with any of the other explanatory variables. To solve this problem, we proceed as follows. Define Δ_d as the spatial difference operator which takes the difference between each establishment and any other establishment located at distance d from that establishment.[5] Applying this spatial difference operator to (7) gives:

$$\Delta_d \tilde{e}_{it} = \alpha \Delta_d \tilde{r}_{a(i)t} + \beta \Delta_d \tilde{X}_{it} + \Delta_d \tilde{\theta}_{z(i)t} + \Delta_d \tilde{\epsilon}_{it} \tag{8}$$

[3]Or equivalently, take the log-linearisation of the non-linear relationship around the equilibrium point.

[4]Another possibility is to condition out the variable means to give the within estimator. For simplicity, we only consider time-differencing here. However, below we report results for both time-differencing and within estimation.

[5]Assume for the moment, that there is only one such establishment. We outline the details of the way we actually select neighbours below.

Now, we impose a crucial identifying assumption: Site specific effects change smoothly across space. That is, for d sufficiently small $\Delta_d \tilde{\theta}_{z(i)t} \approx 0$. Noting, also that taxes will be the same for establishments within the same jurisdiction this give us:

$$\Delta_d \tilde{e}_{it} = \beta \Delta_d \tilde{X}_{it} + \Delta_d \tilde{\epsilon}_{it} \tag{9}$$

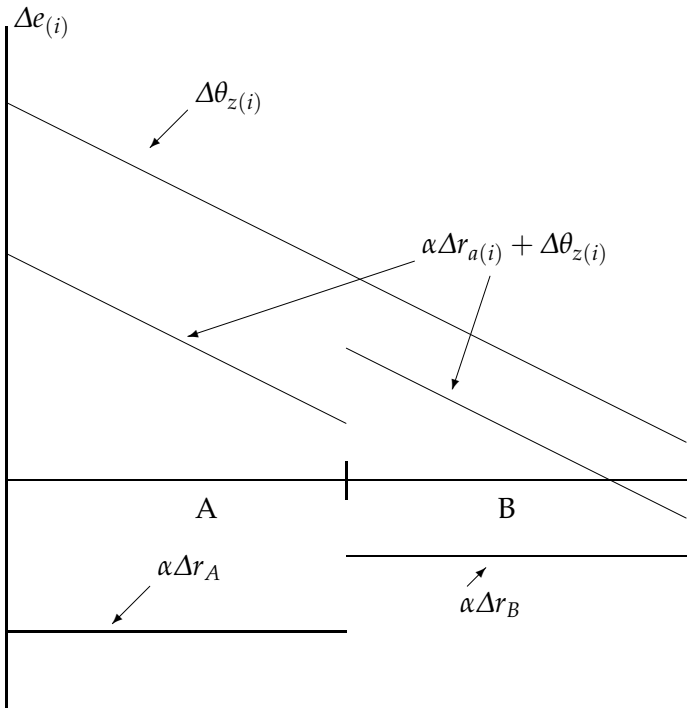
for establishments in the same jurisdiction and:

$$\Delta_d \tilde{e}_{it} = \alpha \Delta_d \tilde{r}_{a(i)t} + \beta \Delta_d \tilde{X}_{it} + \Delta_d \tilde{\epsilon}_{it} \tag{10}$$

for establishments across jurisdictional boundaries. This shows that we can use neighbouring establishments located across jurisdictional boundaries to identify the effects of local taxation. We can also use neighbouring establishments within the same jurisdiction to improve our estimates of the effect of establishment specific variables. Of course, we cannot use them to identify the effects of local taxation because establishments within the same jurisdiction face the same tax rate.

The easiest way to understand how the methodology works is to picture two neighbouring jurisdictions (A, B) as in the figure below. Assume that the increase in the site specific effect is highest at the left hand end of A and lowest at the right hand end of B. The line $\Delta\theta_{z(i)t}$ shows the effect on establishment employment at each location holding everything else equal. Everything else is not equal, however. Assume that jurisdictions base their tax increases on the *average* change in site characteristics in their jurisdiction.[6] Jurisdiction A sees larger increases in taxes than jurisdiction B. The impact on employment (again ceteris paribus) is shown as $\alpha\Delta r_{a(i)}$. Notice, that we have assumed that the impact of site specific effects tends to outweigh the increase in taxation, so that *on average* employment in A increases faster than employment in B. Thus, even after conditioning out establishment specific effects, it appears that employment is positively related to taxes. Now, however, consider two sites on the border between A and B. By assumption, the establishments experience approximately the same site specific effect. All else equal, they would grow employment by roughly the same amount. However, the establishment in A sees a higher tax increase and partially substitutes away from employment. The overall effect on employment is given by $\alpha\Delta r_{a(i)} + \Delta\theta_{z(i)}$ which is larger for the firm in B than in A. Our procedure compares the growth in employment in the establishment on the boundary in A to the growth in employment in the establishment on the boundary in B. Now, we correctly identify the negative relationship between increased taxation and employment. Of course, this example is just one possibility, but it does serve to emphasise exactly how our methodology allows us to correctly identify the impact of local taxes on employment.

[6]Notice that this assumption about behaviour is consistent with our findings, reported below, about the relationship between establishment specific effects and taxation. Jurisdictions with higher productivity firms tend to charge higher taxes.



To summarise, we use the panel dimension of our data to remove establishment and jurisdiction fixed-effects. We then identify establishments with similar site specific effects but that face different tax rates. These are establishments that are located close to one another but in different jurisdictions. We use these establishments to identify the impact of local taxation on employment. We adopt a similar approach to studying the impact of local taxation on the entry and exit decisions of establishments.

F. ***Interpreting the results***

Before proceeding, we make a number of points arising from the way that we model and estimate the impact of local taxation. First, we could extend the model to incorporate other factors of production. Taxes on capital could clearly cause establishments to change the amount of these other inputs that they use, which in turn could impact on employment through changes to the marginal product of labour. These omitted inputs mean we need to be cautious about the interpretation of our results. If the price of these other factors does not vary across location, then our results capture both the direct and indirect effect of taxes on capital. If the price of these other factors does vary across locations then the differences across locations should be captured by the time varying local effects.

A second issue relates to the interpretation of the establishment specific variables (X_{it}). In the specification derived from the model, wages are the only establishment specific variable that enter. Several comments are in order. If establishment are identical and workers are mobile then neighbouring establishments should pay the same wage and wages should thus drop out of the specification when we time and space difference (i.e they should not enter $\Delta_d \tilde{X}_{it}$ in equation (9)). Of course, neighbouring establishments may well not be identical, so we may still want

to include wages in equation (9) to allow for these differences. We may also want to include establishment specific variables other than wages to capture time varying differences in technology across establishments. These variables may also help us capture the influence of adjustment costs on the impact of local taxation on employment.

G. *Estimation issues*

A number of estimation issues remain to be tackled in future work. First, time and space differencing have implications for the error structure which we have not allowed for in our current specifications. As usual, our estimates should be consistent, but we still need to correct the standard deviation of our estimated coefficients. Also important is allowing for establishments that are part of the same multi-plant firm. We do have information on whether this is the case and should be able to correct for this in future versions of the paper.

A second issue relates to the endogeneity of local tax rates ($r_{a(i)t}$). Political variables, for example the party affiliation of the jurisdictional authority should provide suitable instruments, but we are still in the process of constructing the relevant data. An institutional reform that we discuss further below should also help with this endogeneity issue

3. Data

To implement our methodology, our data needs to satisfy a number of requirements. First, we need to have a panel of individual establishment level data. Cross-sectional data or spatial unit aggregates (e.g. state or country data) do not allow us to first difference to remove establishment and jurisdiction-specific effects. We then need to be able to precisely locate these establishments so that we can identify which pairs of establishments are neighbours that lie across jurisdictional boundaries. Finally, once we have identified these establishments we need to identify a local tax which is time-varying. We would prefer this local tax to be economically significant to increase the chances of detecting any impact on location and employment decisions. Data satisfying all of these requirements is available for the UK for the ten year period from 1984 to 1994. We first describe the establishment level data set we use before turning to details of the particular local tax that we consider.

A. *Production data*

Our empirical analysis uses exhaustive establishment level data from the 1984 to 1994 Annual Respondent Database (ARD) which is the data underlying the Annual Census of Production in the UK.[7] Collected by the Office for National Statistics (ONS), the ARD is an extremely rich data set which contains information about all UK establishments (see Griffith, 1999, for a detailed description of this data). We restrict ourselves to production establishments in manufacturing industries using the Standard Industrial Classification (SIC) 92 (SIC15000 to 36639) for the whole country except Northern Ireland. For every establishment, we know its postcode, five-digit industrial

[7]This description of the ARD draws extensively on Duranton and Overman (2002)

classification, and number of employees. In further work, if we want additional information on establishment specific variables, we will need to restrict ourselves to establishments that are part of a sub-sample of 'selected' firms. These are the firms that are requested to make a detailed return in any year and are generally larger. The precise sampling frame for selected firms can be found in Griffith (1999).

The postcode is particularly useful for locating plants. In the UK, postcodes typically refer to one property or a very small group of dwellings. Large buildings may even comprise more than one postcode. See Raper, Rhind, and Shepherd (1992) for a complete description of the UK postcode system. The CODE-POINT data set from the Ordnance Survey (OS) gives spatial coordinates for all UK postcodes. This data is the most precise postcode geo-referencing data available for the UK. Each Code-Point record contains information about its location, and about the number and type of postal delivery points. By merging this data together with the ARD we can generate very detailed information about the geographical location of all UK manufacturing establishments. In so doing, we could directly establish the Eastings and Northings for around 90% of establishments. These give the grid reference for any location taking as the origin a point located South West of the UK.

The main problem for the remaining 10%, for which the postcode could not be matched with spatial co-ordinates, relates to postcode updates. These take place when new postcodes are created in a particular postcode area. Unfortunately, this could be a source of systematic rather than random errors as wrong postcodes will be reported more frequently in areas where an update recently took place. To reduce this source of systematic error to a minimum, we checked our data against a data set of postcode updates. This left us with a small percentage of establishments that could not be given a grid reference. We believe that the missing establishments that we could not match with CODE-POINT truly reflect random errors due to reporting mistakes. For all but a tiny percentage of matched establishments the OS acknowledges a potential location error below 100 metres. For the remaining observations, the maximum error is a few kilometres.

B. ***Local taxation***

The local tax that we consider is a property tax on non-residential property known as the UK business rate. During most of our sample period, these property tax rates varied over time and jurisdictions. They were, however, subject to a major reform introduced in the sixth year of our study period (1990) which eliminated jurisdictional variation from 1992 onwards.

UK business rates are a local property tax levied on the *occupiers* (not owners) of non-domestic properties according to the rental value of the property that they occupy. During the period that we are considering ($1984 - 1994$) these taxes represented a considerable tax on business. To give some idea of the economic significance of the tax, note that in 1992 business paid £13bn in local rates. A figure that was almost equal to the £15bn that they paid in corporation tax. Very little, if any, of this money, was used to finance local services for businesses as the main activities of UK local authorities relate to household services such as education and refuse collection.

In the first six years of our sample period tax rates were set locally. The tax a business paid then depended on the value of the buildings that it occupied. The tax rates were known as 'rate poundages' and the value of the buildings as the 'rateable value'. The tax rate was changed yearly

Specification	Average tax rate	Standard deviation	Ratio highest to lowest
Before reform (1987-88)	227.8	32.4	3.0
After reform (1990-91)	34.8	0.0	1.0

Table 1. Local taxation rates

and decided at the local authority level.[8] Rateable values of buildings were fixed in 1973 and did not change until 1990. 1990 saw two major reforms to the rates system. First, properties were revalued to their 1990 value. Second, a uniform business rate was imposed across all local authorities thus removing any local variation. This uniform business rate was chosen to be revenue neutral taking in to account the revaluation of properties that occurred. Thus, given that the average property value increased almost eightfold, the uniform business rate was approximately 1/8th of the pre-reform average. Clearly, these changes could have very large effects on the taxation paid by individual properties. These reforms were introduced with a two year transition period, so that rates were only equalised by 1992.

The first row of Table 1, taken from Bond, Denny, Hall, and McCluskey (1996), shows the extent to which taxes varied in the pre-reform period. The second row reflects the effect of both the revaluation on average tax rates and the fact that local variation no longer existed.

The reform of the tax system in the middle of the period actually helps us in our attempt to identify the impact of local taxation. Because the reform was driven by the national government it means that the change in tax rates as authorities move to the uniform business rate are often large and essentially independent of contemporaneous changes in local economic conditions (including establishment employment). These large, essentially exogenous changes, should help with identification and should also mitigate endogeneity problems with regard to local tax rates. We use this fact below when we consider 'long differences' in terms of employment growth rates.

4. Results

Our basic regression uses log employment as the dependent variable. Explanatory variables are (log) local tax rate, (log) wage rate. We also include industry-year dummies where appropriate. We present results for four different specifications. In the first, we estimate equation (5) using OLS. The second and third are both based on equation (7). In the second, we use within estimation to remove the establishment specific and jurisdiction fixed-effects. In the third, we time-difference rather than using the within estimator. The fourth specification is estimated using our difference in difference estimation. The results that we report use a distance threshold of 2 kilometres to identify neighbours.

Looking at the OLS results first, we see that there appears to be a positive significant effect of both wages and tax rates on employment. However, simple OLS ignores both establishment and site specific characteristics. As discussed above, within estimation and first differencing can

[8]There are roughly 500 local authorities. In contrast to the US these local authorities cover the entire area of Great Britain, i.e. there are no unincorporated land areas.

Specification	Tax rate	Wage rate
OLS	0.213*	0.676*
	(0.036)	(0.022)
Within	0.080*	-0.280*
	(0.019)	(0.013)
First difference	0.027	-0.329*
	(0.027)	(0.016)
Difference-difference	-0.043*	-0.253*
	(0.013)	(0.015)

Notes: Check number of observations. Standard errors in brackets. * denotes significance at the 5% level.

Table 2. Regression results

be used to remove establishment specific unobservables. Results for the impact of wages now show that higher local wages cause establishments to substitute away from labour. This shows the importance of controlling for unobserved establishment specific effects. Jurisdictions with higher wages host establishments with higher establishment specific productivity effects. Thus, in the cross section it appears that higher wages are positively related with establishment employment. Once we condition out these establishment specific effects, however, increasing wages have a negative impact on employment growth in line with the theory (see (4)).

Taxes still have a positive effect on employment in both the within and first difference specification (although the coefficient is only significant in the former specification). This implies that increasing taxes on capital (in this case buildings) is associated with increasing local establishment employment. That is, that the 'substitution effect' away from capital outweighs the direct 'income effect' on overall establishment size.

However, as discussed above, both these specifications deal with establishment heterogeneity, but not the issue of site heterogeneity. The fourth specification shows that allowing for these unobserved site specific effects dramatically changes our conclusions. Now, we see that both wages and tax rate have a significant negative impact on employment.

5. Conclusion

Our preliminary results point to the importance of controlling for both unobserved establishment specific and unobserved site specific characteristics. Simple OLS results suggest a positive relationship between employment and both wages and taxes. Allowing for unobserved establishment specific effects we find a negative relationship between wages and employment. The relationship between employment and taxes appears to positive (although not necessarily significant). Finally, allowing for unobserved location specific effects we find a negative significant relationship between employment and both wages and taxes. As discussed in the text, further work remains to be done on refining our methodology, but our initial results show that time-space differencing can be a useful way of controlling for establishment and location heterogeneity.

References

Baldwin, Richard E., Rikard Forslid, Philippe Martin, Gianmarco I. P. Ottaviano, and Frederic Robert-Nicoud. 2004. *Economic Geography and Public Policy*. New Jersey: Princeton University Press.

Bartik, Timothy. 1991. *Who benefits from state and local economic development policies?* Kalamazoo, Michigan: W. E. Upjohn Institute for Employment Research.

Bond, Stephen, Kevin Denny, John Hall, and William McCluskey. 1996. Who pays business rates? *Fiscal Studies* 17(1).

Duranton, Gilles and Henry G. Overman. 2002. Testing for localisation using micro-geographic data. Discussion Paper 3379, Centre for Economic Policy Research.

Gordon, Roger. 1983. An optimal taxation approach to fiscal federalism. *Quarterly Journal of Economics* 98(4):567–586.

Griffith, Rachel. 1999. Using the ard establishment level data: an application to estimating production functions. *Economic Journal* 109(456):F416–F442.

Guimaraes, Paulo, Octavio Figueiredo, and Douglas Woodward. 2004. Industrial location modeling: Extending the random utility framework. *Journal of Regional Science* 44(1).

Head, C. Keith and Thierry Mayer. 2004. Market potential and the location of Japanese investment in Europe. *The Review of Economics and Statistics* 86(4).

Holmes, Thomas J. 1998. The effect of state policies on the location of manufacturing: Evidence from state borders. *Journal of Political Economy* 106(4):667–705.

Raper, Jonathan F., David W. Rhind, and John W. Shepherd. 1992. *Postcodes : The New Geography*. Harlow, Essex: Longman Scientific and Technical.

Tiebout, Charles. 1956. A pure theory or local expenditures. *Journal of Political Economy* 64(5):416–424.

Wildasin, David. 1988. Nash equilibria in models of fiscal competition. *Journal of Public Economics* 35(2):229–240.

Wilson, John. 1986. A theory of interregional tax competition. *Journal of Urban Economics* 19(3):296–315.

Zodrow, George and Peter Mieszkowski. 1986. Pigou, Tiebout, property taxation and the underprovision of local public goods. *Journal of Urban Economics* 19(3):356–370.