Capital Mobility, Agglomeration and Corporate Tax Rates: Is the Race to the Bottom for Real?

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* Views expressed are those of the individual authors and do not necessarily reflect official positions of De Nederlandsche Bank.
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Abstract
Based on a data set for 19 OECD countries for the period 1981-2001, we estimate the impact of capital mobility (FDI) on corporate tax rates. So far the literature has been concerned with the related but rather different question as to the sensitivity of FDI to tax rates. Our paper takes an opposite perspective and asks what the impact of capital mobility is on corporate tax rates. In doing so, we explicitly take the role of agglomeration into account. In theory, core countries can afford a higher tax rate compared to peripheral countries. In our estimation strategy, we instrument capital mobility to deal with reverse causality. The main conclusion is that increased international capital mobility implies a lower corporate tax rate. But we also find that agglomeration matters: core countries have a higher corporate tax rate. If there is a race to the bottom, it seems that it is more real for some countries than others.

Key words: new economic geography, corporate income taxation, capital mobility

JEL Codes: F12, F20, H32

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1. Introduction

In recent years capital has become increasingly mobile internationally: most of the remaining capital controls and restrictions on, for instance, the activities of multinational firms have been removed by now. One side effect of the increased international capital mobility is that it provides opportunities for multinational firms to minimise or even avoid paying corporate income taxes. In this setting, many people fear that globalisation, and in particular increased capital mobility, forces national governments to decrease the tax burden on the mobile production factor, capital. In doing so, tax competition across governments is intensified. This may result into a “race to the bottom” in corporate income taxes. Some critics even go a step further and believe that ultimately the redistributive function of the welfare state is threatened by footloose capital.

These concerns are, at least to some extent, fuelled by the actual development of the most obvious and readily available measure of corporate income taxes, the statutory tax rate. In recent years almost every OECD country has reduced the statutory tax rates. Also economic theory shows that the concern for a race to the bottom is not unfounded. A review of the tax competition literature leads to the main result that (under some restrictive assumptions) an increase in capital mobility could go along with a decrease of the corporate tax rate and an under-provision of public goods. That is not to say that a race to the bottom is inevitable though. Several other theoretical contributions relax one or more restrictive assumptions of the basic model and reach different or even opposite conclusions. In particular, when countries are asymmetric, because of agglomeration or clustering of economic activity, an increase in capital mobility could instead result into a “race to the top” (Baldwin and Krugman, 2004).

Given these opposite predictions from theory, we agree with Krogstrup (2003, 2004a, 2005) that the question how capital mobility affects corporate income taxation is ultimately an empirical one. The aim of this paper is therefore to investigate the impact of capital mobility on corporate tax rates. Only a limited number of studies investigate this issue; most of the literature is concerned with the related but rather different issue as to the sensitivity of FDI to tax rates. Our paper takes an opposite perspective and asks what the impact of capital mobility is on corporate tax rates. This paper contributes to the literature in several ways. First, we investigate explicitly the role of agglomeration effects in the determination of a country’s tax rate. The basic idea is that higher capital mobility may lead to agglomeration of economic
activity; and this may go along with a higher corporate tax rate. Second, several indicators for agglomeration are used: varying the distance decay and including a “real” measure of trade costs improves on the existing analysis of agglomeration effects. Finally, because there is a potential source of endogeneity in these types of regressions, we use an instrumental variable approach, in which the Golub-index on capital restrictions will serve as an instrument for international capital mobility. Our first main conclusion is that increased international capital mobility puts a downward pressure on the corporate tax rate. This conclusion also holds when agglomeration variables are added to our empirical model. Our second main conclusion is that agglomeration does matter: we find evidence that more centrally located or agglomerated countries have a higher corporate tax rate.

The paper is organized as follows. We start in section 2 with a brief discussion of the main theoretical views on the relationship between corporate tax rates and capital mobility. In addition, we introduce the main hypotheses that will subsequently be tested in the empirical part. Section 3 introduces our data set and provides some descriptive statistics for our main variables of interest. Section 4 discusses estimation issues (like the endogeneity of capital mobility), presents the empirical model and discusses our main findings. Finally, section 5 concludes.

2. Theoretical background and main hypotheses

2.1 Corporate tax rates and capital mobility

Fears about the negative effects of increased capital mobility on the capital tax rate and the provision of public expenditures can be given a theoretical foundation. Using the standard tax competition literature, it is quite easy to show that an increase in capital mobility could go along with a decrease of the source based capital tax rate and an under-provision of public goods. The seminal contribution here is the model by Zodrow and Mierzkowski (1986); see also the survey paper by Wilson (1999). Assume a two country model with two factors of production (capital and labour), where labour is immobile but capital is mobile between the two countries. Production takes place under perfect competition and constant returns to scale. Firm output can be traded freely, that is to say, there are no trade costs, thereby ensuring perfect goods market integration. It is also assumed that the government provides a public good, which is financed with a source based tax on capital. Given symmetry in every other respect (e.g. technology, preferences, country size), it can be shown that any increase in the
degree of economic integration, which coincides in this model with an increase in the degree of capital mobility, will imply a lower tax rate in both countries.

The equilibrium tax rate set by the government does not only fall when capital mobility increases, the resulting equilibrium tax rate is also lower than the socially optimal tax rate, and the gap between these two tax rates widens, as the degree of international capital mobility increases. This last result seems to vindicate those who argue that increased factor (here, capital) mobility leads to a race to the bottom. The standard tax competition model is, however, based on some rather strong assumptions (see also Krogstrup, 2002 and Sørensen, 2006). In setting their tax rate, governments are assumed to play a non-cooperative game. When one would allow for tax policy coordination for instance, it is no longer clear why increased capital mobility needs to go along with lower tax rates. In addition, when using the tax revenues to provide for public goods that benefit the mobile production factor, Baldwin and Forslid (2002) show that increased factor mobility will not lead to a race to the bottom. Also, when the tax rates on (mobile) capital and (immobile) labour are allowed to differ, the “race to the bottom” result is no longer inevitable, since governments, when confronted with an increase in capital mobility, may simply decide to shift the tax burden to labour. Another reason why increased capital mobility does not need to have a negative effect on the capital tax rate is to be found in the ownership of firms. If it is allowed that firms located in a particular country are owned by domestic as well as foreign owners, it is no longer obvious why increased capital mobility should lead to lower tax rates. In fact, increased foreign ownership per se provides countries with the incentive to increase tax rates, as it introduces the possibility of tax exportation (see Huizinga and Nicodème, 2003). The introduction of other asymmetries leads to similar qualifications. Notably, when the two countries differ in size (for instance in terms of their GDP or population), it can be shown that the larger country will have a higher equilibrium tax rate. In the standard tax competition literature (see Bucovetsky, 1991), this size effect is the result of the fact that a large country suffers relatively less when it has a higher tax rate in terms of capital outflows than a small country. For any given capital flow between a large and a small country, the introduction of a tax rate differential always has a larger impact on the smaller country.

More fundamentally, asymmetries between countries need not necessarily to be the result of exogenous differences in country size, as is the case in the standard tax competition literature, but they may very well be the endogenous outcome of the location choices of the mobile
factors of production. The question of how the spatial distribution of economic activity comes about is the main feature of the new economic geography literature (NEG); see Fujita, Krugman and Venables (1999). For our present purposes, the point to emphasize is that NEG models provide an alternative analysis of the tax competition issue. In a two country NEG model, the combination of internal increasing returns to scale and the existence of trade costs open up the possibility that the mobile production factor(s) will agglomerate in one of the two countries. The key insight here is that this agglomeration process is self-reinforcing: in equilibrium, the factor rewards for the mobile factors of production are higher in the “agglomeration” compared to the “periphery”. This means that by being located in the agglomerated region, the mobile factors of production receive an agglomeration rent, while such a rent is absent in the standard, neoclassical tax competition models.  

As shown extensively by Baldwin et al (2003, chapter 15) and Krogstrup (2004b), such an agglomeration rent has important implications for the relationship between capital mobility and capital tax rates. With a positive agglomeration rent and perfect capital mobility, the core country, that is the country where (most) capital is located, can allow itself to have a higher tax rate than the peripheral country as long as the agglomeration rent exceeds the tax differential. Attempts by the peripheral country to lure capital away from the core country by decreasing its tax rate, will not lead to a re-location of capital as long as the tax gap falls short of the agglomeration rent. Assuming complete (!) agglomeration, Baldwin and Krugman (2004) use a two country NEG model to show that even with full capital mobility a race to the bottom will not materialise.  

Agglomeration is, however, not the only equilibrium outcome in such a NEG model. Typically, it is only when trade or transportation costs fall below a certain threshold level that agglomeration results. When trade costs are above this threshold level, a spreading equilibrium occurs where the mobile factors of production—here: capital—are evenly spread across locations. In that case, the NEG model leads to a similar conclusion as the standard tax competition model with respect to the effects of capital mobility on capital tax rates (see also Figure 1 in Sørensen, 2006).

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2 In these models, given a decreasing marginal productivity of capital, an increase in the tax rate in one region triggers a capital outflow to the other region (because the net return is higher in the other region). The outflow will result in an increase in the gross return to capital in the tax-increasing region, and a fall in the gross return in the other region. Fernandez (2005) develops a model with agglomeration where external increasing returns ensure that governments set a corporate tax rate that is even lower than in the absence of agglomeration effects.  

3 This observation was made previously by Kind et al (2000), Ludema and Wooton (2000) and Andersson and Forslid (2003). The latter study, see also Baldwin and Forslid (2002) and Brakman et al (2005), also includes the role of government spending.
2.2 Hypotheses

The main message of the NEG literature for our present purposes is that the relationship between capital mobility and capital tax rates is more complicated than the standard tax competition model predicts. In particular, and assuming that trade costs are not too high, this relationship will depend on the degree of agglomeration. As emphasized by for instance Baldwin and Krugman (2004), the NEG view on capital mobility and tax competition is not merely a theoretical curiosity. The stylized facts on capital mobility and capital tax rates are not or, at least, not always in accordance with the notion of a race to the bottom as predicted by the standard tax competition model. For the case of the EU countries, Baldwin and Krugman (2004) even argue that a race to the top seems to be more in line with the facts. De Mooij et al (2005, p. 87) argue for instance that in the 1980s and 1990s, periods associated with increased capital mobility, the tax burden on capital in the OECD countries actually increased. There is no conclusive evidence, however, to suggest that this has indeed happened. What is clear is that for almost every OECD country statutory income tax rates have come down from the 1980s onwards. However, this decline in statutory tax rates has been accompanied by a broadening of tax bases. As a result, other measures of corporate taxes show a rather blurred picture with respect to their development over time. Devereux, Griffith and Klemm (2002) conclude, for instance, that effective marginal rates have remained rather stable. The same goes for tax revenues on corporate income as a % of GDP, whereas effective average tax rates have come down. A main reason for this conflicting empirical evidence is to be found in the sample period and measurement differences with respect to capital mobility and the corresponding tax rate. Additionally, the mixed empirical evidence suggests that the relationship between capital mobility and tax rates might be more complicated than the standard tax competition model suggests. It is for this reason that the main objective of our empirical inquiry will be to estimate the impact of capital mobility on capital tax rates while controlling for agglomeration effects that are stressed by the NEG literature.

There is no shortage of empirical studies on the relationship between capital mobility and capital tax rates (see Hines, 1999). These studies typically find that lower corporate tax rates, be it statutory/effective or marginal/average corporate tax rates, are associated with higher levels of FDI. In their meta-analysis of these studies, De Mooij and Ederveen (2001) find that “the mean value of the tax rate elasticity in the literature is around -3.3, i.e. a 1% reduction in the host-country tax rate raises foreign direct investment in that country by 3.3%” (De Mooij and Ederveen, 2001, p. 5). Despite a considerable variation in this tax rate elasticity across
studies, this finding strongly suggests that in making FDI decisions, firms are not indifferent to (cross-country differences in) corporate tax rates. Note that these studies try to establish whether the corporate tax rate has an effect on FDI. The implied causality runs from tax rates to FDI. The tax competition literature, and also the “race to the bottom” debate are, however, basically concerned with exactly the opposite question: what is the effect of increased capital mobility (for instance measured by increased FDI) on tax rates? This question is also the starting point for the present paper and in line with Krogstrup (2004a, pp. 5-6) we observe that the abovementioned finding of a significant negative tax elasticity of FDI is a necessary but not sufficient condition for the empirical analysis of tax competition. It is necessary because without FDI being sensitive to tax rates, the tax competition debate makes no sense to start with. It is not sufficient because the negative tax elasticity does not tell us if the degree of capital mobility is one of the (policy induced) determinants of the tax rate on capital. This makes clear that any empirical analysis of the effects of capital mobility on the tax rate has to take the problem of reverse causality into account. In section 4, we will explain how we dealt with this crucial issue.

Before introducing our data set and presenting the estimation results, it is useful to state the main hypotheses that follow from our brief overview of the tax competition literature:

- An increase in the degree of capital mobility will lead to a decrease of corporate tax rates (standard tax competition effect)
- Agglomeration matters: more agglomerated countries have higher corporate tax rates (agglomeration effect)
- The effect of capital mobility on corporate tax rates may vary across time or sub-groups (core vs. periphery); the level of trade costs will be important here.

The first two hypotheses follow from the preceding discussion. The third hypothesis is straightforward to the extent that it may always be the case that the relationship between the variables of interest is not constant across sub-samples. In this case, however, theory provides us with an additional argument to investigate this: the NEG literature predicts that when economic conditions change, notably the level of trade costs change, the relationship between

4 Some studies go further and aim to bring out the special mechanisms through which taxes influence FDI. In this context, Razin et al (2006) for instance find that the source-country tax rate works primarily on the selection process, whereas the host-country tax rate affects mainly the magnitude of FDI, once they occur.

5 Krogstrup (2004a) identifies two more necessary conditions for tax competition to be taking place. First, capital must be mobile across borders and second, governments should be able to actively use the tax instrument and to react to changes in other countries’ tax rates.
capital mobility and tax rates may change too. To see this, note, first, that the level of trade costs is crucial in determining the balance between agglomeration and spreading forces and, second, that it is the extent of agglomeration that determines the scope for taxation. These observations combined lead to the conclusion that the relationship between capital mobility and tax rates depends upon the level of trade costs. It is this relationship that gives an additional impetus to the third hypothesis. In particular, see again Baldwin et al (2003) for a theoretical foundation from the NEG perspective, one expects that the negative correlation between capital mobility and the tax rate falls and the agglomeration effect ceteris paribus gets stronger, when trade costs drop below a certain threshold level.

To date there are still very few studies that try to assess the effect of changes in capital mobility on corporate tax rates and that, in doing so, take agglomeration effects into account. Krogstrup (2003, 2004a) is a notable exception. Our study not only differs from her work in terms of the sample and methodology employed but also in terms of the hypotheses tested. Krogstrup (2003, 2004a) also tests whether there is a downward pressure of capital mobility on corporate tax rates (our 1st hypothesis) but pays less attention to agglomeration effects and the relevance of trade costs (our 2nd and 3rd hypothesis).

3 Data set
The sample used for the panel regression analysis includes annual data for 19 OECD countries and covers the 1981-2001 period. A more detailed description of the full data set, including the control variables and the countries included in our sample, is given in the data appendix. In this section, the attention focuses on the main variables of our empirical analysis. The dependent variable in our empirical inquiry is the corporate income tax rate. Measures of the corporate income tax rate differ widely in the literature. The most obvious and readily available measure is the statutory tax rate, i.e. the tax rate which can be directly constructed from tax codes. This can be a misleading indicator, however, because it pays no attention to the tax base. To deal with this problem, several studies use the average tax rate as a measure for the corporate income tax rate. The main disadvantage of this approach is that it is an ex post measure and as such it is not the appropriate decision variable of the government. Because governments can decide about both the tax rate and the tax base, effective tax burdens are to be preferred in our analysis. Effective tax rates are computed from tax codes

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and measure the tax burden on a hypothetical corporate investment project using tax legislation. When evaluating tax competition pressures empirically, the \textit{average} effective corporate tax rate is the most appropriate measure, because it is this tax rate rather than the marginal one which ultimately matters for the location decision of a firm (Gorter and De Mooij, 2001).

For these reasons we use effective average tax rates (EATR) in our empirical analysis. Devereux, Griffith and Klemm (2002) have computed the (base case) EATR for projects earning positive economic profits. Figure 1 shows for the 19 countries in our sample the unweighted annual average EATR and the cross-country standard deviation. It follows that the EATR fell from around 40\% in 1981 to around 28\% in 2001 and that the EATR has converged across countries over the past two decades. The latter is reflected in a gradually decline of the standard deviation. Despite this convergence, there are still significant differences between countries: in Ireland the EATR equalled 7.7\% in 2001, while in Japan it amounted to 35.8\%.

Our main explanatory variable is the degree of international capital mobility. Various variables have been used in the literature as proxies for the degree of international capital mobility. First, under the assumption that increases in capital mobility result in increases in cross border investment, Swank (1998) and Garrett and Mitchell (2001) use the \textit{volume} of FDI stocks or flows as a measure of capital mobility.\footnote{Whether stocks or flows are the conceptually preferred measure to use is disputable, see Krogstrup (2003).} In fact, this is a quite standard way of measuring the degree of capital market integration and it is analogous to measuring goods market integration with trade volumes. O’Rourke and Williamson (1999) suggest however to use either a price approach (by means of covered interest rate differentials) or a macro approach (the correlation between national savings and investment following Feldstein and}
Horioka, 1980), both of which are less useful for our present purposes. The tax competition debate is not so much concerned with the relationship between the (re-) location of portfolio capital and taxes but primarily with the relationship between the mobility of real or “bricks and mortar” capital and taxation and this part of international capital mobility is aptly summarized by FDI. Another approach to measuring capital mobility is followed by Krogstrup (2003) and Swank (1998). These studies use indices of the liberalisation of capital markets based on the legal framework governing international capital transactions.

Two measures of international capital mobility have been chosen for the present study. First, we use the sum of inward and outward FDI flows as a percentage of gross fixed capital formation (GFCF). Our choice to express the FDI flows in terms of GFCF is motivated by the availability of the data: the UNCTAD provides these data directly at their website. Moreover, it turns out that – apart from level differences – it makes no qualitative difference whether we express FDI flows in terms of GFCF or in terms of GDP, as both measures show a similar development over time. Figure 2 depicts the development of our (unweighted) measure of capital mobility. It confirms the general trend that international capital markets have become much more integrated in recent decades. At the same time, this measure shows that the standard deviation has increased over time, suggesting that the dispersion in the degree of international capital mobility has increased.

Second, we use the so-called Golub-index as a measure for the (legal) restrictions placed on international capital mobility. This index was assembled by the OECD to summarise and quantify mainly statutory barriers to inward FDI and their evolution over time. The main reason to use this index is that it is thought to be correlated with international capital flows (here, FDI), but at the same time it is unlikely that the Golub-index is determined by the corporate tax rate. This implies that this index qualifies as an instrument: any effect of this index on the tax rate runs entirely through the capital mobility variable (see section 4). The development of the Golub-index, depicted in Figure 3, shows that the liberalisation of FDI flows has been substantial over the past two decades for most countries, except the United States and Japan (which had relatively low statutory restrictions to begin with). There are,

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8 The correlation coefficient between FDI flows/GDP and FDI flows/GFCF is 0.99.
9 Admittedly, this figure exaggerates the increase in capital mobility, as it includes the FDI data for 1999 and 2000, which were years with a very high level of FDI flows. Nevertheless, when we extend our sample period to include the years 2002–2004, the degree of capital mobility, as measured by FDI flows, still shows a very clear increase over time.
However, significant differences between countries (a higher score on this index means more restrictions on FDI flows). The most open countries are in Europe, while — according to this index — Canada and Australia are the countries with the highest levels of restrictions. The development of the standard deviation indicates that the dispersion in the degree of openness to inward FDI flows has narrowed (not shown here).

Finally, in order to test for the relevance of agglomeration, some measure of agglomeration is needed. The empirical literature on the new economic geography suggests many variables which could function as a proxy for agglomeration. We use several versions of a market potential function as representing the agglomeration effect. The main reason to do so is that the market potential variable provides information on (relative) location by including distance and, as such, really touches upon the main idea of the new economic geography that relative location matters. The typical market potential function measures the potential of a location as a weighted sum of the purchasing power (GDP) of all other locations, with the weights being a declining function of distance: \( MP_i = \sum_j \frac{gdp_j}{D_{ij}^{\beta}} \), where \( i \) and \( j \) are country indices, \( D_{ij} \) is the distance (in km.) between countries \( i \) and \( j \) and \( \beta \) is the distance decay parameter. We add two kinds of adjustments to the typical market potential function, so that we end up with six versions of the basic market potential variable. First, we vary the so-called distance decay parameter \( \beta \). Even though \( \beta = 1 \) is quite often found in market potential studies or related gravity studies of international trade (see Head and Mayer, 2000), there are also estimates that actually estimate the distance coefficients in a full-blown NEG model. These studies suggest that \( \beta \) may differ significantly from one (see Crozet, 2004 or Brakman, Garretsen, and Schramm, 2005). By varying \( \beta \) we can vary the “punishment” countries face for being relatively isolated. To see this, note that when \( \beta \) is set at 0.5, relatively remote countries are punished less for being relatively isolated, whereas when \( \beta \) is set at 2 relatively remote
countries are punished more for being relatively isolated. As our second adjustment, we correct the typical market potential function of country \( i \) with a measure of trade costs, namely the \( \text{cif/fob} \) ratio: 
\[
TC_i = (\text{cif} / \text{fob})_i \cdot MP_i
\]
The idea is that in NEG models the agglomeration effect is typically defined by the combination or interaction of some market access variable (here, MP) with transportation or trade costs.

Distances are drawn from the CEPII database. In this dataset, distances are calculated following the great circle formula, which uses latitudes and longitudes of the most important agglomerations (in terms of population). The distances incorporate internal distances as well, which implies that the average distance between producers and consumers within a country is taken into account. By incorporating these internal distances we are able to include the GDP of the respective country as well in the market potential. For internal distance we use the proxy 
\[
0.667 \sqrt{\frac{\text{area}}{\pi}}
\]
in which area is the size of a country in km\(^2\) (see Head and Mayer, 2000 for a discussion of this measure for internal distance). The \( \text{cif/fob} \) ratios are calculated from the Direction of Trade Statistics.  

Because importing countries report the value of imports from partner countries inclusive of carriage, insurance and freight (cif) and exporting countries report their value free on board (fob), we first calculated the \( \text{cif/fob} \) ratio between each pair of countries: 
\[
t_{ij} = \frac{\text{cif}_{ij}}{\text{fob}_{ij}}
\]
Next, we averaged for each country the resulting 18 \( \text{cif/fob} \) ratios: 
\[
(\text{cif} / \text{fob})_i = \frac{1}{18} \sum_{j} t_{ij}
\]
Figure 4 depicts the development of our (unweighted) measure of trade cost. It clearly shows that since the 1980s trade costs between countries have fallen.

Table 1 gives the ranking of the countries for two of our market potential variables in two years. Also this table includes the order of ranking of countries’ size uncorrected for distance (measured simply by GDP). For all variables the ranking is in ascending order of magnitude (least agglomerated / smallest countries are ranked first in the table). Several conclusions follow. First, distance, and hence location, is important, as it crucially affects the ranking of countries: the United States and Japan are clearly the largest countries in terms of GDP, but when corrected for distance, Belgium and the Netherlands turn out to be the most

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\(^{10}\) We recognize that there are a number of serious measurement problems with respect to the \( \text{cif/fob} \) ratio, see e.g. Hummels (1999). The broad coverage, in terms of countries and time period, is however an important advantage. Hummels (1999) uses the \( \text{cif/fob} \) measure and arrives at a similar development of the average \( \text{cif-fob} \) ratio as shown by our Figure 4.
agglomerated countries, thanks to the proximity of these two countries to other countries with a relatively high GDP. Second, Table 1 shows that the distance decay parameter $\gamma$ is potentially a relevant parameter, as it crucially affects the ranking of countries. Consider for instance the United States (or Canada): if distance matters more ($\gamma$ rises from 0.5 to 2), the lower is its ranking of the market potential. Finally, Table 1 shows, unsurprisingly, that the ranking of the countries’ market potential is relatively stable over time.

Table 1: Ranking for several agglomeration measures

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<td>FR</td>
<td>UK</td>
<td>UK</td>
</tr>
<tr>
<td>FR</td>
<td>UK</td>
<td>GER</td>
<td></td>
<td>UK</td>
<td>GER</td>
<td>GER</td>
</tr>
<tr>
<td>GER</td>
<td>GBR</td>
<td>JAP</td>
<td></td>
<td>GER</td>
<td>CAN</td>
<td>JAP</td>
</tr>
<tr>
<td>JAP</td>
<td>NET</td>
<td>BEL</td>
<td></td>
<td>JAP</td>
<td>NET</td>
<td>BEL</td>
</tr>
<tr>
<td>USA</td>
<td>BEL</td>
<td>NET</td>
<td></td>
<td>USA</td>
<td>BEL</td>
<td>NET</td>
</tr>
</tbody>
</table>

Not shown in the table is the ranking for our preferred measure of the tax rate, the effective average tax rate (EATR). To get a first idea about the relation between the market potential variables and this tax rate, we computed Spearman’s correlation coefficients. It turns out that the correlation between the EATR and the various market potential variables in 1981 was weakly negative, whereas in 2001 the correlation is strongly positive. This can be explained by the fact that the degree of capital mobility was fairly low in 1981, but high in 2001. The positive correlation coefficient between the EATR and the various market potential variables is a first sign of the agglomeration effect.

The correlation coefficients in 2001 between size and the various market potentials are respectively -0.03 (for $\gamma=2$), 0.07 (for $\gamma=1$) and 0.12 (for $\gamma=0.5$).
4 Estimation results

4.1 Specification and estimation strategy

Before we present our main estimation results, we first explain our estimation strategy. In general terms and in line with section 2, the equation to be estimated is 12:

\[ \text{TAXRATE}_{i,t} = f(\text{CAPMOB}_{i,t}, X_{i,t}, \text{NEG}_{i,t}) \]

where \( i \) and \( t \) are the country- and time-index, and where \( \text{TAXRATE}_{i,t}, \text{CAPMOB}_{i,t}, \) and \( \text{NEG}_{i,t} \) stand for the corporate tax rate, capital mobility, and the New Economic Geography (NEG) or agglomeration proxies, respectively, and \( X_{i,t} \) is a group of control variables.

As we explained in the previous section, the effective average tax rate (EATR) is our preferred measure for \( \text{TAXRATE} \) but we have experimented with other corporate tax burden variables as well. Similarly, our preferred measure for capital mobility is the sum of a country’s FDI inflow and outflow scaled by gross fixed capital formation (\( \text{FDIFLOWS} \)). Here too, we have experimented with alternatives (only in- or outflows; FDI stocks versus flows). Given our emphasis on agglomeration, several forms of the market potential are included as NEG variables. The first three market potential variables are assumed to differ only in the distance decay parameter \( \gamma \), with \( \text{MP1} \) assuming that \( \gamma = 1 \); \( \text{MPH} \) assuming that \( \gamma = 0.5 \) and \( \text{MPD} \) assuming that \( \gamma = 2 \). In addition, a final version of the market potential variable (\( \text{TC}1 \)) includes a direct measure of trade costs, namely the \( \text{cif/fob} \) ratio while setting the distance decay parameter \( \gamma \) at 1.

Finally, for the set of control variables \( X \) we opted for:

- \( \text{SIZE} \), the GDP of country \( i \) as a share of total GDP in our sample;
- \( \text{NEIGHBOUR} \), the average statutory corporate tax rate in all other countries;
- \( \text{LEFT} \), left party cabinet portfolios as % of all cabinet portfolios;
- \( \text{GOVINV} \), fixed government investment as a % of total disbursements.

Out of a larger group of control variables, we picked these control variables for our basic specification because each of these variables represents a different channel of influence on the corporate tax rate. The size variable is fairly straightforward: even the standard tax competition literature predicts that larger countries have higher equilibrium tax rates. The (statutory) tax rate from other countries is included because countries might react to changes

---

12 We assume that the relationship between the corporate tax rate and the explanatory variables is linear. This seems to be an unrealistic constraint, given our NEG perspective. However, one should remember that the relationship between taxes and capital mobility is linear for a wide range of transportation costs in these models. But note that we have estimated a specification with quadratic FDI as well. Although our main results still hold assuming a quadratic function, the main problem is the interpretation of these results.
in each other’s tax rates. This simple notion of tax competition implies that we expect an increase of \textit{NEIGHBOUR} to lead to an increase of the tax rate in country \textit{i}. The political determinants of the corporate tax rate are proxied by \textit{LEFT}, the idea being that left-wing governments ceteris paribus are characterized by higher corporate tax rates. Finally, \textit{GOINV} is included because it captures directly the impact of government actions on the attractiveness of a location. The more the government invests, the higher the corporate tax rate.

Keeping in mind the theoretical discussion in section 2, one immediate problem with any attempt to estimate (1) is that our variable \textit{FDIFLOWS} is endogenous; in particular we must take into account that FDI may be determined by the corporate tax rate. To deal with this, we instrumented \textit{FDIFLOWS} with the Golub-index (Golub, 2003). Our maintained hypothesis is that changes in the Golub-index have a direct impact on the degree of capital mobility but not on the effective average tax rate (\textit{EATR}). The possible impact of a change of legal restrictions on \textit{EATR} will be assumed to be indirect, through the degree of capital mobility. In our view this is a reasonable assumption to make: policy makers change corporate tax rates or tax bases not because of changes in legal restrictions on international capital mobility (here, FDI) but they do so only if the actual capital flows change. The Golub-index seems therefore a useful instrument. It also turned out to be a significant instrument. In our 2SLS estimations, see below, the 1st stage regression results (not shown here) invariably showed that fewer legal restrictions on (inward) FDI (a decrease of the Golub-index) leads to increased capital mobility.\textsuperscript{13} Based on the empirical research on the determinants of FDI (see Barba Navaretti and Venables, 2004), we experimented with other possible instruments for FDI as well, like the trade to GDP ratio, but these instruments were (mostly) not significant, so we did not include them in our final specification.

We not only instrumented \textit{FDIFLOWS}, but we also used one-period lagged \textit{FDIFLOWS} in our estimations. If policy makers react to changes in the degree of capital mobility by changing corporate tax rates we take it that this reaction will not be instantaneously. Our sample period is not very long (annual data for 1981-2001) and when doing sub-sample estimations the sample period is even shortened further. With such a relatively short time-

\textsuperscript{13} Krogstrup (2004a) uses a similar index, the Quinn-index, to measure the degree of capital mobility and then regresses this index on the capital tax rate. While not denying the relevance of this relationship we think that this is an indirect one, which disqualifies the use of these indices as a proxy for capital mobility in equation (1).
series, tests for (co-)integration are of limited use.\footnote{We did check the stationarity of our series though by conducting a panel unit root test (Levin Lin Chu test). The null hypothesis that the series have a unit root is rejected for our main variables of interest.} In our view, and different from Krogstrup (2004a), it is to be preferred to estimate (1) in levels. That is to say, it is our assumption that the hypothesis that follows from the tax competition literature as discussed in section 2.1 is that (policy induced) changes in the level of the corporate tax rate are a result of change in the level of capital mobility. Finally, in addition to the variables introduced above we also included fixed effects in our pooled 2SLS estimation of equation (1) to take care of country specific effects.

4.2 Does capital mobility put a downward pressure on corporate tax rates?

The first hypothesis to be tested is whether an increase in capital mobility will lead to a decrease of corporate tax rates (the standard tax competition effect). Or more specifically, does an increase of $\text{FDIFLOWS}$, instrumented by the Golub-index, lead to decrease of the effective average corporate tax rate, $\text{EATR}$? In this sub-section we only give full-sample estimation results and do not include the agglomeration variables yet, see Table 2.

<table>
<thead>
<tr>
<th>Table 2: Standard tax competition hypothesis, full sample</th>
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<tbody>
<tr>
<td>I</td>
</tr>
<tr>
<td>--------------------------------------</td>
</tr>
<tr>
<td>Constant</td>
</tr>
<tr>
<td>(45.97)**</td>
</tr>
<tr>
<td>$\text{FDIFLOWS}$</td>
</tr>
<tr>
<td>(-9.36)**</td>
</tr>
<tr>
<td>LEFT</td>
</tr>
<tr>
<td>(3.151)**</td>
</tr>
<tr>
<td>$\text{NEIGHBOUR}$</td>
</tr>
<tr>
<td>(2.557)**</td>
</tr>
<tr>
<td>$\text{GOVINV}$</td>
</tr>
<tr>
<td>(2.142)**</td>
</tr>
<tr>
<td>$\text{SIZE}$</td>
</tr>
<tr>
<td>(2.555)**</td>
</tr>
<tr>
<td>Adj. $R^2$</td>
</tr>
<tr>
<td># obs.</td>
</tr>
</tbody>
</table>

Dependent variable: $\text{EATR}$; 2 SLS estimation; t-values between brackets; fixed effects included (not shown here); instrument list: Golub-index and all independent variables listed in table (except FDI variable); unbalanced panel; adj. sample period: 1982-1999; for definition of variables and list of countries included, see section 3 and the data appendix; ***, **, * significant at 1, 5 and 10% significance level.

From Table 2 it is clear that we find some confirmation for the hypothesis that increased capital mobility puts a downward pressure on the corporate tax rate. Without the control variables (column I), the estimation results imply that a 1% increase in our measure of capital mobility leads to a 0.5% decrease of the effective corporate tax rate. The effect is somewhat
smaller when we add the control variables (column II). Note that the control variables are all significant and have the expected sign. Briefly stated, they suggest that the corporate tax rate in a country is higher when the government is leftist; when the country is relatively large in terms of GDP, and when a country's level of government investment expenditures is higher.

We also find evidence of tax competition taking place, as the tax rate in neighbouring countries turns out to have a positive effect on a country’s own tax rate. The next question is whether and how this conclusion has to be changed when we add the agglomeration variables.

4.3 Adding NEG variables: is there an agglomeration effect?

As explained in section 2, the relationship between capital mobility and corporate income tax rates might be quite different when we allow for agglomeration effects. When we for instance split our sample in low and high density countries (where density is measured as population per km$^2$) and using the same specification as in column II of Table 2, we find that for the group of countries with a low population density the FDI coefficient is still significant, but this is no longer the case for the high density countries. Within-country population density is a rather crude measure of agglomeration (and we thus prefer other measures in our estimations), but this result suggests that it may also be interesting from an empirical point of view to take agglomeration effects into account. Table 3 gives the estimation results when we add our preferred agglomeration variable, various versions of the market potential variable.

<table>
<thead>
<tr>
<th>Table 3: Adding agglomeration, full sample</th>
</tr>
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<tbody>
<tr>
<td></td>
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<tr>
<td>---</td>
</tr>
<tr>
<td>Constant</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>FDIFLOWS</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>LEFT</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>NEIGHBOUR</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>GOVINV</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>SIZE</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>MARKET</td>
</tr>
<tr>
<td>POTENTIAL</td>
</tr>
<tr>
<td>Adj. R$^2$</td>
</tr>
<tr>
<td># obs.</td>
</tr>
</tbody>
</table>

Dependent variable: EATR; 2 SLS estimation; t-values between brackets; fixed effects included (not shown here); instrument list: Golub-index and all independent variables listed in table (except FDI variable); unbalanced panel; adj. sample period: 1982-1999; for definition of variables and list of countries included, see section 3 and the data appendix; ***, **, * significant at 1, 5 and 10% significance level
The estimation results reported in Table 3 give rise to the following observations. First, the size and significance of FDIFLOWS is hardly affected by the inclusion of the market potential variables. Hence, even if one controls for agglomeration, capital mobility seems to exert a downward pressure on corporate tax rates. Also varying the distance parameter (columns I-III with respectively the distance decay at $\gamma=1$ (MP1), $\gamma=0.5$ (MPH) and $\gamma=2$ (MPD), or correcting the market potential with trade costs ($TC1=\text{cif/fob trade costs} \times MP1$), see column IV, do not change this main finding. Second, the significance of the group of control variables is rather similar if compared with column II of Table 2. Third, and most important, there is some evidence that agglomeration matters to the extent that countries with a larger market potential or market access have a higher corporate tax rate because our market potential variable, irrespective of how it is defined exactly, is significant and positive in all specifications. Finally, we performed an extensive robustness analysis to check how sensitive the results are to changes in the definition of the main variables of interest and/or in the sample composition. It follows that our main results carry through when we use different measures of capital mobility (FDI stock or only FDI in- or outflows). However, when we split the sample into two sub-periods, we find that the FDI coefficient is not significant in the 1980s, but is in the 1990s, while the market potential variable is hardly significant at all. These results are rather sensitive to the exact cut-off year to split the sample, though. When we restrict our sample so as to include EU countries only, we find that for the EU, the downward pressure of capital mobility on the tax rate is primarily counteracted by the size effect and somewhat less by the agglomeration effect.

4.4 Matching our empirical results with NEG theory

Because we reported the uncorrected estimation results for the MP variable – that is, the results without appropriate scaling – Table 3 hides important information regarding the ranking of the market potential coefficients across the several cases of distance decay. However, with appropriate scaling, it turns out that when distance matters more (a higher value of $\gamma$, hence MPD), the market potential coefficient is still relatively higher. Hence, the implied ranking that we arrive at for the estimation results in the last row of Table 3 is that:\textsuperscript{15} $MPH<MP1<MPD$. The question that now arises is whether this result is compatible with the NEG theory. To answer this we first have a closer look at the so-called Core-Periphery model that is the basis for the NEG models of tax competition like Baldwin and Krugman (2004). As

\textsuperscript{15} Due to rounding off, this is not immediately visible in the table.
is further explained in the Appendix, the Core-Periphery model predicts that the agglomeration rent will be the highest for low levels of trade costs (Baldwin et al, 2003, ch. 15). If one accepts that a lower distance parameter corresponds with lower trade costs, then a lower value for $? \leq 2$ would thus imply a larger agglomeration rent and a higher tax rate (without mobile capital relocating to a less centrally located country with lower corporate taxes). The idea simply being that with a higher degree of agglomeration a country can have a higher corporate tax rate as compared to the case of less agglomeration. Hence, using the Core-Periphery model, we expect that the MP-coefficient results in terms of the order of ranking would show that: $MPD \leq MP1 \leq MPH$. This ranking is, however, opposite to our estimation results in Table 3 (see Figure A1 in the Appendix for a graphical illustration). Having said this, the 2nd core model in the NEG literature (Puga, 1999) predicts a different relationship between the agglomeration rent and trade costs. In this model, the agglomeration rent will be the highest for intermediate levels of trade costs, see Figure A2 in the Appendix. This is due to the fact that, when trade costs fall over time, the two country economy moves from spreading to agglomeration to renewed spreading. Our estimation results in Table 3 would be compatible with this model. Namely, if for instance with $? = 2$ (high trade costs) the economy would be in the agglomeration range and for $? = 1$ and $? = 0.5$ (low trade costs) the economy would be in an equilibrium of renewed spreading.

Table 4: Impact of Falling Trade Costs

<table>
<thead>
<tr>
<th></th>
<th>I: full sample</th>
<th>II, 1990-1999</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>-0.249</td>
<td>0.102</td>
</tr>
<tr>
<td></td>
<td>(-3.212)***</td>
<td>(0.871)</td>
</tr>
<tr>
<td>FDIFLOWS</td>
<td>-0.310</td>
<td>-0.151</td>
</tr>
<tr>
<td></td>
<td>(-4.945)***</td>
<td>(-3.205)***</td>
</tr>
<tr>
<td>LEFT</td>
<td>0.032</td>
<td>0.099</td>
</tr>
<tr>
<td></td>
<td>(2.392)**</td>
<td>(0.762)</td>
</tr>
<tr>
<td>NEIGHBOUR</td>
<td>0.680</td>
<td>0.157</td>
</tr>
<tr>
<td></td>
<td>(5.866)***</td>
<td>(0.516)</td>
</tr>
<tr>
<td>GOVINV</td>
<td>0.007</td>
<td>0.007</td>
</tr>
<tr>
<td></td>
<td>(1.932)*</td>
<td>(1.755)*</td>
</tr>
<tr>
<td>SIZE</td>
<td>2.665</td>
<td>1.168</td>
</tr>
<tr>
<td></td>
<td>(4.162)***</td>
<td>(2.174)**</td>
</tr>
<tr>
<td>TCD</td>
<td>4.102</td>
<td>1.677</td>
</tr>
<tr>
<td></td>
<td>(5.046)***</td>
<td>(2.088)**</td>
</tr>
<tr>
<td>Adj. R²</td>
<td>0.718</td>
<td>0.817</td>
</tr>
<tr>
<td># obs.</td>
<td>306</td>
<td>170</td>
</tr>
</tbody>
</table>

Dependent variable: EATR; 2 SLS estimation; t-values between brackets; fixed effects included (not shown here); instrument list: Golub-index and all independent variables listed in table (except FDI variable); unbalanced panel; adj. sample period: 1982-1999; for definition of variables and list of countries included, see section 3 and the data appendix; ***, **, * significant at 1, 5 and 10% significance level. $TCD=(((cif/fob \ trade \ costs)\times MPD)$
The above line of reasoning is based on a thought-experiment whereby changes in the distance decay parameter are approximations of changes in the level of trade costs or, in NEG parlour, of the freeness of trade. Another and more realistic way to conduct the same experiment is by using the trade-costs-corrected-market-potential $TC$. It is more realistic since we can actually, through the $cif/fob$ trade costs measure, track actual trade costs over time for every country in our sample. It is beyond dispute that these trade costs have fallen over time (see Figure 4). We have thus estimated our model for the sub-sample 1990-1999 as well and compare the “trade cost corrected market potential” coefficient in this period with the corresponding coefficient for the whole sample, the basic idea being that the 1990s are to be associated with lower trade costs. The Core-Periphery model, see again Figure A1, would predict that because of the fall in trade costs, the $TC$ coefficient will be higher (or in any case not lower) for the 1990s. A lower $TC$ coefficient for the period 1990-1999 could, however, be compatible with the other core NEG model (see again Figure A2). Table 4 summarises the results.\textsuperscript{16} It follows that the market potential coefficient in our sub-sample (column II) is lower than the market potential coefficient for the full sample (column I). This is, once again, in accordance with the second core model of the NEG literature.

Let us finally examine the relation between capital mobility and the tax rate from a NEG perspective. The hypothesis that follows from the Core Periphery (CP) model is that the coefficient for $FDIFLOWS$ would get smaller, or at least not larger, as trade costs fall and the chances increase that agglomeration becomes stronger. This is because in case of more agglomeration the downward pressure from capital mobility on the tax rate would ceteris paribus be weaker. In the 2\textsuperscript{nd} core NEG-model, see Figure A2, where the 2 country economy moves from spreading to agglomeration to renewed spreading for low enough trade costs, the correlation between the tax rate and capital mobility is less clear-cut. The estimation results in Table 4 (see 2\textsuperscript{nd} row of Table 4) can be aligned with both models: the FDI-coefficient in the period associated with low trade costs (1990-1999) is lower than the FDI-coefficient for the full sample estimation. This suggests that in the 1990s agglomeration has become more important. In terms of both models this could be the case when the level of trade costs is such that the economy is in the agglomeration regime. Any definite statements on this matter are, however, not possible because in terms of Figures A1 and A2 we simply do not know where exactly to position our estimation results on these curves! One can only exclude certain

\textsuperscript{16} Note that we reported the results for $?^2=2$ ($TCD$) because the market potential variable is largest in this case. The results do not change qualitatively for $TCH$ or $TC1$. 

20
possibilities given our priors as to the change of trade costs and the market potential variables over time.

Note that the feedback from empirics to NEG theory is only meant as a first pass and certainly not the final word on this matter. Even though the hypotheses are taken from the core NEG models, it should be recalled that these are two country models and that we have simply assumed that the analytics of a 2 country model carry over to the multi-country case (see Brakman, Garretsen and Schramm (2005) on this (heroic) assumption). Moreover, it should be recalled that trade costs, measured by the \( \frac{ CIF }{ FOB } \) ratio, faces serious measurement problems (Hummels, 1999). Also, our approach to vary with the distance decay variable is only an imperfect way to approximate falling trade costs. These issues certainly warrant further research.

5. Conclusions

The question how an increase in capital mobility affects corporate tax rates is ultimately an empirical one. This paper has provided such an empirical investigation. Using a panel of 19 OECD countries for the period 1981-2001, we have examined whether

(1) an increase in the degree of capital mobility leads to a decrease of corporate tax rates;
(2) more agglomerated countries can afford higher corporate tax rates;
(3) the effect of capital mobility on corporate tax rates varies across time or sub-groups, where we focus on the role of trade costs.

We find that increased international capital mobility has a negative effect on the corporate tax rate, which is consistent with the standard tax competition literature. This result is relatively robust to alternative specifications. Second, the downward pressure of capital mobility on tax rates is also present when agglomeration variables are added to our empirical model. But, and in accordance with the predictions of the new economic geography (NEG) literature, we also find some evidence that agglomeration effects matter. Compared to more peripheral countries, core countries have a higher corporate tax rate. Finally, these main results hold for alternative measures of trade costs and the market potential. The introduction of agglomeration effects is the key contribution of the new economic geography (NEG) literature to the “race to the bottom” debate on the impact of capital mobility on corporate taxation. Our results illustrate that it is, however, quite difficult to ground the empirical findings, as the relationship between agglomeration, capital mobility and taxation depends on the particular NEG model. Further research on this is certainly needed.
Appendix

The interpretation of the results for the market potential variable

The free-ness of trade in a two region NEG model between countries i and j is given by

\[ f_{ij} = (T_{ij})^{1-e} \]

where \( e \) is the substitution elasticity between varieties of the manufactured good and \( T_{ij} \) is the transport cost function. In turn, \( T_{ij} = T(D_{ij}) \), with \( T \) being the trade cost parameter and \( D_{ij} \) is the distance function between countries i and j. In the two country case the distance between the two countries can be normalized to 1 with the result that \( f_{ij} = T^{1-e} \) (see also Puga, 1999). In a multi-country setting it no longer makes sense to normalize inter-country distances and this is also true for our sample of 19 countries (unless we make the unrealistic assumption that all 19 countries are at equidistance to each other). Hence, we have to specify a distance function: assume that \( T_{ij} = T(D_{ij})^{\gamma} \) we then arrive at \( f_{ij} = [T(D_{ij})^{\gamma}]^{1-e} \). Other distance specifications are of course possible but this one is quite common in for instance gravity equations of trade and in NEG applications too (Head and Mayer, 2000, Crozet, 2004).

Defining the free-ness of trade as \( f_{ij} = [T(D_{ij})^{\gamma}]^{1-e} \).shows that the free-ness of trade changes when for instance the distance decay parameter \( \gamma \) changes or when actual trade or transport costs \( T \) change. In section 4.4 the discussion of Table 3 is based on alleged changes in \( \gamma \) whereas the discussion of Table 4 is based on changing \( T \). In both cases the free-ness of trade ceteris paribus changes.

In the Core Periphery (CP) model (which is basically the initial NEG model due to Krugman, 1991) that underlies the analysis of the relationship between capital mobility and tax rates in Baldwin et al (2003), the relationship between the free-ness of trade (or trade costs) and the degree of agglomeration is as depicted by Figure A1. This so-called Tomahawk figure shows for the two region CP model that for low levels of the free-ness of trade (= high trade costs) we end up with spreading and only when the free-ness of trade surpasses \( f^B \) we end up with (full) agglomeration \( f^B \) is the so called break point; \( f^S \) is the sustain point). Given \( D_{ij} \) and \( e \), a higher (lower) distance decay parameter \( \gamma \) and/or a lower (higher) \( T \) are associated with a lower (higher) free-ness of trade. This means that we can rank our 3 distance parameters along the horizontal axis as depicted below Figure A.1. Given these respective distance parameters and the associated estimation results for the MP coefficient in Table 3 we can, however, not say where exactly we are on the horizontal axis. But, given this ranking of the distance parameters through the relationship between the distance parameter and the free-ness of trade, we know that it is not possible to be in the agglomeration equilibrium for \( \gamma = 2 \) and at
the same time to still be in the spreading equilibrium for the case for \( \gamma = 1 \) or \( \gamma = 0.5 \) as well (the reverse is possible). A similar reasoning leads us to expect that the MP-coefficient in Table 4 for the full sample period (1990s) a period associated with higher (lower) trade costs \( T \) is relatively low (high).

**Figure A1 Free-ness of trade and Agglomeration in CP model: The Tomahawk**

\[
\begin{align*}
\gamma & \quad \text{implied ranking of } f \text{ on } f^- \text{-axis (Table 3): } \gamma = 2 < \gamma = 1 < \gamma = 0.5 \\
\gamma & \quad \text{implied ranking of } f \text{ on } f^- \text{-axis (Table 4): full sample period} < 1990s
\end{align*}
\]

If anything, we therefore expect the coefficient for the Market Potential variable with \( \gamma = 0.5 \) (MPH) to be *at least as large* as the coefficient associated with \( \gamma = 2 \) (MPD) or \( \gamma = 1 \) (MP1). The idea simply being that with agglomeration a country can have a higher corporate tax rate as compared to case of spreading. Following a similar line of reasoning for our TC variables (TC=(\textit{cif/fob} measure)*MP), we can thus also hypothesize that the MP- coefficient for the 1990s – i.e. the period with lower trade costs – will be higher than the trade costs coefficient for the whole period.

Our conclusions in the main text as to the feedback from the estimation results in Tables 3 and 4 to the NEG theory are sensitive to underlying NEG model. The CP model is one of the two core models in the NEG literature (Puga, 1999). In the other core model, the relationship between agglomeration and the free-ness of trade is different, as Figure A.2 illustrates (see for
an in-depth explanation Puga, 1999, Head and Mayer, 2004 or Brakman, Garretsen, and Schramm, 2005). Figure A2 depicts the so called inverted U-curve also known as the Bell Shaped curve where moving from left to right on the horizontal axis (that is from high to low trade costs), the 2 country economy moves from spreading to (partial) agglomeration to renewed spreading. There are now 2 break-points \( f^B_{\text{low}} \) and \( f^B_{\text{high}} \). Given our previous argument about the implied ranking of the free-ness of trade \( f \), Figure A2 illustrates that the restrictions to be placed on the market potential coefficient and the correlation between the tax rate (e.g. \( EATR \)) and capital mobility (e.g. \( FDIFLOWS \)) would be different from those based on the NEG model underlying Figure A1. In fact, our estimation results as shown in Tables 3 and 4 can be aligned with Figure A2, if for instance agglomeration has become more important in the 1990s.

Figure A2  Free-ness of trade and Agglomeration: The Inverted U-curve

? implied ranking of \( f \) on \( f \)-axis (Table 3): \( 2 < 1 < 0.5 \)

? implied ranking of \( f \) on \( f \)-axis (Table 4): full sample period < 1990s
Data appendix

The sample used for the panel regression analysis includes OECD 19 countries and covers the 1981-2001 period with an annual frequency (although some series have a shorter time period). The countries included are Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom, Australia, Canada, Japan and United States. In the table below, the definitions and sources of data used in the empirical research are described briefly.

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<th>Definition</th>
<th>Source</th>
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<td>Dependent variables</td>
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<td></td>
</tr>
<tr>
<td>EATR</td>
<td>Effective average tax rate</td>
<td>Devereux, Griffith, Klemm (2002)(^\text{17})</td>
</tr>
<tr>
<td>Captax</td>
<td>Capital tax ratio based on gross operating surplus</td>
<td>Carey and Rabelson (2002)</td>
</tr>
<tr>
<td>Cortot</td>
<td>Corporate tax revenues as a share of total tax revenues</td>
<td>OECD Revenue Statistics</td>
</tr>
<tr>
<td>Corgdp</td>
<td>Corporate tax revenues as a share of GDP</td>
<td>OECD Revenue Statistics</td>
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<td>Explanatory variables</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Golub</td>
<td>Index to measure inward FDI restrictions</td>
<td>Golub (2003)</td>
</tr>
<tr>
<td>FDIOUTFLOWS</td>
<td>Sum of FDI in- and outflows as a percentage of GFCF</td>
<td>Unctad, FDI online</td>
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<tr>
<td>FDIinflows</td>
<td>FDI inflows as a percentage of GFCF</td>
<td>Unctad, FDI online</td>
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<td>FDIoutflows</td>
<td>FDI outflows as a percentage of GFCF</td>
<td>Unctad, FDI online</td>
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<td>Market potential (with ( \beta = 1 )) ( MP_1 = \sum_j \frac{gd_{ij}}{D_{ij}} )</td>
<td>GDP data: OECD Annual National Accounts Distance: CEPII(^\text{18})</td>
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<tr>
<td>MPH</td>
<td>Market potential (with ( \beta = 0.5 )) ( MP_1 = \sum_j \frac{gd_{0.5j}}{D_{0.5ij}} )</td>
<td>GDP data: OECD Annual National Accounts Distance: CEPII</td>
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<td>MPD</td>
<td>Market potential (with ( \beta = 2 )) ( MP_1 = \sum_j \frac{gd_{2j}}{D_{2ij}} )</td>
<td>GDP data: OECD Annual National Accounts Distance: CEPII</td>
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<td>TC1</td>
<td>Trade-cost-corrected-market potential (with ( \beta = 1 )) ( TC1 = (cif / fob)<em>{ij} \sum_j \frac{gd</em>{ij}}{D_{ij}} )</td>
<td>Market potential: see above ( cif / fob ) ratio: IMF, Direction of Trade Statistics</td>
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<td>TCH</td>
<td>Trade-cost-corrected-market potential (with ( \beta = 0.5 )) ( TCH_{ij} = (cif / fob)<em>{ij} \sum_j \frac{gd</em>{0.5j}}{D_{0.5ij}} )</td>
<td>Market potential: see above ( cif / fob ) ratio: IMF, Direction of Trade Statistics</td>
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<td>MPD</td>
<td>Market potential (with ( \beta = 2 )) ( MPD = (cif / fob)<em>{ij} \sum_j \frac{gd</em>{2j}}{D_{2ij}} )</td>
<td>Market potential: see above ( cif / fob ) ratio: IMF, Direction of Trade Statistics</td>
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\(^{17}\) These can be taken from: [http://www.warwick.ac.uk/fac/soc/economics/staff/faculty/devereux](http://www.warwick.ac.uk/fac/soc/economics/staff/faculty/devereux)

\(^{18}\) These can be taken from: [http://www.cepii.fr/anglaisgraph/bdd/distances.htm](http://www.cepii.fr/anglaisgraph/bdd/distances.htm)
### Control variables

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<td>NEIGHBOUR</td>
<td>Average statutory corporate tax rate in other countries</td>
<td>Devereux, Griffith, Klemm (2002)</td>
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<td>LEFT</td>
<td>Left party cabinet portfolios as a % of all cabinet portfolios</td>
<td>Swank, Comparative Parties Data Set[^19]</td>
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<td>SIZE</td>
<td>gdp country i as a share of gdp total</td>
<td>OECD, Annual National Accounts</td>
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<td>GOVINV</td>
<td>Government fixed investment as a share of total disbursements</td>
<td>OECD, Economic Outlook</td>
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[^19]: These can be taken from the following website: [http://www.marquette.edu/polisci/swank.htm](http://www.marquette.edu/polisci/swank.htm)
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