What do we know about corporate tax competition?

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Abstract

We review the empirical literature on competition in source-based taxes on corporate income. Drawing an analogy to the competition models for the goods market indicates how evidence for the existence of tax competition can be provided, and highlights that tax competition can take many forms. With this in mind we classify the empirical literature, and highlight the importance of the measurement of tax rates and openness. Using measures based on the statutory tax system, there is evidence for tax competition mostly in the European Union. In contrast to the view of Gordon (1992) small countries appear to be the leader of the tax competition game.

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1 Introduction

In the last two decades, both policy makers and academics have been increasingly occupied with tax competition. Policy makers have been concerned about a race to the bottom in tax rates on corporate income. The EU has set out a code of conduct to combat 'harmful tax competition' and the OECD has pursued what it believes to be tax havens in an attempt to inhibit profit shifting, and indirectly to slow tax competition. On the academic side, there have been numerous developments of the theory of tax competition. Fuelled by a continued fall in corporate tax rates there has been a flurry of activity to provide evidence for the existence of tax competition, but so far the findings have at best been inconclusive.

This paper aims to review what we have learned from empirical studies of tax competition. It focuses on one particular form of tax competition - that is competition at a national level in taxes on corporate source income. To this end it only briefly refers to a significant number of empirical studies which aim to test for strategic interactions between governments over other forms of taxation, over other aspects of fiscal and regulatory policy, and any strategic interaction at a sub-national level. A number of such papers are reviewed by Brueckner (2003).

Before going any further, it is useful to state what we consider - for the purposes of this paper, at least - to be tax competition. Few definitions have been offered in the literature, and none of them exactly describes what we address in this paper. Roháč (2006, p. 87) defines tax competition as 'the process of uncooperative setting of tax rates in order to attract mobile tax bases - leading to inefficiently low amounts of public goods'. However, we do not want to constrain the term to cover only competition over mobile tax bases. Also we not consider the underprovision of public goods to be a necessary feature of tax competition, but rather an outcome in certain circumstances. In a second definition, he writes of 'interdependent setting of tax rates and tax bases'. This appears more general, and is in line with the approach of Brueckner (2003) who considers only strategic interaction, but this does not clearly include the behaviour of a small open economy, which we want to include in this paper.

Many of the classic theoretical statements on tax competition, dating back to Wilson (1986) and Zodrow and Mieszkowski (1986) are based on models of small open economies. While these papers do model strategic interaction between players in a game, the nature of the game is such that countries can not affect the world rate of return of capital. Hence the classical tax competition models rather describe the effects of a source-based tax on capital income in a small open economy, where the 'world' rate of return is fixed. This approach is reflected in much of the empirical literature reviewed here, in that many empirical studies simply consider the determinants of rates of corporation tax in individual countries, without taking account of tax rates (or other variables)

in other countries. Since these approaches are commonly considered to be consistent with 'tax competition', we do not want to define the term only to include strategic interaction where two or more players react to each other's strategy.

Second, competition can take various forms. Brueckner (2003) makes a useful distinction between strategic interaction where governments compete over resource flows and where there are other cross-border spillovers. Both resource flows and other spillovers could take several forms. Resource flows could include flows of capital, firms and profit. Spillovers could include information or environmental spillovers. Yardstick competition - where voters judge the actions of their own government by observing behaviour in other jurisdictions - is one example.

In this paper, we therefore summarise the types of behaviour we are concerned with as 'the uncooperative setting of source-based taxes on corporate income where the country is constrained by the tax setting behaviour of other countries.' Such a definition is intended to encompass the behaviour of welfare-maximising or non-welfare-maximising governments, in a small open economy or as strategic interaction between the governments of two or more larger countries. The aim of the governments may be to secure resource flows, or to encourage, discourage or respond to, other forms of spillover.

This very general definition of tax competition already indicates that the theoretical tax competition literature can provide us with multiple testable hypotheses. In Section 2 we draw analogies to general competition models to structure the empirical predictions of the various tax competition models. With this in mind, we proceed to analyse what empirical work has uncovered about the nature of tax competition. Broadly, there are three types of studies which have been carried out. There are studies which describe trends in a variety of measures of tax rates and tax revenues. There are studies which aim to explain the setting of the tax rate in one country based on factors only from that country. And there are studies which consider strategic interaction by examining the extent to which tax rates in one country depend on those in other countries. In Section 4 we survey all three types of studies.

However, before launching into a summary of empirical work, in Section 3, we first step back and discuss what questions the literature is trying to address, and whether and how those questions can be convincingly answered. Section 5 provides a brief conclusion. The Appendix provides a brief summary of each of the empirical papers surveyed here.

2 Testable predictions from the tax competition literature

This section draws an analogy between some of the theoretical tax competition contributions and the standard competition models. The aim is to find common testable hypotheses rather than to provide a comprehensive survey of the theoretical literature.[1] The link between the tax competition models and competition on the goods market is most obvious in the simple tax competition models where governments are revenue maximizing. Here the tax rate can be seen as the price a company needs to pay to buy the good of being active in the country. The public infrastructure which needs to be provided to attract companies can be interpreted as the costs of producing the good. For more elaborate tax competition models involving welfare maximising governments the analogy to the standard competition model remains applicable, but covers only certain aspects of the complete tax competition model. The main analogies and the derived empirical predictions are summarized in Table 1.

The earliest mentioning of tax competition in the spirit of this survey dates back to Bradford and Oates (1971) and Oates (1972). These early contributions contain no formalized tax competition models, but rather describe the effect of positive fiscal externalities on the efficient provision of local public goods. The seminal conclusion is that tax competition leads to an underprovision of public goods. Despite not being fully formalized it can be seen that this conclusion hinges on two crucial assumptions. First the government would provide the efficient amount of public goods in the absence of tax competition (e.g. acts like a benevolent dictator) and secondly there are no alternative sources of government revenues. The underprovision of public goods is a testable hypothesis in theory, but in practice it requires knowledge about the optimal level of public goods and whether the government is acting in the best interest of its citizen.

The first formalized tax competition models by Zodrow and Mieszokski (1986) and Wilson (1986) describe a situation where small open countries decide on the tax rate on a fully mobile factor. Because of the perfect mobility of capital each country will take the world rate of return on capital as given and the tax rate will be competed down to zero. These standard tax competition models can be seen as an equivalent to a Bertrand competition with a large number of players. Therefore the result is identical to the perfect competition case, where each market participants acts as price taker.[2] This implies a clear empirical prediction, namely the famous race to the bottom with the result of zero taxation. Since this is clearly not supported by the data, it is worth to examine the underlying assumptions necessary for this outcome.[3] The main assumptions are

[1] For surveys of the theoretical tax competition literature see Wilson (1999) and Fuest et al. (2005).

[2] The authors use Cournot competition in the original article. However, the large number of players implies that the outcome is equivalent, namely the one of perfect competition.

[3] Strictly, the model is based on effective marginal tax rates, which could be zero even in the presence of a tax. However, evidence in Devereux, Griffith and Klemm (2002) suggests that they are not generally zero.

that capital is fully mobile and that the number of countries is large. The first assumption implies that even a marginally higher tax burden induces capital to leave the country. The large number of countries ensures that the decreasing returns to capital do not play a role in the reallocation.

Relaxing the assumption of a large number of countries Wildasin (1988) and Hoyt (1991) show that a smaller number of countries implies a higher tax rate, because countries have 'market power' in setting tax rates on mobile factors. Despite the assumption of perfect capital mobility, investments in any particular country are imperfect substitutes. This originates from the complementarity with an immobile factor which implies decreasing marginal productivity of capital in each country. There is a resemblance between these models and the monopolistic competition case. Each country has some market power to tax firms, which diminishes with an increasing number of countries. However, in contrast to the standard monopolistic competition the assumption of free entry and exit is implausible. Bucovetsky (1991) and Wilson (1991) go one step further and model tax competition between asymmetric countries. They conclude with a stronger reduction of the tax rate in the smaller country, which is again a clear empirical prediction. Further, looking for an equivalent competition model we find that the situation resembles an asymmetric Bertrand competition. Due to location specific immobile production factors, marginal returns to capital are decreasing in each location and therefore the two jurisdictions are imperfect substitutes. Hence each country has some power in setting its tax rate and faces a positively sloped tax reaction function. This, in turn, is the most important empirically testable hypothesis.

Gordon (1992) allows for sequential setting of the tax rates and models a Stackelberg competition. A large country (the US) taxes the worldwide income of its resident companies, while giving a credit for foreign taxes paid in other small countries. The small countries have an incentive to set a tax rate up to the limit of that levied in the large country, and this allows the large country to maintain a positive tax rate. The ability of a large country to impose positive tax rates not only depends on its market power with respect to other countries, but also on the bargaining power vis-á-vis the companies. For example, modelling a game between two countries and a monopolist Haufler and Wooton (1999) conclude that a sufficiently large country can maintain a positive tax rate. In the case of symmetrical countries the tax rate will be competed down to zero. In contrast Ferret and Wooton (2010) show that both countries can maintain positive tax rates if there are two companies in the industry.

Table 1: Testable predictions of theoretical tax competition literature

Category	**Tax competition paper**	**Equivalent competition model**	**Testable hypotheses**
I	Bradford and Oates (1971) Oates (1972)	no formalized competition model	Inefficient low levels of public goods
II	Zodrow and Mieszkowski (1986) Wilson (1986)	Bertrand competition with N players equivalent to perfect competition	'Race to the bottom' Zero (effective marginal) tax rate
III	Wildasin (1988) Hoyt (1991)	Monopolistic competition with n<N players	'Inefficiently low taxes' More countries imply lower tax rates
IV	Bucovetsky (1991) Wilson (1991)	Asymmetric Bertrand competition (Launhardt/Hotelling)	Small countries set lower tax rates Positively sloped reaction functions
V	Gordon (1992)	Stackelberg competition	Large countries set higher tax rates Positively sloped reaction functions
VI	Haufler and Wooton (1999) Ferret and Wooton (2010)	Asymmetric Bertrand competition with monopsony/dyopsony	Only large country sets positive taxes Both countries set positive taxes Positively sloped reaction functions
VII	Ludema and Wooton (2000) Kind, et al. (2000) Andersson and Forslid (2003) Baldwin and Krugman (2004) Forslid (2005)	Dispersed case: Asymmetric Bertrand competition Concentrated case: Monopolistic competition with N=2 players (constrained monopoly)	Dispersed case: Positively sloped reaction functions Concentrated case: Higher tax rate in the core Generally: Non-linear impact of economic integration
VIII	Persson and Tabellini (1992)	Asymmetric Bertrand competition	Economic integration lowers tax rates, mitigating political effect Positively sloped reaction functions
IX	Besely and Case (1995)	not applicable	Positively sloped reaction functions

The reason for the countries to be able to impose positive tax rates are location-specific rents because of access to the markets. Another possible source of a location-specific rent is that accruing to an agglomeration of economic activity. The role of tax in new economic geography models which include explicit modelling of agglomeration forces has been studied in a number of papers, for example, Ludema and Wooton (2000), Kind, Midelfart-Knarvik and Schjelderup (2000), Andersson and Forslid (2003), Baldwin and Krugman (2004) and reviewed by Forslid (2005). The common feature of this type of models is the two possible equilibria either the existence of an agglomeration (concentrated case) or the absence of a stable economic core (dispersed case). The nature of the tax competition is state dependent. In the concentrated case, the economic core can tax the arising agglomeration rents up to the point where the periphery would become the new core. Therefore the governments in the core have a monopoly power over the tax base with the restriction that the periphery can not attract the mobile firms. This is more or less equivalent to a the case of monopolistic competition with just two players. In the case of a dispersed equilibrium the tax competition game is back to the standard Bertrand competition. This implies positively sloped reaction functions and the standard result of downward competition in tax rates.

The second and probably more important feature of the new economic geography models is the analysis of the impact of economic integration on the tax competition. A reduction in trade costs at first increases the agglomerative forces, but beyond a certain level the impact reverses. This implies a non-linear relationship between economic integration and the strength of agglomerations, and in direct consequence tax competition.

Yet another form of tax competition models is concerned with the political process underlying the tax setting process. Persson and Tabellini (1992) consider the effects of economic integration on tax competition, in a model with mobile capital, its ownership distributed across the population, and taxes set by the median voter. In this model, greater economic integration makes capital more responsive to taxes, as in the standard model. This intensifies tax competition and lowers tax rates. But it also shifts the median voter to the 'left', which mitigates the tax reduction. The underlying competition concept is again the asymmetric Bertrand competition, which implies that there are positively sloped reaction functions. The political process, however influences the shape of these reaction functions. In contrast, in the yardstick competition model of Besely and Case (1995) the positively sloped reaction functions are entirely determined by the political process. The voters evaluate the performance of the politicians through comparison with the neighbouring jurisdictions, which results in a positive interaction of the tax rates even if there are no fiscal externalities.

3 Conceptual Issues

Three main empirical predictions emerge from Table 1. First there is the well known prediction that tax competition will lead to lower levels of taxation, in particular in small countries. Second, most more recent tax competition models have the common denominator of a positively sloped reaction function.[4] And finally, there is the prediction of a non-linear impact of economic integration on the strength of tax competition. This section explores to which extent these empirical predictions are testable.

3.1 Lack of counterfactual for tax rates

The supposedly clearest prediction from the theoretical tax competition models is the reduction in the level of taxation. However, to provide empirical evidence for tax competition along these lines one would need to show two things. First the level of taxation needs to be lower than set by an unconstrained government. And second this disparity needs to be attributed to external, i.e. tax competition, forces rather than other reasons.[5]

Unfortunately, theoretical models (typically of optimal tax rates) do not even give clear-cut predictions for the first part of this proof. For example, models differ in their prescriptions for whether capital income should be taxed at all.[6] Irrespective of this, a common justification for a tax on corporate profit is that it is required as a backstop to the personal income tax; the force of this depends on the rigour of administration of the income tax. Another possibility is that taxes should be levied to match marginal congestion costs. Each of these issues arises in both closed and open economies, and whether or not the government is engaged in tax competition.[7]

While it proves to be very difficult to attribute the level of taxation to either competitive pressures or other reasons, it did not stop the early empirical literature to find a shortcut to test for tax competition. The most common approach in the empirical literature is to implicitly or explicitly consider the link between tax competition and the degree of economic integration of the economy. Several examples of such papers are discussed below. This can potentially cut through the problem

[4]Once the expenditure side is included, it is also possible to construct tax competition models which predict negative reaction functions. For example Mintz and Tulkens (1986) derive negative reaction functions when government compete in commodity taxes and need to provide a fixed expenditure level. Also, De Mooij and Vrijburg (2012) show that strategic substitutability in tax rates is more likely for capital exporting countries and if private and public goods are complements.

[5]The argument holds whether we assume a benevolent government or a wasteful government in the spirit of Brennan and Buchanan (1980).

[6]For a recent survey of this issue, see Banks and Diamond (2010).

[7]Yet another explanation of corporate taxes may be political. A plausible assumption here is that voters lack understanding of the economic theory of source-based taxes on corporate profit. A popular view might be that business should 'pay its fair share of taxes'. Maintaining a corporation tax allows politicians to respond to this popular view, while keeping lower (visible) taxes on income and consumption.

of determining the expected tax rate in a country, in favour of asking only whether the tax rate is affected by the degree of economic linkages with other economies. However, this approach also postulates a clear relationship between economic integration and tax competition, which is at best controversial.

3.2 Economic integration and tax competition

A significant number of empirical studies aim to test the prediction of the standard tax competition literature where capital is fully mobile and the tax rate is competed down to zero.[8] However, it is necessary to draw a distinction between economic integration, capital mobility and trade mobility. In the absence of a direct measure of capital mobility a number of studies use trade openness as a proxy. This is clearly problematic, because the new economic geography literature predicts a non-linear relationship between trade openness and tax competition.

More direct measures of capital restrictions like the index provided by Quinn (1997) can only mitigate this problem, but never fully capture capital mobility. A country may be completely open, in the sense of having no restrictions on flows of factors or goods. But the costs of moving capital may nevertheless be high, so that it may be better to think of capital being only imperfectly mobile. Even in standard tax competition framework capital is only fully mobile due to the large number of alternative locations where it can earn the same marginal return. Capital mobility becomes even more difficult to measure in the presence of a location-specific rent within a country's borders. We would not necessarily expect such a rent to be unaffected by changes in the degree of openness: rather the reverse. In fact more economic integration in the sense of a reduction of trade cost can reduce the *de facto* mobility of capital because of increased incentives to be in the economic core.

Additionally the yardstick models do not require any economic integration beyond the flow of information for tax competition to emerge. In sum, it can be very difficult to infer something about tax competition through the relationship of economic integration and tax rates. Nevertheless, it is very likely that economic integration does play a role in the tax setting decisions and therefore it should be taken into account when testing for tax competition.

3.3 Identifying strategic interaction

Given the difficulties of identifying tax competition from the level of economic integration, one way of proceeding is to test specific models directly. A more concrete way of doing so is to test directly for positively sloped reaction functions. If other factors are adequately controlled for, then if there is empirical evidence that the tax rate in j positively affects the tax rates in i that would appear to

[8] This is also reflected in the review of the role of capital mobility on capital taxation by Zodrow (2010).

be consistent with tax competition, and inconsistent with governments not reacting strategically to each other. This leaves us with the empirical problem how to provide evidence for strategic interaction in tax rates between governments.

Each country can only set one tax rate in response to influence from potentially more competing countries. This implicit aggregation of the competitive pressures is modelled explicitly in the construction of a spatial weighting matrix which averages the competitors tax rates. The appropriate choice of the weighting matrix depends on the tax competition model which one wants to test. In consequence the empirical tax competition literature varies significantly in the design of the weighting matrix. Redoano (2007) even goes one step further and proposes different weighting matrices to distinguish between different forms of tax competition. Following her reasoning uniform weights suggest the presence of a common trend, while geographic weights are more useful to detect expenditure spillovers. Her preferred weights to provide evidence for corporate tax competition are size or weights based on economic ties. While it is important to derive the design of the spatial weights from theory, one needs to be aware that this introduces additional information which affects the sample data information. Therefore it is important that the spatial weights are exogenous.[9] For example Davies and Voget (2010) theoretically derive their market potential weights and construct exogenous proxies for them. Further they allow for different strategic reactions to EU member states and non EU member states. This brings the additional benefit of a smaller number of neighbours in the spatial weighting matrix, which in turn makes the distinction between spatial interaction and a common trend easier. A sparse weighting matrix reduces the collinearity between the spatial lag and year dummies, which capture common trends and ensure that strategic interaction is correctly identified.

Strategic interaction amongst governments may be consistent with different forms of competition. Apart from identifying whether there is a competitive process in tax rates, it would also be useful to identify in more detail the nature of the competition. The most central distinction, identified by Brueckner (2003) is that between competition for resource flows and competition over other spillovers, including information. Revelli (2005) also addresses how these two forms of competition can be identified from each other. He proposes the use of supplementary tests: that is, as well as estimating reaction functions directly, he suggests that other elements of models could also be estimated. For example, in a yardstick model there may be various political factors which could affect the intensity of competition. If the observed competition is indeed related to such factors, this would be consistent with a yardstick approach. Another approach (see Devereux, Lockwood and Redoano (2008)) is to argue that yardstick competition does not necessarily require mobility of goods or factors. So if competition is more intense in more open economies, then this is

[9]See LeSage and Pace (2009) for a discussion of the design of spatial weighting matrices.

more likely to be the result of competition for mobile resources than a form of yardstick competition.

A similar approach could be applied to differentiate between the different types of resource flow models: distinguishing between competition for capital, firms and profit. One fairly straightforward aspect of this would be to identify competition in alternative forms of tax rates. Theory suggests that flows of capital depend on effective marginal tax rates, discrete investment decisions depend on effective average tax rates, and profit shifting depends on statutory tax rates. Since these forms of tax rates are all different, it may be possible to differentiate between them.

A second aspect which differentiates them is whether we would expect strategic interaction in these tax rates. For a small open economy, flows of capital depend only on the world required rate of return and the country's own effective marginal tax rate. So, conditional on these factors, we would not expect to observe strategic interaction. Also if agglomeration rent exists, or if firms have to incur significant sunk fixed cost to relocate a country has some power in setting its tax rate. In contrast, competition for initial firm location decisions and for profit could induce strategic interaction even for small open economies. This is why the existence of very small tax havens remains a problem for much larger countries. Such small tax havens cannot realistically be the home for a substantial share of capital, which needs a physical location. But they can attract a significant share of profit. Hence in competition for resources, we may be more likely to observe competition in statutory rates than in effective marginal tax rates.[10]

3.4 Timing of tax rate changes

One additional factor should be taken into account. The popular view that tax competition is taking place is fuelled by continuing reductions in corporation tax rates. But this introduces an important question of timing. If reductions in tax rates are indeed a result of competition, does this mean that other factors are continuously changing and that tax rates are constantly in equilibrium? Or, if there are costs associated with changing tax rates, are we simply observing a slow movement to a new equilibrium. For example, suppose that reductions in trade costs and greater capital mobility induce a new equilibrium at lower tax rates. Measured by the absence of regulations concerning movement of capital and trade, most OECD countries are now open. Yet source-based taxes on corporate income persist. In the absence of location-specific rent, another possibility is that tax rates are simply very slow to adjust. But that makes empirical analysis based on existing tax rates complex, since it would imply that existing tax rates are not simply the product of the degree of openness of the economy, but also of a possibly long adjustment process.

[10] Devereux, Griffith and Klemm (2002) also investigate this.

4 Empirical Evidence

We classify the empirical tax competition literature in two dimensions, shown in Table 2.[11] First, we categorise it according to three groups of **observed phenomena**. First we consider studies based on legal tax rates, such as the statutory tax rate or forward-looking measures of effective tax rates. Second, we consider studies based on the expected results of the tax competition, namely measures based on tax revenues. These can be simply revenues expressed as a proportion of GDP, or some other backward-looking measure. A third possibility, which we do not explore in as much detail here, are other variables over which governments may compete, including other taxes or expenditures.

The second dimension is the **depth of analysis**. Again we have three broad categories. The first are studies which mainly considers the development and trends of the variables described above. The second category additionally tries to identify the determinants of these developments in fiscal variables, typically through econometric studies using information on factors from the same country. The third category consists of studies which estimate directly the interactions between the governments.

Combining these two dimensions Table 2 depicts the nine resulting broad categories. We identify studies which belong to each of these categories. More details of each study are given in the Appendix. We focus primarily on the first two columns, which relate specifically to source-based taxes on corporate income. However, future work on strategic interaction should also build on papers in the bottom right hand corner, which have examined strategic interaction in other contexts.

4.1 Development and trends

The first comprehensive empirical investigation of trends in source-based taxes on corporate income can be found in Ruding Committee (1992). The Ruding Committee investigates various different measures of capital taxation through the 1980s. For European countries, Ruding finds a clear downward pattern in statutory corporate tax rates, accompanied by changes which broadened the tax base. The net effect is a smaller reduction in effective marginal tax rates. Despite these reductions, there is an increase in average corporate tax revenues. Ruding Committee (1992) interprets these trends as evidence for tax competition and consequently proposes a minimum statutory corporate within the EU.

[11] There are other ways to classify the empirical tax competition literature. For example, Hochgatterer and Leibrecht (2012) distinguish between indirect and direct studies of tax competition, where the latter category is divided into first generation studies (similar to our category of *domestic determinants* and second generation (similar to our category *strategic interaction*) studies.

Table 2: **Classification of Empirical Studies**

Depth of analysis \ **Observed Phenomena**	**Measures based on statutory tax system**	**Measures based on tax revenues**	**Measures of other taxes and expenditures**
Development and Trends	Ruding Committee (1992) Chennells and Griffith (1997) Devereux, Griffith and Klemm (2002) Simmons (2006)	Ruding Committee (1992) Mendoza, Razin and Tesar (1994) Desai (1999) Simmons (2006)	
Domestic Determinants	Devereux (1995), Grubert (2001) Bretschger and Hettich (2002, 2005) Swank and Steinmo (2002) Slemrod (2004) Haufler, Klemm and Schjelderup (2006) Schwarz (2007) Loretz (2007)	Garrett (1995, 1998a, 1998b, 2000) Quinn (1997), Rodrik (1997), Swank (1998) Hallerberg and Basinger (1998) Garrett and Mitchell (2001) Swank and Steinmo (2002), Slemrod (2004) Bretschger and Hettich (2005) Winner (2005), Schwarz (2007)	Rodrik (1998) Alesina and Wacziarg (1998) Liberati (2007) Ram (2009)
Strategic Interaction	*i) local jurisdictions* Buettner (2001) Chirinko and Wilson (2010, 2011) Charlot and Paty (2010) *ii) vertical interaction* Boadway and Hayashi (2001) Leprince, Madiès and Paty (2007) *iii) international level* Redoano (2007), Chatelais and Peryat (2008) Crabbé and Vandenbussche (2008) Cassette and Paty (2008) Devereux, Lockwood and Redoano (2008) Ruiz and Gerard (2008), Davies and Voget (2010) Heinemann, Overesch and Rincke (2010) Overesch and Rincke (2011) Osterloh and Debus (2012)	Altshuler and Goodspeed (2002) Ruiz and Gerard (2008)	Case, Rosen and Hines Jr. (1993) Kelejian and Robinson (1993) Anderson and Wassmer (1995) Besley and Case (1995) Bivand and Szymanski (1997, 2000) Murdoch, Sandler and Sargent (1997) Besley and Rosen (1998), Brueckner (1998) Figlio, Kolpink and Reid (1999) Saavedra (2000), Brett and Pinkse (2000) Esteller-Moré and Solé-Ollé (2001) Goodspeed (2002) Bordignon, Cerniglia and Revelli (2003) Revelli (2001, 2003), Solé-Ollé (2003) Egger, Pfaffermayr and Winner (2005) Devereux, Lockwood and Redoano (2007) Redoano (2007), Feld and Reulier (2008) Parchet (2012)

Mendoza, Razin and Tesar (1994) propose new measures of taxation, which we refer to as 'implicit' tax rates. First all taxes are divided into three categories: on capital, labour and consumption. They are then scaled by a broad measure of taxable income to construct estimates of average tax rates: we discuss these measures further below. The paper compares the developments of the implicit tax rates in the G-7 countries between 1965 and 1990. It reports that all three types of implicit tax fluctuated sharply over time. Capital and consumption taxes do not exhibit a trend over time, while taxes on labour income generally increased. The absence of any downward trend is consistent with Ruding's (1992) observations on corporate tax revenues.

Along the same lines, Desai (1999) investigates the tax revenues in OECD countries in combination with the home country taxation of the capital exporters and argued that - consistent with Gordon (1992) - the race to the bottom is attenuated by the foreign credit status of exporting firms. Chennells and Griffith (1997) also investigate developments in statutory corporate tax rates, forward-looking effective tax rates and revenues for 10 industrialized countries, and find results consistent with earlier studies.

Devereux, Griffith and Klemm (2002) undertake a similar analysis for a larger sample of the EU15 and G7 countries. They confirm the downward trend in the statutory tax rates, accompanied by a broadening of the tax base. In sum this results in a decline in effective average tax rates while the effective marginal tax rates remained roughly stable. The authors consider two possible reasons for these trends. The first is that tax competition is primarily over mobile profit, which is determined by statutory rates. Downward pressure on rates is offset by broadening of the tax base, which enables countries to more or less maintain their effective marginal tax rates on capital (a formal model similar to this is in Haufler and Schjelderup (2000)). A second interpretation is that the observed reforms are consistent with reducing the effective average tax rate more for more profitable activities than for less profitable activities. To the extent to which multinational firms are both more mobile, and more profitable, than other firms this could be interpreted as an attempt to attract more mobile firms, while maintaining a relatively higher effective tax burden on less mobile firms.

Most recently Simmons (2006) reviews this strand of literature and analyses the trends and convergence in statutory tax rates, effective marginal and average tax rates and tax revenues, and finds results in line with the previous literature.

4.2 Domestic determinants of tax rates

The largest group of studies reported on here can be classified as econometric studies which aim to examine the determinants of tax rates by reference to country-specific variables. That is, they go

beyond simply describing trends in the data. But they stop short of estimating reaction functions, where the tax rate in country i is regressed on the tax rate in country j or some group of other countries. The latter case estimates strategic interaction directly, and we discuss such studies below.

We do not simply describe each of these studies in turn though the main characteristics of each study are listed in Table A1 in the Appendix. Instead, we highlight some of the important characteristics of this literature, while giving a broad summary of their results. Virtually all theses studies have as their aim to identify the effects of increasing globalisation, internationalisation or increased capital mobility on source-based taxes on corporate income. We will generally refer to this as the effects of openness. In this sense they are more similar than dissimilar. But they differ in two important dimensions: the measurement of tax rates and the measurement of openness.

Most of the earlier papers in this literature come from political science. These papers use a variety of measures of tax rates based on tax revenues. For example, a series of papers by Garrett (1995, 1998a, 1998b, 2000), Quinn (1997), Hallerberg and Basinger (1998), Swank (1998) and Garrett and Mitchell (2001) all use measures based on tax revenues. Typically, these are implicit tax rates of the form introduced by Mendoza, Razin and Tesar (1994). Broadly these papers find either a positive relationship between openness and these measures of tax rates, or a very weak relationship. However, Rodrik (1997) finds that liberalization of capital markets at increasing levels of trade openness tends to reduce the implicit tax rates on capital and increase implicit tax rates on labour.[12]

There are two aspects of the **tax measures** used in these studies which are troubling. The first is that they are based on tax revenues, which are the product of the tax system itself and the level of profit earned. So an important question is whether the degree of openness can affect both of these factors, i.e. whether increased openness can have generated higher profit. If so, then we cannot infer anything about the effects of openness on the underlying tax system by considering only tax measures based on tax revenues.

Given the trends described above - that statutory tax rates and forward-looking effective tax rates have fallen while revenues have remained constant or increased - it seems highly plausible that profits have increased, offsetting the revenue consequences of changes in the underlying tax system. This is consistent with the results of these papers. Increases in profit could come from a number of sources. Companies are able to outsource production to lower cost locations. The

[12]Schulze and Ursprung (1999) provide an extensive summary about the early empirical literature on globalization and government activities. Subsequently Rodrik (1998) finds a positive empirical connection between trade openness and the size of government. This has inspired a related but separate strand of theoretical and empirical literature: see for example, Alesina and Wacziarg (1998), Liberati (2007) and Ram (2009).

increased opportunities to shift activities nearer to markets, or nearer to other producers in an agglomerated area, may also increase profit.

There is a second problem with the Mendoza, Razin and Tesar (1994) measures. That is, they are extremely broad. The tax rate on 'capital' is far broader than simply a source-based tax on corporate profit. It includes residence based taxes, capital transfer taxes, inheritance taxes, property taxes and a variety of other forms of tax.[13] Devereux and Klemm (2004) analyse these taxes and show that they take a very different form compared to measures of statutory and effective tax rates.

A more recent set of papers (predominantly from economists) instead uses measures of statutory or forward-looking effective tax rates. The earliest of these papers were Grubert (2001), Bretschger and Hettich (2002), Swank and Steinmo (2002) and Krogstrup (2004)[14], although this has now been followed by several other papers, listed and described in the Appendix. Of course, these measures of taxation also have problems. As noted above, the statutory rate is relevant for profit shifting, but since it does not take account of the tax base it is less important for flows of capital and firms, which depend on effective tax rates. Forward-looking measures of effective tax rates, such as those defined by Devereux and Griffith (1998, 2003) do take into account changes in the tax base, but only in a limited way. Nevertheless, these tax rates are not affected by changes in the level of profit, or other economic variables.

In general, there appears to be a stronger negative relationship between these measures of tax rates and measure of openness. For example, Bretschger and Hettich (2005) explicitly compare the two approaches of using forward-looking and backward-looking rates.[15] The former are negatively related to openness; the latter are positively related to openness. Schwarz (2007) also finds a stronger negative relationship with forward-looking than with backward-looking measures (and no significant relationship for micro-based backward-looking measures).[16] Slemrod (2004) finds that openness puts downward pressure on statutory rates, but not on tax revenues. Loretz (2007) investigates forward-looking cross-border effective tax rates, and also finds a negative relationship with openness.

Although this seems to be a broad pattern of differences in the relationship of openness and

[13]See Martinez-Mongay (2000) for a comprehensive discussion of the implicit tax rates and a slightly different measure of implicit tax rates. Further, Volkerink, Sturm and De Han (2002) show that some of tax ratios of Mendoza, Razin and Tesar (1994) have some major flaws and propose more detailed implicit tax rates.

[14]A much earlier paper also using effective tax rates, though not in an econometric analysis, is Devereux (1995).

[15]They use the forward-looking rates developed by Genser, Hettich and Schmidt (2000), but Hansson and Olofsdotter (2005) and Bretschger (2005) provide similar results when using the Devereux and Griffith (1999), respectively the Mendoza et al. (1994) rates.

[16]The micro-based effective tax rates calculated by Nicodème (2001) are defined as the country averages of corporate taxes paid in relation to corporate profits and are therefore backward-looking in their nature.

the two different forms of measures of tax rates, these differences are not completely consistent across studies. For example, Winner (2005) uses implicit tax rates on capital and labour, but finds evidence for the negative impact of increased capital mobility on capital taxation.

Another possible reason for differences between studies is in their treatment of the other key variable: **openness**. A variety of measures have been used again, as shown in the Appendix. Two approaches have been common.

One is to use measures based on flows of either capital or goods and services. A very common approach, beginning with Garrett (1995), uses the sum of exports and imports as a proportion of GDP. A variation on this, as used, for example, by Haufler, Klemm and Schjelderup (2006) is to use the sum of inward and outward FDI as a proportion of GDP. Of course, such measures are not ideal: indeed they do not really measure the extent of openness, at all, but rather the result of openness. Further, and as a result, care needs to be taken in any estimation because of their endogeneity.

Using the sum of exports and imports raises the issue of whether the study is measuring openness to trade or openness to capital flows. As we have discussed above, an economy which is open to trade may become either more or less attractive as a location for investment (depending on where the market, and factors supplies, are located). This may induce changes to source-based corporate tax rates even if there is no change to capital mobility. In particular, greater trade openness may lead to higher location-specific rent and hence higher tax rates.

Use of foreign direct investment is also questionable. First, it is not clear why only direct investment is used, and not portfolio investment. Certainly, it is possible that there are very low costs to cross-border portfolio investment yet much higher costs to cross-border direct investment. But this also raises a question of what we mean by openness. High costs (fixed setup costs, for example) may persist even if there are no official constraints on the movement of capital.

Second, it is not necessarily the case that the sum of inward and outward FDI is related to openness. Flows of both goods and services and capital depend on domestic conditions. There will be an inflow of capital if domestic investment opportunities exceed domestic saving. Suppose investment opportunities are fixed, and capital is freely mobile. Then a rise in domestic savings will reduce inflows of capital. Unless the econometric model adequately controls for the determinants of domestic saving (and domestic investment opportunities), then cross-border flows of capital cannot be taken to measure openness.

Just as with tax rates, the main alternative measures of openness are based on legal controls on capital movements. Several papers use a set of indices created by Quinn (1997) which attempt

to measure such legal capital and financial controls. These do not suffer from the same problems as cross-border flows. But, as with constructed measures of effective tax rates, it is likely that these indices do not reflect all relevant aspects of the degree of openness of an economy. Many papers use both indices of capital controls and measures of flows of goods and services. There are also some other more innovative measures. For example, Winner (2005) uses the correlation of savings and investment as a measure of openness. However, on the whole, there does not seem to be a clear-cut difference in the main results of these papers depending on the measure of openness used.

The broad conclusions of this literature are therefore that there appears to be a negative relationship between measures of openness and statutory or forward-looking measures of tax rates. But - perhaps because openness has the effect of raising profit - if anything, there is a positive relationship with measures of taxation based on tax revenues.

Unlike in the papers discussing trends in taxation, this literature has not distinguished between alternative models of tax competition. Recall that Devereux, Griffith and Klemm (2002) explore differences in trends in statutory tax rates, and effective average and marginal tax rates, and discuss whether differences in trends reflect differences in competition for profit, firms or capital. By contrast, the papers in this literature do not generally investigate these distinctions.

There is a small number of papers which include a measure of the neighbours tax rates as control variables when analysing the impact of openness on taxation.[17] While this is not directly intended as providing evidence for strategic interaction or tax competition it does give a flavour for the existence of tax competition. For example Basinger and Hallerberg (2004) find a positive correlation of neighbours tax changes on the change of the taxation. Similarly Haufler et al. (2006) and Garretsen and Peeters (2007) find a positive correlation between the neighbours tax rates and the ratio of capital to labour taxation, respectively the capital taxation. In contrast Dreher (2006) finds little impact of the neighbours tax rates on different measures of government expenditures and taxes. However, this can potentially be explained through the use of a dynamic panel, which implies that the paper addresses the endogeneity of lagged dependent variable but ignores the endogeneity of the spatial lag. In contrast to this small group of studies which include the neighbours tax rates only as an additional control variable there is a large group of studies which aim to test for strategic interaction and therefore adequately take into account the endogeneity of the neighbours tax rates.

4.3 Strategic Interaction

There is a significant and growing empirical literature which aims to test for strategic competition between governments in various fiscal variables. Most of these studies have been at sub-national

[17] See appendix table A.1a for a more detailled summary of the papers.

level, and most have considered policies other than taxes on corporate income. For example, an early paper in this literature is Case, Rosen and Hines Jr. (1993) which examines the relationship between public expenditures of the 50 US states between 1970 and 1985. Besley and Case (1995), Figlio, Kolpink and Reid (1999), Saavedra (2000), Rork (2003), Egger, Pfaffermayr and Winner (2005), and Devereux, Lockwood and Redoano (2007) also all consider strategic interaction amongst the US states, in a number of dimensions: tax rates on personal income, sales, cigarettes and fuel and welfare spending.[18]

Some other studies investigate strategic behaviour at a still lower level: US counties (Kelejian and Robinson (1993)), Californian cities (Brueckner (1998)), municipalities in Detroit (Anderson and Wassmer (1995)), English districts (Bivand and Szymanski (1997, 2000) and Revelli (2001, 2003)), Belgian municipalities (Heyndels and Vuchelen (1998)), and municipalities in British Columbia (Brett and Pinkse (2000)), Boston (Brueckner and Saavedra (2001), Milan (Bordignon, et al. (2003)), Barcelona (Solé-Ollé (2003)) and Dutch municipalities (Allers and Elhorst (2005)). Again, these studies address a range of different aspects of taxes and expenditures.

There are a few papers providing evidence for strategic interaction between local authorities when setting local business tax rates. Buettner (2001) finds evidence for local tax competition in Baden-Wuerttemberg (Germany) and Charlot and Paty (2010) for French municipalities. In contrast Chirinko and Wilson (2010, 2011) find a negative slope for the reaction function which is at odds with the standard tax competition theory. There are two potential explanations for this different result. First Chirinko and Wilson introduce dynamics by including spatial lags from previous years. Secondly, corporate tax competition between local authorities could be influenced by vertical tax competition between the local jurisdictions and the federal government. Deductibility of local taxes from the federal tax base or revenue sharing mechanisms may imply that local and federal tax rates are strategic substitutes. In consequence horizontal and vertical tax competition may interact and therefore may not be investigated separately. The extent of interaction between the two forms of tax competition depends on the specifics of the fiscal system in the country, e.g. whether the tax bases completely overlap and how much of the total tax burden is due to local taxes. Therefore it is not contradictory that Boadway and Hayashi (2001) find evidence for vertical tax competition for Canadian provinces (large overlap in the tax base and significant share of taxes at the local level) while Leprince, Madiès and Paty (2007) find no vertical interaction between French municipalities (different tax base and smaller share of overall tax burden) and higher tier governments.[19]

[18] Additionally to the large number of studies of strategic interactions between US states, a number of studies address strategic interaction between regions in other countries. See for example Feld and Reulier (2008) and Parchet (2012) for an investigation of strategic interaction in the setting of personal income tax rates in Swiss Cantons.

[19] See also Besley and Rosen (1998), Esteller-Moré and Solé-Ollé (2001) and Rizzo (2009) for studies of vertical tax competition in other forms of taxation.

An additional limitation of studies investigating local corporate tax competition is that alternative locations outside the country are not taken into account. Arguably, firms are basing their decisions on the overall, i.e. local and federal, tax burden and will also consider locations abroad. Therefore we are mostly interested in empirical studies of international tax competition. However, there are very few studies which examine strategic interaction between national governments. Murdoch, Sandler and Sargent (1997) examine environmental emissions in a range of countries, and Goodspeed (2002) examines income tax rates in EU countries.

Only very recently a small but increasing number of papers investigates the existence of strategic interaction in source-based taxes in corporate income. In an early contribution Altshuler and Goodspeed (2002) examine interactions in corporation tax revenues as a proportion of GDP in the OECD between 1968 and 1999. Their main finding is that the EU countries behaved as if the U.S. were a Stackelberg leader in setting corporate taxes after the US 1986 Tax Reform Act but not before. This is consistent with the model of Gordon (1992). There is no evidence that either the UK or Germany played such a leadership role. They also find that over time, EU countries have become less intensely competitive among themselves. This last finding may reflect the fact that their data preceded the expansion of the EU in 2004 which introduced 10 new countries with generally very low corporation tax rates.

The use of revenue based measures to test of tax competition is problematic because of the endogeneity problem discussed in the previous section. However, there is an even more direct concern, namely that countries can not actively set corporate tax revenues. Therefore using revenue to infer something about strategic behaviour in different countries is likely to only capture common macroeconomic shocks or regional spillovers in business cycles. This also becomes evident in Ruiz and Gerard (2008) where they only find strategic interaction in the EU 15 countries in the specifications using tax measures based on the statutory tax system and no evidence for strategic interaction in backward-looking measures.

A number of empirical studies have emerged using statutory or forward-looking effective tax rates to test for corporate tax competition. The specific questions addressed can be classified into three broad categories. First there are papers focusing on the type of tax rates countries compete in, which indirectly also addresses the questions which potentially mobile resources are the target of the tax competition. Secondly, most papers concentrate on the questions of the competitors, i.e. which countries are driving the expected race to the bottom. Finally a number of papers explicitly addresses the question how to distinguish strategic interaction from a common trend and more broadly address the timing issue of the tax rate setting.

There are two papers which explicitly try to identify tax competition in various aspects of the tax system. Devereux, Lockwood and Redoano (2008) consider a model in which firms simultaneously allocate capital (which depends on the effective marginal tax rate) and profit (which depends on the statutory tax rate) between countries. As noted above, small open economies may not be able to influence the world rate of return and consequently we would not expect to observe strategic interaction in effective marginal tax rates. However, they may still compete over profit why we would expect to find evidence of strategic behaviour in statutory rates. This is what this study found, based on OECD data from 1982 to 1999. The second study addressing tax competition in more than one tax instrument is Egger, Pfaffermayr and Winner (2007). They develop a model with both personal tax rates and corporate income tax rates. Using data from the OECD from 1995 to 2005 they find a positive reaction function for both personal and corporate income tax rates, while the two tax rates are strategic substitutes.

While Devereux, Lockwood and Redoano (2008) use a uniform weighting matrix in their preferred specification, the exact design of the spatial weighting matrix has become a central point of a number of recent papers. Departing from a uniform weighting matrix the researcher imposes his priors about the nature of the tax competition game. Using for example distance based weights it is assumed that countries are more responsive to geographically close countries. Other frequently used weights include country size. In contrast to the early study of Altshuler and Goodspeed (2002) where the US is seen as a large Stackelberg leader most of the newer contributions see the European Union as the driving force of tax competition. Starting with Redoano (2007) investigating the European Union itself as the driving force of corporate tax competition the focus shifted increasingly to the low tax Eastern European countries. Chatelais and Peryat (2008), Crabbé and Vandenbussche (2008) and Cassette and Paty (2008) all explicitly investigate the role of small respectively Eastern European countries in the tax competition. Chatelais and Peryat (2008) identify small countries located in the center of Europe as key drivers of tax competition. In contrast Crabbé and Vandenbussche (2008) find a domino effect of strategic interaction starting from the new member states. Davies and Voget (2010) use a more elaborate design of the spatial weighting matrix. Based on the new economic geography theory they calculate market potential weights for the neighbouring countries. More importantly they construct exogenous proxies to avoid the endogeneity of the weighting matrix and allow for different tax reaction functions for countries within or outside the EU. The latter does not only allow to show a stronger reaction within the EU, but also reduces the multicollinearity between the spatial lags and a time dummy.

With a growing number of countries the uniformly weighted average of the neighbours tax rates is increasingly correlated to a time specific effect. This implies that the coefficient for the spatial lag will be difficult to distinguish from the coefficient for a time dummy, in particular if uniform weights are applied. Alternatively, the omission of the time dummies may imply that the spatial lag

measures a common shock rather than the strategic interaction. The issue of distinguishing between spatial interaction and a common trend has been tackled in different forms. Devereux, Lockwood and Redoano (2008) rely on uniform weights and include a country specific trend. Overesch and Rincke (2010) in contrast use distance-based weights and are able to include time dummies to account for common shocks. Apart from the use of a different weighting matrix their approach does also include the lagged tax rate to account for persistence in the tax rates. Their results not only confirm the sluggish adjustment of the tax rates, but also the strategic interaction. In fact the long run effect of the spatial interaction is very similar to the study of Devereux, Lockwood and Redoano (2008).[20]

Finally there is the study by Heinemann, Overesch and Rincke (2010) which focuses on the tax rate cutting decisions and how these are determined by the tax rates in neighbouring countries. Although using a different approach their results are in line with the literature finding positive reaction functions. Using 32 European countries they find that a country is more likely to lower its corporate tax rate if its own rate is high and if its neighbours' tax rates are low.

5 Conclusion

This paper has surveyed the evidence for tax competition in source-based taxes on corporate income. To better understand the testable hypotheses of tax competition models we draw an analogy to the standard competition models on the goods market. This highlights that there are a few common features of the tax competition models, most notably inefficiently low tax rates and positively sloped reaction functions. We pick up these predictions and identify a number of conceptual issues and questions which arise when testing the hypotheses in an empirical study.

The seemingly clear prediction of lower tax rates is hard to test empirically because of a lack of the counterfactual. If the efficient level of the tax rate is unknown, it is not possible to show an inefficiently low level because of tax competition. An extensive literature attempted to cut through this problem by showing a negative relationship between economic integration and the level of tax rates. Unfortunately, although such a negative correlation appears to be an implication of simple tax competition models, more complex models have much more complex predictions. For example, it is possible for a reduction in trade costs to induce greater location-specific agglomeration rents. We therefore argue that even if capital is legally completely mobile it may be *de facto* immobile.

In consequence the exact measure of economic integration matters and even a non-linear re-

[20] Recently, Osterloh and Debus (2012) investigate the political process of the tax setting and provide evidence for positive tax reaction function as a byproduct.

lationship between openness and tax rates seems plausible. A second and even more important measurement issue arises in the tax competition literature. The use of tax measures based on tax revenues introduces a number of econometric and conceptual issues. In consequence the results of studies based on these backward looking measures have rather more mixed results. Some early studies found a positive relationship between such measures and openness, although others have been inconclusive; there is no evidence of strategic interaction in such measures. This divergence in results may not be surprising: it is clear from the data that tax revenues have diverged markedly from rates implied by the statutory tax system. One explanation of this might be that revenues depend closely on profits, which may be shifted between countries because of tax rate differentials. Consequently measures of tax rates based on revenues may contain both the cause (low tax rates) and the consequence (large amount of profits shifted into the country) of tax competition. In addition to this endogeneity problem, there is the conceptual issue that tax revenues are not the policy variable set by the governments. Therefore the use of revenue based measures in models of strategic interaction is more likely to measure common shocks than tax competition.

There has been considerable progress in the empirical literature providing evidence for corporate tax competition by showing strategic interaction between the tax rates. The studies are able to overcome the challenge of separating strategic interaction from a common shock to a varying degree. Similarly some of the studies are taking into account that tax rates are slow to adjust and therefore may only react to changes of the neighbours tax rates with a considerable delay. Despite significant variation in the approaches, there emerges a relatively clear pattern of evidence for tax competition. Tax competition seems to be strongest in the European Union and the accession of the small new Member States has provided a further impetus to the downward competition. This is in stark contrast to early tax competition models where large countries, most notably the US, were seen as the Stackelberg leader in the tax competition.

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Table A1: Empirical literature estimating the impact of increased openness/globalisation/internationalization

Study	Garrett (1995)	Quinn (1997)	Rodrik (1997)
Research Question	The impact of economic internationalisation on domestic politics	Impact of International Financial Regulation on various political and economic variables.	Does increased openness lead to more government expenditure because of a higher exposure to risk?
Fiscal and Tax Measures	Government Spending Capital Taxation (implicit tax rates)	Corporate tax (% of Individual Tax) Corporate tax (% of GDP) Corporate tax (% of Total Tax)	Government Spending Capital Taxes (implicit tax rates) Labor Taxes (implicit tax rates)
Instrumentation of 'Tax Competition' (Globalisation)	Capital Mobility (Number of Restriction x -1) Trade (IM+EX)/GDP	Trade (IM + EX)/GDP Financial Openness (Quinn-Index)	Trade (IM+EX)/GDP Capital Account restrictions
Country coverage	AUS, AUT, BEL, CAN, DNK, FIN, FRA, GER, ITA, JPN, NLD, NOR, SWE, GBR, USA	19 OECD countries, 17 non OECD countries	23 OECD countries
Time coverage	1967-1990	Average of 1974-1989	1966-1991
Control Variables	Lagged dependent variable (+), Economic Growth (-), Unemployment (+/0), Left-labour power (+)	Lagged dependent variable (+ !) Income growth per Capita (0) Investment as % GDP (0)	GDP per Capita (0)
Econometric Method	IV-Estimation for the lagged dependent variable	OLS	Fixed effects (+ year dummies)
Results and Conclusion	Trade increases capital taxation Capital Mobility reduces Government spending	Trade openness leads to a shift towards capital taxation Financial liberalisation increases capital taxation	Openness decreases (increases) capital (labour) taxes Openness reduces Government Expenditure

Table A1 (continued): Empirical literature estimating the impact of increased openness/globalisation/internationalization

Study	Garrett (1998a)	Garrett (1998b)	Swank (1998)
Research Question	Globalisation and erosion of the national autonomy.	Can social democracies be sustained in an increasingly internationalized environment?	Does Globalisation put pressure on government to reduce taxes on business income?
Fiscal and Tax Measures	Government Spending Capital tax rate (implicit tax rate)	Government Spending Capital tax rate (implicit rate)	Capital taxes (implicit tax rates) Labour Taxes (implicit tax rates)
Instrumentation of 'Tax Competition' (Globalisation)	Trade (IM +EX)/GDP Multinationalisation: (FDI)/GDP Financial openness (Quinn)		Trade (IM +EX)/GDP Finance Liberalisation Capital Liberalisation Capital Market flows
Country coverage	OECD 30 - (CZE, HUN, KOR, POL, SVK)	OECD countries	AUS, AUT, BEL, CAN, DNK, FIN, FRA, DEU, IRE, ITA, JPN, NLD, NOR, SWE, CHE, GBR, USA
Time coverage	Average of 1985-1994		1966-1993
Control Variables	n.a.		Profits (+), Growth (+), Election (0), Inflation (0), Left government (0),) Investment (0), Gov. expenditure (+), Lagged dependent (+) GDP per Capita (0)
Econometric Method	unconditional correlation		OLS (plus fixed effects where significant)
Results and Conclusion	Correlation between openness and government spending is positive, with capital taxation negative.	There is no evidence that increased globalisation reduces the countries ability to raise taxes from corporate income taxes.	Increased capital mobility increases taxes on capital and labour Openness reduces taxes on capital and labour

Table A1 (continued): Empirical literature estimating the impact of increased openness/globalisation/internationalization

Study	Hallerberg and Basinger (1998)	Garrett (2000)	Grubert (2001)
Research Question	Has internationalization changed tax policies in the OECD?	How do capital mobility and the exchange rate regime influence the fiscal policies in a global world?	
Fiscal and Tax Measures	Corporate tax rates (implicit rates) Personal income tax rates (implicit rates)	Government spending, Budget deficit, Capital, Labour and Consumption taxes (Mendoza et al.)	Effective tax rates on US foreign direct investment
Instrumentation of 'Tax Competition' (Globalisation)	Liberalisation of capital markets	Trade (IM+EX)/GDP Financial Openness (Quinn) Fixed exchange rate dummy Interaction float openness	
Country coverage		AUS, AUT, BEL, CAN, DNK, FIN, FRA, DEU, GRC, IRE, ITA, JPN, NLD, NZL, NOR, ESP, PRT, SWE, CHE, GBR, USA	60 countries
Time coverage	1986-1990	1973-1993	1984-1992
Control Variables		Lagged dependent variable (+) Unemployment (-), Growth (-), Dependency Ratio(0)	
Econometric Method		Fixed effects (+ year dummies)	
Results and Conclusion	Changes in corporate and personal tax rates are only indirectly related to capital market liberalization.	The fixed exchange rate put significantly more pressure on budgetary discipline and reduces capital taxation.	Evidence for a regression towards the mean, effective tax rates for small open economies fell more.

Table A1 (continued): Empirical literature estimating the impact of increased openness/globalisation/internationalization

Study	Garrett and Mitchell (2001)	Bretschger and Hettich (2002)	Swank and Steinmo (2002)
Research Question	Globalisation and the impact on the welfare state. Has increased integration reduced spending and tax revenues?	Impact of Globalisation on the corporate tax rates, respectively the tax mix.	Impact of globalisation on the tax policies of advanced capitalist countries.
Fiscal and Tax Measures	Government Spending Government Consumption Capital taxes (implicit rates) Capital/Labor Ratio (implicit rates)	Effective average tax rate on capital Effective average labour tax rate Social security contributions capital/labour ratio	Statutory corporate tax rate Corporate taxes (implicit rates) Labour taxes (implicit rates) Consumption taxes (implicit rates)
Instrumentation of 'Tax Competition' (Globalisation)	Trade (IM+ES)/GDP Low wage imports, FDI, Financial Openness, Covered Interest Differential	Trade (IM+EX)/GDP Quinn-Indices residuals of regression of size on trade	Financial Openness (Quinn) Trade (IM+EX)/GDP
Country coverage	AUS, AUT, BEL, CAN, DNK, FIN, FRA, DEU, IRE, ITA, JPN, NLD, NZL, NOR, SWE, CHE, GBR, USA	AUT, BEL, CAN, FRA, DEU, GRC, ITA, JPN, NLD, NOR, SWE, CHE, GBR, USA	AUS, BEL, GBR, CAN, DNK, (FIN), FRA, DEU, ITA, JPN, NLD, NOR, SWE, USA
Time coverage	1961-1993 1967-1992 for taxation	1967-1996	1981-1995
Control Variables	Lagged dependent variable (+) Unemployment (-), Growth (-), Dependency Ratio (0), Left (0), Christian Democrats (0/+)	Growth (-), Lagged dependent variable (+) Country Size (+) Centre of political gravity (-)	Lagged dependent variable (+) Growth (0)
Econometric Method	fixed effects (+ year dummies)	Panel corrected Standard Errors Fixed effects	OLS with panel corrected standard errors Fixed effects
Results and Conclusion	Weak support for a positive impact of FDI on Capital taxation and some evidence for a positive impact of trade on the capital/labour ratio.	Significant negative impact of openness on capital tax rates, positive impact of capital/labour ratio.	Both measures of globalisation reduce the statutory tax rate while there is no evidence for an impact on the implicit tax rates.

Table A1 (continued): Empirical literature estimating the impact of increased openness/globalisation/internationalization

Study	Slemrod (2004)	Hansson and Olofsdotter (2005)	Bretschger (2005)
Research Question	What is the impact of increased openness on corporate tax rates and corporate tax revenues?	How does integration influence the tax competition?	Does trade contribute to economic growth?
Fiscal and Tax Measures	Statutory corporate tax rate Corporate taxes (implicit rates)	Implicit tax rate (Mendoza et al) Effective average tax rate (Devereux and Griffith) Statutory corporate tax rate	Implicit tax rates (calculated as Mendoza et al.)
Instrumentation of 'Tax Competition' (Globalisation)	Openness (Sachs and Warner(1995)) Trade (IM+EX)/GDP	Trade (IM+EX)/GDP Capital restrictions (Quinn) Financial openness (Quinn)	Trade (IM+EX)/GDP Capital restrictions (Quinn) Financial openness (Quinn)
Country coverage	OECD ?	AUS, AUT, BEL, CAN. DNK, FIN, FRA, DEU, IRE, ITA, JPN, NLD, NOR, PRT, ESP, SWE, CHE, GBR, USA	BEL, CAN, FRA, DEU, ITA, JPN, NLD, NOR, SWE, CHE, GBR, USA
Time coverage	1980-1995 ?	1971-1997 (highly unbalanced)	1965-1999
Control Variables	Individual tax rate (+) Capital taxation dummy (0) Government expenditure (+) Population (0)	Growth (0,-), Labour force (0), Labour tax(+), Government Size(0), Trade costs (0,-), GDP per capita(+) Market potential (0,+)	Country size(land area) (-) Centre of Political Gravity (-)
Econometric Method	Pooled OLS, fixed effects	Fixed effects (with year dummies) GMM (Arellano and Bond (1991)) for the dynamic model	3SLS, SUR
Results and Conclusion	Openness puts downward pressures on statutory corporate tax rates, but not on corporate tax revenues	Liberalisation of capital flows do lower corporate taxes, but other variables influencing agglomerative forces need to be accounted for.	Trade fosters growth through the channel of reduced capital taxation.

Table A1 (continued): Empirical literature estimating the impact of increased openness/globalisation/internationalization

Study	Bretschger and Hettich (2005)	Winner (2005)	Krogstrup (2006)
Research Question	Are taxes on corporate capital increasing or decreasing with rising globalisation?	Has internationalisation (especially in small open economies) led to a shift from capital taxation to labour taxation?	How does increased integration influence capital taxation in Europe?
Fiscal and Tax Measures	Effective average tax rates (Genser et al. (2000)) Corporate taxes (implicit rates)	Implicit tax rates for capital and labour (Mendoza et al.) Effective marginal tax rates	Various alterations Effective average Tax Rates (Devereux and Griffith)
Instrumentation of 'Tax Competition' (Globalisation)	Trade (IM+EX)/GDP Financial openness (Quinn)	Savings-Investment correlation (S-I)/GDP	Financial Openness (Quinn) Trade(IM+EX)/GDP
Country coverage	BEL, CAN, FRA, DEU, ITA, JPN, NLD, NOR, SWE, CHE, GBR, USA	23 OECD countries	AUT, BEL, FIN, FRA, DEU, GRC IRE, ITA, NLD, PRT, ESP, SWE, GBR
Time coverage	1967-1996	1965-2000	1980-2001
Control Variables	Lagged dependent variable (+) Growth (-) Centre of Political Gravity (-)	Country size (population) (+), GDP (+), Unemployment (-), Public Debt (+), Inflation (0) Lagged dependent variable (+)	GDP per Capita (-,0), Inflation (0), Participation (+), Unemployment(-,0)
Econometric Method	Panel corrected Standard Errors, some country fixed effects	Fixed effects (+ year dummies), GMM (Arellano and Bond (1991)) for the dynamic model	First Differences OLS IV estimation
Results and Conclusion	Using effective (implicit) tax rates there is a robust and significant negative (positive) impact of globalisation on corporate taxation.	Increased openness has induced as shift from capital to labour (and consumption) taxation. Especially since the mid 1980s.	Increased capital mobility exerts a strong downward pressure on corporate taxation.

Table A1 (continued): Empirical literature estimating the impact of increased openness/globalisation/internationalization

Study	Schwarz (2007)	Loretz (2007)	Ram (2009)
Research Question	Does capital mobility reduce the corporate-labour tax ratio?	What determines the bilateral tax burden?	Is country size or trade openness determining the size of government
Fiscal and Tax Measures	Average effective tax rates macro-economic (Mendoza et al.) micro-economic (Nicodeme) forward looking (Devereux)	Bilateral effective tax rates (calculated according to Devereux and Griffith (1999))	Government consumption in percent of GDP
Instrumentation of 'Tax Competition' (Globalisation)	Capital Mobility (Quinn-Index)	Trade (IM+EX)/GDP EU Membership	Trade (IM+EX)/GDP
Country coverage	BEL, DNK, FIN, FRA, DEU, ITA, NLD, JPN, PRT, ESP, USA, AUT, SWE, (AUS, CAN, IRE, CHE, GRC, GBR, NOR)	OECD 30 (-SVK, MEX, TUR)	up to 154 countries
Time coverage	1979-2000 (averaged over 4 years, unbalanced)	1991-2004 (unbalanced)	1960 - 2000 (unbalanced) yearly, 5 or 10 year averages
Control Variables	Effective number of parties (+,0,-), Unemployment (-), Subsidies (0,-), Population (% of total) (+), Government Investments (0,+)	Country Size (GDP)(-), Remoteness (+), Time Trend (-)	Population (+) GDP per capita (-) Urbanisation (+) Population density (+)
Econometric Method	Pooled OLS, (partly with period dummies)	Fixed effects Hausman-Taylor approach	Pooled OLS Fixed effects
Results and Conclusion	Increased capital mobility has reduced the relative tax burden on capital. Evidence is less strong for backward looking measures.	More open economies tend to impose a lower bilateral effective tax rate.	Once fixed effects are included country size does not drive government size, trade openness still has a positive influence on government consumption.

Table A1a: Empirical literature estimating the impact of increased openness/globalisation (including world tax)

Study	Basinger and Hallerberg (2004)	Haufler, Klemm, Schjelderup (2006)	Garretsen and Peeters (2007)	Dreher (2006)
Research Question	How do the domestic politics influence the tax competition?	How does increased openness affect the capital/labour tax ratio?	What is the impact of capital mobility on capital taxation, controlling for agglomerative forces?	What is the overall effect of globalisation on taxes and social policies?
Fiscal and Tax Measures	Change in ... Top marginal corporate tax rate Implicit tax rate (Mendoza et al.)	Ratio of effective average tax rates (Devereux and Griffith) and effective labour taxes (OECD)	Effective Average Tax Rate (Devereux and Griffith)	Implicit tax rates (Mendoza et al or Volkerink et al.) Government spending Effective average tax rates
Instrumentation of 'Tax Competition' (Globalisation)	Capital Controls (in the World) Ideological Distance (in the World)	Trade (IM+EX)/GDP Capital Mobility (Quinn) (inward + outward FDI)/GDP Share of Services (% value added)	Foreign Direct investment (inward + outward FDI)/Gross Fixed Capital Formation	Globalisation index Economic, Political and Social Globalisation Indices
Country coverage	OECD	AUS, AUT, BEL, CAN, DNK, FIN, DEU, GRC, IRE, ITA, JPN, LUX, NLD, NZL, NOR, ESP, CHE, GBR, USA	AUT, BEL, FIN, FRA, DEU, GRC, IRE, ITA, NLD, NOR, PRT, ESP, SWE, CHE, GBR, AUS, CAN, JPN, USA	30 OECD countries
Time coverage	1980-1997	1980-2001	1982-1999	1970-2000 (averaged over 5 years, unbalanced)
Control Variables	Partisanship(-,0), Growth (+,0), Inflation (-), Own Tax Rate (-), **Change in Competitors Tax (+,0)**	Government consumption (-), Wages (% of GDP)(0) Country Size (GDP)(0) **World tax rates (+)**	Market potential , Trade Costs , Country size, Public Investment, % Left parties (all +) **Neighbours Tax Rates (+)**	Lagged dependent variable (0) Dependency Ratio (0), Growth (-), Unemployment (+), Trade Cost (0) **Neighbours Tax Rates (0)**
Econometric Method	Fixed effects	Fixed effects (+ year dummies) IV estimation (for FDI)	2 SLS fixed effects	Fixed effects (+ year dummies) GMM (Arellano and Bond (1991)) for the dynamic model
Results and Conclusion	Tax reforms of (unweighted) competing countries does positively influence tax reforms.	Trade openness or capital restrictions explain little less of capital taxation than share of multinationals (services).	Increased capital mobility reduces the capital tax burden. Further the tax rates of neighbouring countries exert a positive impact.	No conclusive evidence for an overall impact of globalisation on taxation. Some negative impact for the effective average tax rates.

Table A2: Empirical literature estimating interaction amongst local governments

Study	Case et al. (1993)	Kelejian and Robinson (1993)	Anderson and Wassmer (1995)
Research Question	Do state expenditures depend on the expenditure levels of surrounding states?	Do county police expenditures depend on the police expenditures of the neighbouring countries?	How long do property tax abatements last?
Fiscal and Tax Measures	Sum of direct expenditures of state and local governments	Per Capita Police Expenditures at County level	Property tax grants
Instrumentation of 'Tax Competition' (Globalisation)	**Expenditure of neighbours (common borders, share demographics, similar income)**	**Expenditure of neighbours Tax Rates of Neighbours**	**Interdependence amongst municipalities**
Country coverage	Continental US States	Upper Greater Plain States (10 States, 760 counties)	112 municipalities in Detroit
Time coverage	1970-1985	1987	1974-1992
Control Variables	Per Capita Income (+) squared (-), Federal Grants (+), Pop. Density (-), Share of old people (-), Share of black people (-)	Lagged dependent variable (+), Income Tax Rates (+), Population Density (0), Income per Capita (+)	Median Household Income (), Local Property Prices ()
Econometric Method	Maximum Likelihood	IV-Estimation (cross section)	?
Results and Conclusion	A 1$ increase the neighbours expenditures increases ceteris paribus expenditures by 70c	Lagged neighbours expenditures influence current own spending, "keeping up with the neighbours"	There is evidence of positive duration dependence, or an emulation effect, with first-time abatement offers.

Table A2 (continued): Empirical literature estimating interaction amongst local governments

Study	Besley and Case (1995)	Bivand and Szymanski (1997)	Brueckner (1998)
Research Question	Do US Governors engage in yardstick competition setting taxes rates to increase their chance of reelection?	Is there spatial interdependence through yardstick competition?	Is there strategic interaction in the setting of growth controls in Californian Cities?
Fiscal and Tax Measures	Changes (over 2 years) in Effective Personal Taxes (from TAXSIM) implicit tax rates	Garbage collection in England	Growth control measures
Instrumentation of 'Tax Competition' (Globalisation)	**Neighbours Change in Tax Rates**	**Interdependence amongst municipalities**	**Neighbours Growth Controls (neighbour if within 50,100,150M) Altern. Population weighted**
Country coverage	US states	342 local authorities in England	Californian Cities
Time coverage	1960-1988 1977-1988 (for Eff. Tax rates)	before and after 1988 change in law (introduction of compulsory competitive tendering)	1990
Control Variables	Income (), Unemployment (), Governor Characteristics	Wages(+), Labour majority (+), Properties (+), % Houses (-) London dummy (+)	Population (+), Education (+), House Value (+), Pop. Density (-), Share of 1-person households (-)
Econometric Method	Maximum Likelihood	Maximum Likelihood (following Cliff and Ord (1981))	Maximum Likelihood (as in Case et al. (1993))
Results and Conclusion	Neighbours change in tax rate (1$ increase) influence own tax rates (20c) Important for re-election.	Before the law change spatial interdependence (interpreted as yardstick competition) can be observed, less so after the law change.	Growth controls are set interdependent; probably the channel of influence is through the housing prices

Table A2 (continued): Empirical literature estimating interaction amongst local governments

Study	Heyndels and Vuchelen (1998)	Figlio et al. (1999)	Bivand and Szymanksi (2000)
Research Question	Is there tax mimicking among Belgian municipalities?	Do US state engage in welfare competition?	Is there spatial interdependence through yardstick competition?
Fiscal and Tax Measures	Local income tax rates Local property tax rates	(Change in) Welfare Spending	Garbage collection in England
Instrumentation of 'Tax Competition' (Globalisation)	**Neighbours tax rates (Neighbours defined geographically direct and indirect neighbours)**	**Welfare spending of neighbours (migration weighted)**	**Interdependence amongst municipalities**
Country coverage	589 Belgian municipalities	Continental US States	324 English Districts
Time coverage	1991 (budgetary year)	1983-1994	before and after 1988 change in law (introduction of compulsory competitive tendering)
Control Variables	Inhabitants (0,+), Income per capita (-), % young (0). % old (0,+), Area of municipality (0)	Per Capita Income (0), Recipiency Ratio (0), Republican Share (0) Demographics (0)	Wages(+), Metropolitan (0), Properties (+), % Houses (-) London dummy (+), Labour dummy (+)
Econometric Method	3 SLS	First Differences IV Estimation	OLS Maximum Likelihood Spatial Error Estimates
Results and Conclusion	There is evidence for tax mimicking among Belgian government, even between indirect neighbours.	US states do react to neighbours changes in welfare expenditures. The interaction is more pronounced for drops in expenditures.	There is a spatial interdependence in the garbage collection cost which is only partly mitigated through CCT

Table A2 (continued): Empirical literature estimating interaction amongst local governments

Study	Brett and Pinkse (2000)	Saavedra (2000)	Brueckner and Saavedra (2001)
Research Question	How are the municipal taxes set? Is there an influence form neighbouring jurisdictions?	Do US state engage in welfare competition?	Do local governments engage in strategic property tax competition?
Fiscal and Tax Measures	Business property tax rates	(Change in) Welfare Spending	Effective property tax rates Effective business property tax rates
Instrumentation of 'Tax Competition' (Globalisation)	**Neighbours tax rates (Neighbour defined as road connection, common border, distance or migration)**	**Welfare spending of neighbours (migration weighted)**	**Neighbours tax rates (neighbours defined with borders or weighted with distance and/or population)**
Country coverage	147 Municipalities in British Columbia	Continental US States (excl. Nebraska)	70 cities in Boston area
Time coverage	1987, 1991	1985,1990,1995	1980, 1990
Control Variables	'Federal' Business Tax () Median Income (0), workforce in primary industry (0), parks (-), roads(-)	Per Capita Income (0), % Recipient Households (0), % Afro-American (-,0)	state aid, % African-American % college education, public sector earnings (all +), income per capita (-), population growth (-)
Econometric Method	IV Estimation (structural and reduced form) fixed effects	Cross Section, Pooled OLS with fixed effects, GMM Maximum Likelihood Estimation	Maximum Likelihood Estimation
Results and Conclusion	There is interaction between the municipalities that could be interpreted as tax competition, but no fierce downward pressure.	There is evidence for positive spatial interdependence in welfare spending, not only across direct neighbours.	Significantly positive slopes of the reaction function are found and persist after a law change aiming to restricting local competition.

Table A2 (continued): Empirical literature estimating interaction amongst local governments

Study	Revelli (2001)	Rork (2003)	Bordignon et al. (2003)
Research Question	Is there tax mimicking amongst local governments in setting their tax rates?	How does the interaction between local jurisdictions depend on the mobility of the tax base?	Is there yardstick competition in the setting of local Italian Property taxes?
Fiscal and Tax Measures	District property tax rates	Taxes on motor fuel, taxes on tobacco corporate income tax (implicit rate) personal income tax (implicit rate)	Local business property tax rates
Instrumentation of 'Tax Competition' (Globalisation)	**Neighbours property tax rates (neighbours defined as being in the same county)**	**Neighbours tax rates (defined as bordering, and population weighted bordering)**	**Neighbours tax rates**
Country coverage	296 UK non-metropolitan districts	48 US States	143 municipalities in Milan (Italy)
Time coverage	1983-1990	1967-1996	2000
Control Variables	Grants (-), Tax Base (0), % residential property (0), % unemployment (0)	Outstanding debt(), Democrats(+,0) federal transfers (-,0), election (0), unemployment (+,0), income(+,0,-), % old (+,0,-)	Population (-), Urbanisation (+), Grants per capita (0), % young (-), Income per capita (0), % old (-), Left government (0), Elections (-)
Econometric Method	OLS, GMM in first differences time dummies included	IV-Estimation (following Kelejian/Prucha 1998) Fixed effects included	Maximum Likelihood Estimation
Results and Conclusion	There is a strong and significant spatial dependence between local taxes, interpreted as tax mimicking.	The more mobile a tax base is the stronger the positive reaction to a neighbours tax change.	Evidence for yardstick competition as positive spatial dependence is only significant if mayors have electoral concerns.

Table A2 (continued): Empirical literature estimating interaction amongst local governments

Study	Solé-Ollé (2003)	Allers and Elhorst (2005)	Feld and Reulier (2008)
Research Question	Is there 'tax mimicking' and is it connected to electoral concerns?	Is there tax mimicking (or yardstick competition) in property taxes in the Netherlands?	Is there strategic tax setting in the personal income tax in Swiss Cantons?
Fiscal and Tax Measures	Local motor vehicle tax, Local property tax, Local Business Tax (all implicit rates)	Municipal property tax rates	Effective personal income tax (11 income brackets)
Instrumentation of 'Tax Competition' (Globalisation)	**Neighbours tax rates (neighbours defined over distance, similarity in size, economy and political structure of local business tax**	**Neighbours tax rates (defined as having a common border, or being part of 34 largest municipalities)**	**Neighbours effective personal income tax rates Neighbours are defined geographically**
Country coverage	105 municipalities around Barcelona (excluding smaller than 5000 inhabitants and Barcelona)	496 municipalities in the Netherlands	26 Swiss Cantons
Time coverage	1992-1999	2002	1984-1999
Control Variables	Grants (-), coalition (-,0), Size of tax bases (-,0), Income (+,0), Population (0)	Grants (+), Value of property (-), Inhabitants (+,0), Price of tax (-), income (+) % right wing parties (-)	Population (0,+), % young (0,+), % old (0) income (0,-), grants (0,-), unemployment (0)
Econometric Method	IV-Estimation (following Kelejian/Prucha 1998) Fixed effects, time effects	Maximum Likelihood	IV-Estimation (following Kelejian/Prucha 1998) Fixed effects, time effects
Results and Conclusion	Evidence is found for tax interactions. This effect is stronger if electoral pressures are stronger indicating yardstick competition.	There is significant evidence for tax mimicking, which is identified to be driven by yardstick competition, as political forces drive the interaction.	The largest extent of tax competition is obtained for middle-income groups.

Table A2a: Empirical literature estimating local corporate tax competition

Study	Buettner (2001)	Chirinko and Wilson (2011)	Charlot and Paty (2010)	Chirinko and Wilson (2010)
Research Question	Can tax competition be observed in the setting of local business taxes by German communities?	How are capital tax policies set in US states?	Do agglomeration forces strengthen tax interactions?	How is competition in capital tax policies affected by business contributions?
Fiscal and Tax Measures	Collection Rates of local business tax	Investment tax credit, local corporate tax rates, capital apportionment weights	Local business tax rate 'tax professionelle'	Investment tax credit, local corporate tax rates, capital apportionment weights
Instrumentation of 'Tax Competition' (Globalisation)	**Neighbours Collection Rates of local business tax**	**Neighbours tax credits, corporate tax rates, and apportionment weights up to 4 periods lagged**	**Neighbours tax rates (distance-weighted) Regions tax rates**	**Neighbours tax credits, corporate tax rates, and apportionment weights plus 2 periods lagged**
Country coverage	1111 communities in Baden-Wuertenberg (Germany)	48 contiguous US states	354 urban and 129 rural groups of municipalities	48 contiguous US states
Time coverage	1980-1996	1965 - 2006	2002	1988 - 2006
Control Variables	Lagged dependent (+), Welfare expenditures (+), Population (+), Foreigners (+), Protestant Church (-)	Population (?), Investment rates (?), Voter preferences (0)	Residential tax (+,0) Unemployment (0,+) Urban capital stock (+) Urban dummy (-)	Investment rates (0) Voter preferences (0) Election dummies (0) Business contributions (0)
Econometric Method	IV-Estimation (following Kelejian/Prucha) No fixed effects	Common Correlated Effects Pooled estimator	Maximum Likelihood IV-Estimation	OLS IV-Estimation Fixed state and time effects
Results and Conclusion	Positive interaction between communities in setting tax rates, interpreted as evidence for tax competition.	The slope of the tax reaction function is negative for all three measures of capital tax policy.	There is horizontal tax competition, tax rates are higher in agglomerations, but strategic reactions are not different there.	The slope of the reaction function is negative. Little evidence for an effect of business contributions on capital tax policies.

Table A3: Empirical literature estimating interaction amongst local governments and higher tier governments

Study	Besley and Rosen (1998)	Boadway and Hayashi (2001)	Esteller-Moré and Solé-Ollé (2001)
Research Question	Is there are vertical interaction between federal and state taxes?	Is there vertical and or horizontal interaction in setting business income taxes in Canada?	Is there evidence for vertical tax competition in the US?
Fiscal and Tax Measures	Federal and State Taxes on Cigarettes and Fuel	Federal and local business income taxes	Personal income taxes (implicit rates) General sales taxes (implicit rates)
Instrumentation of 'Tax Competition' (Globalisation)	**Federal Tax Rates**	**Federal taxes and taxes of neighbouring jurisdictions Implicit rates**	**Neighbours Tax Rates, Federal Tax Rate**
Country coverage	Continental US States	Federal Canada, Quebec, Ontario, Rest of Provinces	41 US States
Time coverage	1975-1989	1963-1996	1987-1996
Control Variables	Unemployment (), Real GDP() Population (), Pop. Density (),	Deficit/GDP (), per Capita wages () Inflation (), Political Parties, Capital Utilization Rates () International Interest Rate ()	Population (-,0) squared (+,0) Income per Capita (-), squared (+) Population Density (0), Grants per Capita(-), Democrats (+,0)
Econometric Method	Fixed effects IV Estimation	Seemingly Unrelated Regressions (SUR) estimated as feasible GLS	IV-Estimation
Results and Conclusion	State and Federal authorities are competing for the same tax bases and react to each other in setting taxes.	Negative response to federal taxes (vertical competition) and for some regions positive reaction to others (horizontal competition)	Vertical Tax competition dominates the horizontal one. Evidence for a positive relationship between state and federal taxes.

Table A3 (continued): Empirical literature estimating interaction amongst local governments and higher tier governments

Study	Revelli (2003)	Leprince, et al. (2007)	Rizzo (2009)
Research Question	What is the source of the observed spatial dependencies among local governments and between local and federal governments?	Is the tax setting of the local French business tax influenced by higher tier governments or by neighbouring jurisdictions?	To what extent and how affect federal taxes local tax decisions?
Fiscal and Tax Measures	District expenditure, Council taxes Council taxes on property	Local business tax rate ('taxe professionelle')	Cigarette taxes
Instrumentation of 'Tax Competition' (Globalisation)	**Neighbours council taxes and expenditures (neighbours defined as in the same county or bordering)**	**Neighbours local business tax (neighbours defined as sharing a common border)**	**Federal cigarette taxes** **Neighbours cigarette taxes including US neighbours**
Country coverage	238 English Districts	93 French departements	10 Canadian provinces
Time coverage	Fiscal year 2000/2001	1995	1984-1994
Control Variables	Population (-), Population Density (+) Unemployment (-,0) Poverty (0), Grants (+)	Population (0), Income per capita (-), Grants (0,+), Area (-), Beneficiaries of social programs (0)	Population (-), Unemployment (+), % old (-), % young (-) income per capita (non-linear), grants (-)
Econometric Method	OLS Maximum Likelihood IV-Estimation	OLS Maximum Likelihood IV-Estimation	OLS two stage least square
Results and Conclusion	Large part of the horizontal interaction can be attributed to the vertical interaction, where strong complementarities exist.	There is horizontal interaction between departements, but no vertical interaction with the regions.	Federal tax can affect the provincial tax-rate decisions and therefore limit horizontal tax competition.

Table A4: Empirical literature estimating corporate tax competition between national states

Study	Altshuler and Goodspeed (2002)	Egger, Pfaffermayr and Winner (2007)	Devereux et al. (2008)
Research Question	Goal of the paper is to estimate tax reaction functions. Are European Countries following the US in setting their tax rates?	Do countries compete over both, corporate and personal income taxes?	Do countries compete over tax rates?
Fiscal and Tax Measures	Corporate Tax Revenues/GDP Personal Tax Revenues/GDP	Statutory corporate tax rates Statutory personal tax rates Effective corporate taxes Effective personal taxes	Statutory corporate tax rates Effective corporate tax wedge
Instrumentation of 'Tax Competition' (Globalisation)	**Neighbours Tax rates**	**Neighbours tax rates (inverse distance weighted)**	**Neighbours tax rates (neighbours weighted equally, by GDP or openness)**
Country coverage	OECD countries	30 OECD countries	AUS, AUT, BEL, CAN, DNK, FIN, FRA, DEU, GRC, IRE, ITA, JPN, NLD, NZL, NOR, ESP, PRT, SWE, CHE, GBR, USA
Time coverage	1968-1999	1985-2005 (unbalanced)	1982-1999
Control Variables	GDP per Capita (0), Government spending (+) Personal Tax Rate (-)	Country size (GDP) (0) Unemployment (0),	Income tax rate (+,0), Size (+,0), Openness (0), Urbanisation (0) Public Consumption/GDP(0) % old (0), % young (-,0)
Econometric Method	IV Estimation (Kelejian and Prucha 1999)	2SLS GMM Estimation (Kelejian and Prucha 1999) Fixed effects included	IV-Estimation Country fixed effects
Results and Conclusion	10% decrease in the neighbours tax rate decrease own tax rate by 3.6% US rates matters, less pronounced for personal taxes	Both personal and corporate tax rates are strategic complements, whereas the complementarities are stronger for corporate taxes.	There is strong interdependence in statutory tax rates and effective marginal tax rate, which is even stronger for open countries, which indicates tax competition.

Table A4 (continued): Empirical literature estimating corporate tax competition between national states

Study	Ruiz and Gerard (2008)	Redoano (2008)	Crabbé and Vandenbussche (2008)
Research Question	Is there evidence of strategic corporate tax interaction among EU countries?	Is there Fiscal Interaction among European Countries? Is there an European Union effect in this interaction?	Is the proximity of low tax Eastern European countries responsible for falling tax rates in the EU 15 countries?
Fiscal and Tax Measures	Eff. Average Tax Rates (Devereux/Griffith) micro-based eff. Rates (Nicodeme) macro-based eff. Rates (Martinez-Mongay), Implicit Tax Rates	Government Expenditures statutory tax rates	Statutory corporate tax rates
Instrumentation of 'Tax Competition' (Globalisation)	**Tax rates of neighbours (geographical, economic, tax systems)**	Trade (IM+EX)/GDP FDI (inward+outward)/GDP **Neighbours Tax Rates (GDP, Distance, Openness weighted)**	**New Member States tax rates (Distance weighted)**
Country coverage	EU 15 (differing across tax measures)	AUT, BEL, DNK, FIN, FRA, DEU, GRC, IRL, ITA, LUX, NLD, NOR, PRT, ESP, SWE, CHE, GBR	AUT, BEL, DNK, FIN, FRA, DEU, GRC, ITA, LUX, NLD, PRT, ESP, GBR, SWE,
Time coverage	1993-2001 (unbalanced)	1970-1999	1993-2006
Control Variables	Government Expenditure(-), Personal Income Taxes (+), Capital/Population(-), Dependency Ratio (0)	Population (), Share of Women () Share of old () young () people GDP per capita (), Election (), Left Government ()	Population (0) % young (0) % old (0) GDP per capita (0)
Econometric Method	ML (Case et al. (1993)) IV-Estimation (Kelejian/Prucha 1998)	IV-Estimation (Kelejian/Prucha 1998) GMM (Arellano and Bond (1991)) for dynamic model	IV-Estimation Fixed effects with first oder autocorrelation process in error
Results and Conclusion	Hardly any evidence of strategic interaction, mainly for the EATR and distance weighted neighbours.	Evidence for vertical and horizontal tax competition, higher federal tax rates reduce local taxes, positive interdependence on local level.	Strategic reaction of EU 14 countries to the tax rates in the new Member States. No evidence for interaction to other way round.

Table A4 (continued): Empirical literature estimating corporate tax competition between national states

Study	Cassette and Paty (2008)	Chatelais and Peryat (2008)	Davies and Voget (2010)
Research Question	Are there strategic interactions between the former EU15 countries and the Eastern European countries regarding corporate taxes?	Are small countries leaders of the European tax competition?	Has the expansion of the EU increased international tax competition?
Fiscal and Tax Measures	Statutory corporate tax rates	Statutory corporate tax rates	Effective average tax rate Statutory corporate tax rates
Instrumentation of 'Tax Competition' (Globalisation)	**Neighbours tax rates (different weights) separate impact different groups**	**Neighbours tax rates (different weights) Stackelberg leaders tax rates**	**Neighbours tax rates (market potential weights) separate impact for EU and non-EU** EU dummy
Country coverage	27 EU Member States	25 EU Member States plus Iceland	30 OECD (less Turkey) plus EU 27 =37 countries
Time coverage	1995-2005	1995 - 2006	1980-2005 (unbalanced)
Control Variables	Personal income tax rate (+), GDP per capita (0), Population density (0), % old (+)	% old, unemployment, GDP, GDP per capita, deficit, % public expenditure, (coefficients not reported)	Market potential (+), Government expenditures (+) Urbanisation (+) Dependency ratio (-)
Econometric Method	GMM (Arellano and Bond (1991))	IV-Estimation (Kelejian and Prucha 1999) fixed effects included	IV-Estimation
Results and Conclusion	There is evidence for tax competition between Western EU countries, and between Western and Eastern countries but not between Eastern countries.	Small countries in the geographic center of Europe are the leaders of tax competition in Europe.	Both Member States and non Member States display a positive reaction function. However, within the EU the reaction is stronger.

Table A4 (continued): Empirical literature estimating corporate tax competition between national states

Study	Overesch and Rincke (2011)	Heinemann et al. (2010)	Osterloh and Debus (2012)
Research Question	What are the driving forces behind the corporate tax cuts in Europe?	Are the recent tax rate cuts a result of corporate tax competition?	What is the role of partisan politics in corporate tax competition?
Fiscal and Tax Measures	Statutory corporate tax rates Effective average tax rates Effective marginal tax rates	Rate cut reform of statutory corporate income tax rate	Statutory corporate tax rate Effective marginal tax rates
Instrumentation of 'Tax Competition' (Globalisation)	**Neighbours tax rates (Distance weighted)**	**Neighbours tax rates (Distance and population weighted)**	**Neighbours tax rates (Uniform weights)**
Country coverage	EU 27 countries plus ISL, TUR, CHE, NOR, HRV	EU 27 countries plus ISL, TUR, CHE, NOR, HRV	32 European countries
Time coverage	1983 - 2006	1980 - 2007	unbalanced panel 1980-2006
Control Variables	Openness (0), Personal income tax rate (0,+), % young (+),% old (+), Population (0)	Own tax rate (+), Public consumption (0) GDP (0), population (0) Election (+)	Ideology (-), No. Parties (0) GDP (0), GDP growth (0) Old population (+) Personal income tax rate (+)
Econometric Method	Panel fixed effects IV-Estimation time fixed effects included	Linear probability model Probit, Fixed effects logit	Panel fixed effects, IV-Estimation time fixed effects included
Results and Conclusion	Strong evidence for tax competition in statutory rates, no evidence for tax competition in effective tax rates.	If other countries cut their taxes the probability of a tax rate cut significantly increases.	Not only globalisation and external pressure matter for the tax rate setting Partisan politics are important too.

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