WHAT DO WE KNOW ABOUT CORPORATE TAX COMPETITION?

Michael P. Devereux and Simon Loretz

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.

Keywords: tax competition, corporate taxation

JEL Codes: H25, H21

I. 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 European Union (EU) has set out a code of conduct to combat “harmful tax competition” and the Organisation for Economic Co-operation and Development (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 in the theory of tax competition surveyed by Keen and Konrad (2013). Fueled 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 reviews what we have learned from empirical studies of tax competition. It focuses on one particular form of tax competition — specifically, 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 that 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, pp. 87–88) 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 do 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 behavior 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 cannot affect the world rate of return of capital. Hence, the classical tax competition models 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 in this paper, as 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.

Tax 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. One example of this is yardstick competition, where voters judge the actions of their own government by observing behavior in other jurisdictions.

In this paper, we therefore summarize the types of behavior we are concerned with as the uncooperative setting of source-based taxes on corporate income where the country is constrained by the tax setting behavior of other countries. Such a definition is intended to encompass the behavior of welfare-maximizing or non-welfare-maximizing 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 spillovers.
This very general definition of tax competition already indicates that the theoretical tax competition literature can provide us with multiple testable hypotheses. In Section II 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 analyze what empirical work has uncovered about the nature of tax competition. Broadly, there are three types of studies that have been carried out: (1) studies that describe trends in a variety of measures of tax rates and tax revenues; (2) studies that aim to explain the setting of the tax rate in one country based on factors only from that country; and (3) studies that consider strategic interaction by examining the extent to which tax rates in one country depend on those in other countries. In Section IV we survey all three types of studies.

However, before launching into a summary of empirical work, in Section III, we first discuss what questions the literature is trying to address, and whether and how those questions can be convincingly answered. Section V provides a brief conclusion.

II. 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. The link between the tax competition models and competition in goods markets 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 that 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 maximizing 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 formal 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., it acts like a benevolent dictator), and second, 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

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1 Wilson (1999) and Fuest, Huber and Mintz (2005) provide surveys of the theoretical tax competition literature.
<table>
<thead>
<tr>
<th>Category</th>
<th>Tax Competition Paper</th>
<th>Equivalent Competition Model</th>
<th>Testable Hypothesis</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Bradford and Oates (1971) Oates (1972)</td>
<td>No formalized competition model</td>
<td>Inefficient low levels of public goods</td>
</tr>
<tr>
<td>II</td>
<td>Zodrow and Mieszkowski (1986) Wilson (1986)</td>
<td>Bertrand competition with N players equivalent to perfect competition</td>
<td>“Race to the bottom” Zero (effective marginal) tax rate</td>
</tr>
<tr>
<td>V</td>
<td>Gordon (1992)</td>
<td>Stackelberg competition</td>
<td>Large countries set higher tax rates Positively sloped reaction functions</td>
</tr>
<tr>
<td>VI</td>
<td>Haufler and Wooton (1999) Ferret and Wooton (2010)</td>
<td>Asymmetric Bertrand competition with monopsony/dyopsony</td>
<td>Only large country sets positive taxes Both countries set positive taxes Positively sloped reaction functions</td>
</tr>
<tr>
<td>VIII</td>
<td>Persson and Tabellini (1992)</td>
<td>Asymmetric Bertrand competition</td>
<td>Economic integration lowers tax rates, mitigating political effect Positively sloped reaction functions</td>
</tr>
<tr>
<td>IX</td>
<td>Besely and Case (1995)</td>
<td>not applicable</td>
<td>Positively sloped reaction functions</td>
</tr>
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</table>
level of public goods and whether the government is acting in the best interest of its citizens.

The first formal tax competition models by Zodrow and Mieszkowski (1986) and Wilson (1986) describe a situation where small open countries decide on the tax rate of 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 participant acts as a price taker. 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 examining the underlying assumptions necessary for this outcome. The main assumptions are 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 model, 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. Their models imply a larger 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 (e.g., the United States) 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

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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.
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 its bargaining power vis-à-vis the companies. For example, modeling 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.

The reason that the countries are able to impose positive tax rates is the existence of location-specific rents due to access to markets or the agglomeration of economic activity. The role of tax in new economic geography models that include explicit modeling 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 model is two possible equilibria: either the existence of an agglomeration (the concentrated case) or the absence of a stable economic core (the dispersed case). The nature of 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 cannot attract the mobile firms. This is more or less equivalent to a case of monopolistic competition with only two players. In the case of a dispersed equilibrium the tax competition game is again 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 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 agglomeration, and in direct consequence tax competition.

Yet another form of tax competition model 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, the ownership of capital 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 concept is again 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 neighboring jurisdictions, which results in a positive interaction of the tax rates even if there are no fiscal externalities.
III. 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 of the more recent tax competition models have the common feature of a positively sloped reaction function. And finally, there is the prediction of a non-linear impact of economic integration on the strength of tax competition. This section explores the extent to which these empirical predictions are testable.

A. Lack of a Counterfactual for Tax Rates

The supposedly clearest prediction from the theoretical tax competition models is a 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. Unfortunately, theoretical models (typically of optimal tax rates) do not even give clear-cut predictions for the first part of these. For example, models differ in their prescriptions for whether capital income should be taxed at all. 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 effectiveness of the 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.

While it is thus very difficult to attribute the level of taxation to either competitive pressures or other reasons, this did not stop the early empirical literature from finding a shortcut to test for tax competition. The most common approach 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 approach can potentially bypass the problem of determining the expected tax rate in a country in favor of ask-

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4 Once the expenditure side is included, it is also possible to construct tax competition models that predict negative reaction functions. For example Mintz and Tulkens (1986) derive negative reaction functions when governments 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 Banks and Diamond (2010) provide a recent survey of this issue.

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.
ing 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.

B. Economic Integration and Tax Competition

A significant number of empirical studies test the prediction of the standard tax competition literature where capital is fully mobile and the tax rate is competed down to zero. 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 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 as being only imperfectly mobile. Even in the 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, 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 tax setting decisions and therefore it should be taken into account when testing for tax competition.

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

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8 This is also reflected in the review of the role of capital mobility on capital taxation by Zodrow (2010).
Each country can only set one tax rate in response to influence from many potentially competing countries. This implicit aggregation of the competitive pressures is modeled explicitly in the construction of a spatial weighting matrix that averages the competitors tax rates. The appropriate choice of the weighting matrix depends on the tax competition model one wants to test. As a 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 in detecting 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. 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 neighbors 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 ensures that strategic interaction is correctly identified.

Strategic interaction among 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. 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 that 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, discussed by 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 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

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9 LeSage and Pace (2009) provide a discussion of the design of spatial weighting matrices.
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 that differentiates the different types of resource flow models is whether we would expect strategic interaction in these tax rates. For a small open economy, flows of capital depend only on the internationally determined 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 rents exist or if firms have to incur significant fixed costs 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.\(^\text{10}\)

D. Timing of Tax Rate Changes

One additional factor should be taken into account. The popular view that tax competition is taking place is fueled 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.

IV. EMPIRICAL EVIDENCE

We classify the empirical tax competition literature in two dimensions, shown in Table 2.\(^\text{11}\) The first dimension categorizes competition according to three groups of observed phenomena. First, we consider studies based on legal tax rates, such as the statutory

\(^{10}\) Devereux, Griffith, and Klemm (2002) also investigate this issue.

\(^{11}\) 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 studies (similar to our category of strategic interactions).
Table 2
Classification of Empirical Studies

<table>
<thead>
<tr>
<th>Observed Phenomena</th>
<th>Measures Based on Statutory Tax System</th>
<th>Measures Based on Tax Revenues</th>
<th>Measures of Other Taxes and Expenditures</th>
</tr>
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tax rate or forward-looking measures of effective tax rates. Second, we consider studies based on the expected results of 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 that mainly consider 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 that estimate directly the interactions between the governments.

Combining these two dimensions Table 2 depicts nine resulting broad categories. We identify studies that belong to each of these categories. More details of each study are given in the Appendix of the working paper version of this paper (Devereux and Loretz, 2012). 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.

A. Developments 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 that 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 tax within the EU.

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: capital, labor, 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 labor income generally increased. The absence of any downward trend is consistent with Ruding Committee’s (1992) observations on corporate tax revenues.

Along the same lines, Desai (1999) investigates tax revenues in OECD countries in combination with home country taxation of capital exporters and argues — consistent with Gordon (1992) — that the race to the bottom is attenuated by the foreign credit status of exporting firms. Chennells and Griffith (1997) also investigate developments
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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 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 (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 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 the literature and analyzes 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.

B. Domestic Determinants of Tax Rates

The largest group of studies analyzed in this review can be classified as econometric studies that examine the determinants of tax rates by reference to country-specific variables and thus 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 our working paper Appendix (Devereux and Loretz, 2012). Instead, we highlight some of the important characteristics of this literature, while giving a broad summary of their results. Virtually all these studies attempt to identify the effects of increasing globalization, internationalization, or increased capital mobility on source-based taxes on corporate income. We will generally refer to this as the effect 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 labor.\footnote{Schulze and Ursprung (1999) provide an extensive summary of the early empirical literature on globaliza-
tion and government activities. Subsequently Rodrik (1998) finds a positive empirical connection between trade openness and the size of government, which has inspired a related but separate strand of theoretical and empirical literature, including Alesina and Wacziarg (1998), Liberati (2007) and Ram (2009).}

Two aspects of the tax measures used in these studies 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 could 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 increased opportunities to shift activities nearer to markets, or nearer to other producers in an agglomerated area, may also increase profit.

A second problem with the Mendoza, Razin, and Tesar (1994) measures is that 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.\footnote{Martinez-Mongay (2000) provides 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 the tax ratios of Mendoza, Razin, and Tesar (1994) have some major flaws and propose more detailed implicit tax rates.} Devereux and Klemm (2004) analyze 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 by economists) instead uses measures of statutory or forward-looking effective tax rates. The earliest of these papers were Gru
dbert (2001), Bretschger and Hettich (2002), Swank and Steinmo (2002), and Krogstrup (2004),\footnote{A much earlier paper also using effective tax rates, though not in an econometric analysis, is Devereux (1995).} although these studies have now been followed by several other papers, listed and described in the Appendix of Devereux and Loretz (2012). 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 (1999, 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 measures of openness. For example, Bretschger and Hettich (2005) explicitly compare the two approaches of using forward-looking and backward-looking rates.\footnote{They use the forward-looking rates developed by Genser, Hettich, and Schmidt (2000). Hansson and Olofsdotter (2005) and Bretschger (2005) obtain similar results when using the Devereux and Griffith (1999) and the Mendoza, Razin, and Tesar (1994) rates, respectively.} 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).\footnote{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.} 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 these studies suggest a broad pattern of differences in the relationship of openness and 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 labor, 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. 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 foreign direct investment (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 discussed above, an economy that 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) that 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 conclusion of this literature is 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 that include a measure of the neighboring countries’ tax rates as control variables when analyzing the impact of openness on taxation. While this is not directly intended to provide evidence for strategic interaction or tax competition, it does give a flavor for the existence of tax competition. For example, Basinger and Hallerberg (2004) find a positive correlation between tax changes in a country and tax changes of its neighbors. Similarly Haufler, Klemm, and Schjelderup (2006) and Garretsen and Peeters (2007) find a positive correlation between neighbors’ capital tax rates and the ratio of capital to labor taxation. In contrast, Dreher (2006) finds little impact of neighbors’ tax rates on different measures of government expenditures and

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17 Appendix Table A.1a in Devereux and Loretz (2012) provides a more detailed summary of these papers.
What Do We Know about Corporate Tax Competition?

C. Strategic Interaction

There is a significant and growing empirical literature that tests for strategic competition between governments in various fiscal variables. Most of these studies have been at the sub-national 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 (1993), which examines the relationship between the public expenditures of the 50 U.S. 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 among the U.S. states in a number of dimensions: tax rates on personal income, sales, cigarettes, fuel, and welfare spending.\(^\text{18}\)

Some other studies investigate strategic behavior 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, Cerniglia, and Revelli, 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) as do 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 standard tax competition theory. There are two potential explanations for this result. First, Chirinko and Wilson introduce dynamics by including spatial lags from previous years. Second, 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. As a consequence, horizontal and vertical tax

\(^{18}\) In addition to the large number of studies of strategic interactions between U.S. states, a number of studies address strategic interaction between regions in other countries. Feld and Reulier (2008) and Parchet (2012), for example, provide an investigation of strategic interaction in the setting of personal income tax rates in Swiss Cantons.
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 Boodway and Hayashi (2001) find evidence for vertical tax competition for Canadian provinces (characterized by large overlaps in the tax base and significant shares of taxes at the local level), while Leprince, Madiès, and Paty (2007) find no vertical interaction between French municipalities (with different tax bases and smaller shares of the overall tax burden) and higher tier governments.19

An additional limitation of studies investigating local corporate tax competition is that alternative locations outside the country are not taken into account. Arguably, firms base 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 that 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.

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 United States were a Stackelberg leader in setting corporate taxes after the U.S. Tax Reform Act of 1986 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 that introduced 10 new countries with generally very low corporation tax rates.

The use of revenue-based measures to test for 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 cannot actively set corporate tax revenues. Therefore using revenue to infer something about strategic behavior 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 use 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

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19 Besley and Rosen (1998), Esteller-Moré and Solé-Ollé (2001), and Rizzo (2009) also provide studies of vertical tax competition in other forms of taxation.
countries compete in, which indirectly also addresses the questions that potentially mobile resources are the target of the tax competition. Second, most papers concentrate on determining competitors, i.e., which countries are driving the expected race to the bottom. Finally, a number of papers explicitly address the question of how to distinguish strategic interaction from a common trend and more broadly address the timing of tax rate setting.

There are two papers that 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, which is why we would expect to find evidence of strategic behavior in statutory rates. This is what Devereux, Lockwood, and Redoano found, based on OECD data from 1982–1999. A second study addressing tax competition in more than one tax instrument is Egger, Pfaffermayr, and Winner (2007), who develop a model with both personal tax rates and corporate income tax rates. Using data from the OECD from 1995–2005 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. By 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. Another frequently used weight is country size. In contrast to the early study of Altshuler and Goodspeed (2002) where the United States is seen as a large Stackelberg leader, most of the newer contributions see the EU as the driving force of tax competition. Starting with Redoano (2007), who investigated the EU as the driving force of corporate tax competition, the focus has shifted increasingly to the low tax Eastern European countries. Chatelais and Peryat (2008), Crabbé and Vandenbussche (2009), and Cassette and Paty (2008) all explicitly investigate the role of small respectively Eastern European countries in 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 (2009) 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 neighboring countries. More importantly they construct exogenous proxies to avoid the endogeneity of the weighting matrix and allow for different tax reaction functions to countries within or outside the EU. The latter not only shows a stronger reaction within the EU, but also reduces multicollinearity between the spatial lags and a time dummy.
With a growing number of countries the uniformly weighted average of the tax rates of neighboring countries is increasingly correlated with 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, particularly if uniform weights are applied. Alternatively, the omission of 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 (2011), 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 also includes the lagged tax rate to account for persistence in the tax rates. Their results not only confirm the sluggish adjustment of tax rates, but also strategic interactions. In fact the long run effect of the spatial interaction is very similar to Devereux, Lockwood, and Redoano (2008).

Finally, Heinemann, Overesch, and Rincke (2010) focus on tax rate cutting decisions and how these are determined by the tax rates in neighboring countries. Although using a different approach, their results are consistent 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 neighbors’ tax rates are low.

V. POLICY IMPLICATIONS AND CONCLUSION

This paper surveys 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 in goods markets. This highlights a few common features of tax competition models, most notably inefficiently low tax rates and positively sloped reaction functions. We focus on these predictions and identify a number of conceptual issues and questions that arise when testing the hypotheses in an empirical study.

The seemingly clear prediction of lower tax rates is hard to test empirically because of the lack of a counterfactual. If the efficient level of the tax rate is unknown, it is not possible to show an inefficiently low level due to tax competition. An extensive literature attempts to address 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.

As a consequence, the exact measure of economic integration matters and even a non-linear relationship between openness and tax rates seems plausible. A second and even

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20 Recently, Osterloh, and Debus (2012) investigate the political process of tax setting and provide evidence for a positive tax reaction function as a byproduct.
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. As a 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 the 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 amounts 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 in providing evidence for corporate tax competition by showing strategic interaction between tax rates. These studies are able to overcome the challenge of separating strategic interaction from a common shock to varying degrees. Similarly, some studies take into account that tax rates are slow to adjust and therefore may only react to changes of neighbors’ 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 EU and the accession of the small new member states has provided a further impetus to downward competition. This is in stark contrast to early tax competition models where large countries, most notably the United States, were seen as the Stackelberg leader in tax competition.

What are the policy implications of the existence of tax competition in the form we have identified in this survey? The analogy to goods market competition would suggest that competition is beneficial because it prevents potentially wasteful governments from imposing overly high taxes. However, this conclusion may fall short because the surplus of corporations is not equivalent to government revenues. Therefore, tax competition in its most extreme form may not be a desirable outcome. Tax coordination in order to reduce corporate tax competition has proved to be difficult to implement on an international basis. Therefore the best response, especially for large countries like the United States, may be to improve the attractiveness of the country as a corporate location. This in turn will allow the maintenance of a higher corporate tax rate, provided other countries do not facilitate profit shifting to a large extent. In a sense one could draw another analogy to the goods market and interpret some of the parts of international tax regimes as dumping since they allow different tax treatment for foreign firms. As in the case of international trade, countries must agree to ban such favorable treatment for foreign companies, which also reflects the stance of the EU. Corporate tax competition is not bad as such, but it needs to follow certain rules in order not to be harmful.
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REFERENCES


