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Countries Do Compete over Corporate Tax Rates while Keeping Revenues Stable

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1 Introduction

In the last few decades, the global landscape of corporate income taxation has witnessed a significant transformation characterized by a widespread decline in tax rates levied on corporate profits. For instance, in OECD countries, the average statutory tax rate on firms' income was 46.5% in 1982 and reached 21.2% in 2022. This phenomenon has sparked intense debate among policymakers and economists regarding its potential impact on tax revenues and broader economic implications. Understanding what is driving reductions in tax levels and the effects on government revenues is crucial for designing effective tax policies and ensuring sustainable fiscal frameworks, and is thus the motive behind this discussion.

As countries increasingly engage in cross-border trade and investments, the effectiveness of corporate income tax policies becomes intertwined with considerations of capital mobility and investment flows. Quinn's index on the intensity of capital controls indeed reveals a concomitant relaxation of capital restrictions to the rise of trade activities. Consequently, as countries become more interconnected through trade, the need for effective tax coordination becomes evident. In fact, harmonizing tax policies and promoting international tax cooperation can help address challenges such as base erosion, profit shifting, and tax avoidance, which can undermine fair taxation and erode tax revenues. The efforts of the OECD are heading in this direction, and a particular example is the BEPS project that started back in 2013. Aiming to tackle harmful base erosion and profit shifting, as of today, it is signed by 135 countries and, in December 2022, the Council of the European Union unanimously agreed to implement the Minimum Tax Directive, which mirrors Pillar Two of the BEPS project and introduces the global minimum tax on corporate profits.

Part of the literature, such as Weichenrieder (2005), in spite of the drastic downward trend in corporate tax rates, has investigated the advantages of retaining corporate taxation. Firstly, corporate income taxation serves as a vital source of tax revenues for governments. This is especially true for developing countries, where corporate tax revenues comprise a large part of the fiscal budget. For instance, in 2021, in Colombia and Chile, corporate income tax revenues accounted for 23% and 17% of all tax revenues, respectively, while in Germany and Italy they accounted for only 6% and 4%, respectively.

Secondly, corporate income taxation acts as a backstop for personal income tax systems. Without corporate income taxation, there would be an increased incentive for individuals to reclassify their income as corporate profits, thereby reducing their personal tax liability. All in all, corporate income taxation still plays a central role in many different ways, and therefore downward tax rates must be carefully analyzed.

The following discussion breaks up as follows. Initially, the paper "Do countries compete over corporate tax rates?" by Devereux, Lockwood, et al. (2008) is described and commented. Here, the authors study how governments set their tax levels as part of a strategic interaction with other jurisdictions. Building up a decision model for firms' and countries' strategies, they conclude by arguing that the decline in corporate income tax rates can be attributed in large part to increased tax competition caused by the loosening of capital restrictions. It follows the second article, "Corporate tax revenues in OECD countries" by Clausing (2007). She examines the determinants of tax revenues, breaking them down into their components so that governments can understand what they are determined by. In fact, revenues are not only driven by tax rates, but the reaction of businesses, in terms of profitability or participation in the economy, also plays an important role. In addition, the third Section links the previous two analyses, poses criticisms and suggestions, and unveils an upcoming area for policy action. Lastly, a sum-up closes the essay.

2 | Countries do compete over corporate tax rates

The continuous reduction of the corporate income tax burden may seem to some to be detrimental to government tax revenues. Actually, lowering firm income tax rates is part of a strategic game in which countries have found themselves not to lose existing and potential capital after the surge of internationalization and trade. Devereux, Lockwood, et al. (2008), in their paper titled "Do countries compete over corporate tax rates?", model this interaction between states as a competitive game. First, by constructing Nash equilibrium tax rates and then comparing them with actual tax rates, they explain the decline in corporate income tax rates with the progressive loosening of capital controls.

2.1 A theoretical framework

2.1.1 A model of corporate tax competition

In a tax-competitive setting with two countries, home and foreign, both have inhabitants and a multinational firm with its headquarters. Every resident benefits from consuming a private good, x, and of a public good, g. The provision of the public good by the local government is financed through a source-based corporate tax on the profits realised in the country. Consequently, the global after-tax profit of the multinational with the parent in the home country is:

$$\begin{aligned}\Pi &= \overbrace{f(k) - rk - q - \tau(f(k) - ark - q)}^{\text{home profit}} + \overbrace{(1-\tau^*)(q-c)}^{\text{foreign profit}} \\ &= (1-\tau)(f(k) - zrk - q) + (1-\tau^*)(q-c)\end{aligned} \tag{2.1}$$

where the home profit is realised from the output, $f(k)$, employing k units of capital, which is purchased from households at price r, and a discrete input bought from the affiliate in the foreign country at price q, i.e. the transfer price. In the home country, the firm pays the tax $\tau(f(k) - ark - q)$, where $0 \leq \tau \leq 1$ is the statutory tax rate, and $a \geq 0$ is the portion of the cost of capital deductible from revenues, i.e. the rate of allowance. Finally, the profit of the foreign affiliate, $q - c$, where c is the cost of producing the discrete input, is taxed at the foreign statutory tax rate τ^*.

In their model, Zodrow and Mieszkowski (1986) consider the presence of only one instrument at the government's disposal, a tax on returns to capital, here, Devereux, Lockwood, et al. (2008) provide the government with the possibility to set a, and consequently influencing the EMTR, that is $z - 1 = \frac{(1-a\tau)}{1-\tau} - 1$.

2.1.2 The players' perspective

The objective of both parent firms is to maximize the global profits, Π and Π^*, having as control variables the transfer prices, q and q^*, and the capital, k and k^*, resulting, for the home multinational, in $\max_{q,k} \Pi$. In doing so, firms consider the possibility of being convicted of a fine EF by the government if they disobey the arm's length principle for transfer pricing. Therefore, the maximization problem of the home multinational breaks down as follow, and it illustrates how the multinational firm chooses where to locate investments and corporate income:

$$\max_{q,k} \Pi - EF(i) \quad \Longrightarrow \quad (i)\, \frac{\partial \Pi}{\partial q} = 0\,,\; q = c + \frac{\tau - \tau^*}{2\alpha} \quad ; \quad (ii)\, \frac{\partial \Pi}{\partial k} = 0\,,\; f'(k) = zr \tag{2.2}$$

From Eq. 2.2 (i), it follows that q is the profit-maximizing transfer price, and it depends on the difference between the two statutory rates. As τ increases, the home parent is more encouraged to rise q in order to shift the profits to the foreign affiliate, where the statutory tax rate is lower, and conversely, if τ^* grows. In Eq. 2.2 (ii), the capital is implicitly defined and depends on the interest rate r and on z. A higher z requires a higher capital productivity $f'(k)$, which is associated with a lower capital stock k in the country.

Once described the general setting and the firm's perspective, it is now necessary to analyze the country's behaviour in the strategic tax game, with the ultimate goal of finding its symmetric Nash equilibrium and reaction functions. In other words, how and if a government reacts when other countries change their tax rates.

The home government maximizes the welfare in the country by choosing its own statutory tax rate τ and the coefficient z, taking the foreign rates, τ^* and z^*, as given: $\max_{\tau,z} W = r\kappa + \Pi - EF + v(g)$. As the inhabitants fully own the firm, the first three terms represent the income of the residents, consisting of the return from the capital κ borrowed to the firm, the profit Π minus the possible fines EF, and $v(g)$, the utility from the consumption of the public good.

The budget constraint of the government, where $\pi(zr)$ is the profit function, is $g = \tau(\pi(zr) - q) + (z-1)rk(zr) + \tau(q^* - c)$. The first two terms are the tax collected by the home government from the national parent as a mixture of the statutory tax base and the EMTR base. The last term represents the revenues from the profits realised by the local affiliate of the foreign parent.

The government maximizes W, subject to its budget constraint, and the optimal tax rates result from the first-order conditions: $\frac{\partial W}{\partial \tau} = W_\tau = 0$ and $\frac{\partial W}{\partial z} = W_z = 0$. In equilibrium, it is now imposed that both countries choose the same rates, $(\tau,\, z)$=(τ^*,z^*). In other words, a symmetric Nash equilibrium of the governments' choices (strategies) is reached. Solving the optimization problem of the government at the symmetric Nash equilibrium, i.e. $(\tau = \tau^* = \hat{\tau}, z = z^* = \hat{z})$, $\hat{\tau}$ and $\hat{z}$ result in:

$$W_\tau = \frac{\partial \hat{\Pi}}{\partial \tau} + v' \frac{\partial g}{\partial \tau} \quad \xrightarrow{\text{solving for } \hat{\tau}} \quad \hat{\tau} = \frac{\alpha(v'-1)(\pi - c)}{v'} \tag{2.3}$$

$$W_z = \frac{\partial \hat{\Pi}}{\partial z} + v' \frac{\partial g}{\partial z} + \frac{\partial W}{\partial r}\frac{\partial r}{\partial z} \quad \xrightarrow{\text{solving for } \hat{z}} \quad \frac{\hat{z}-1}{\hat{z}} = \frac{(v'-1)(1-\hat{\tau})}{v'\epsilon} + \frac{\partial W}{\partial r}\left(\frac{z\partial r}{r\partial z}\right)\frac{1}{v'k\epsilon} \tag{2.4}$$

Eq. 2.3 characterizes $\hat{\tau}$, the statutory tax rate in equilibrium. It depends on the statutory tax base $(\pi - c)$, and it is inversely proportional to the sensitivity of the tax base to the statutory tax, $\left(\frac{1}{\alpha}\right)$ from Eq. 2.2 (i). This suggests that as the tax base becomes more sensitive to changes in the statutory tax rate (higher $\frac{1}{\alpha}$), the equilibrium tax rate decreases. Eq. 2.4 defines the optimal EMTR, $(\hat{z} - 1)$. Interestingly, if the government aims to increase its revenue, and the elasticity of taxable income ϵ is inversely related to the EMTR, then a higher value of ϵ would result in a lower EMTR. This relationship suggests that when firms are more responsive to changes in tax rates (higher ϵ), the government needs to set a lower EMTR to generate the desired level of revenue.

2.1.3 Reaction functions

Theoretically, both the tax instruments of a government, τ and z, react to both τ^* and z^*, their reaction functions are $\tau = T(\tau^*, z^*)$, $z = Z(\tau^*, z^*)$. The best approximation around the Nash equilibrium of the reaction functions can be obtained by linearizing W_τ and W_z using total differentiation.

$$\begin{pmatrix} W_{\tau\tau} & W_{\tau z} \\ W_{\tau z} & W_{zz} \end{pmatrix} \begin{pmatrix} \partial\tau \\ \partial z \end{pmatrix} = - \begin{pmatrix} W_{\tau\tau^*} & W_{\tau z^*} \\ W_{z\tau^*} & W_{zz^*} \end{pmatrix} \begin{pmatrix} \partial\tau^* \\ \partial z^* \end{pmatrix} \tag{2.5}$$

From Eq. 2.5, it is now possible to describe the slopes of the reaction functions. Firstly, τ and τ^* are strategic complements, $W_{\tau\tau^*} > 0$. If τ^* grows, q decreases and the statutory tax base $\pi - c$ increases, resulting in a higher τ. Secondly, τ and z^* are strategic complements, $W_{\tau z^*} > 0$. If z^* grows, results in a lower price of capital and higher profits $\pi(zr)$ and higher τ. Moreover, z and τ^* are strategically independent, $W_{z\tau^*} = 0$. If τ^* grows, this influences the transfer prices q and q^*, but it does not influence z. Lastly, Devereux, Lockwood, et al. (2008) finds that z and z^* are also strategic complements, $W_{zz^*} > 0$, but only imposing further assumptions.

In conclusion, the key findings of the theoretical model built by the authors are the following. First, there are positive effects within the same tax, i.e. $\frac{\partial \tau}{\partial \tau^*} > 0$, $\frac{\partial z}{\partial z^*} > 0$. Second, between different taxes, the effects are smaller, in particular $\frac{\partial z}{\partial \tau^*} < 0$, $\frac{\partial \tau}{\partial z^*} > 0$.

2.2 Testing the theory

2.2.1 Equations for the reaction functions

Once found the theoretical assumptions to test, Devereux, Lockwood, et al. (2008) expresses, and expands, the empirical formulation for both the reaction functions, $T(\cdot)$ and $Z(\cdot)$. At first, in both reaction functions, a vector $\mathbf{X}$ of variables that affect public spending is included. Considering n countries, the country's i reaction functions are $\tau_i = T_i(\boldsymbol{\tau}_{-i}, \mathbf{z}_{-i}, \mathbf{X}_i)$ and $z_i = Z_i(\boldsymbol{\tau}_{-i}, \mathbf{z}_{-i}, \mathbf{X}_i)$. A linear approximation of both at the Nash equilibrium, like in Section 2.1.3, is:

$$\tau_{i,t} = \hat{\tau}_i + \sum_{j \neq i} \frac{\partial T_i}{\partial \tau_j} \boldsymbol{\tau}_j + \sum_{j \neq i} \frac{\partial T_i}{\partial z_j} \mathbf{z}_j + \boldsymbol{\eta}_1' \mathbf{X}_i \qquad i = 1, \ldots, n \tag{2.6}$$

$$z_{i,t} = \hat{z}_i + \sum_{j \neq i} \frac{\partial Z_i}{\partial \tau_j} \boldsymbol{\tau}_j + \sum_{j \neq i} \frac{\partial Z_i}{\partial z_j} \mathbf{z}_j + \boldsymbol{\eta}_2' \mathbf{X}_i \qquad i = 1, \ldots, n \tag{2.7}$$

where $\hat{\tau}_i$ and $\hat{z}_i$ are the Nash equilibrium rates, and $\boldsymbol{\eta}_1'$ and $\boldsymbol{\eta}_2'$ are the coefficients for $\mathbf{X}_i$. The second and third terms describe the behaviour of the reaction functions to changes in the rates of the other countries. Clearly, this impacts the calculations significantly and, therefore, Devereux, Lockwood, et al. (2008) replaces them like follows, e.g. $\frac{\partial T_i}{\partial \tau_j} = \beta_1 \omega_{ij}$ and $\frac{\partial T_i}{\partial z_j} = \gamma_1 \omega_{ij}$, assuming every country exhibits a uniform response to the weighted average tax rates of the other countries, $\overline{\tau}_i$ and $\overline{z}_i$.

To conclude, the following are the equations used by the authors to empirically test the theoretical assumptions of the reaction functions modelled in the previous sections:

$$\tau_{i,t} = \beta_1 \overline{\tau}_{i,t} + \gamma_1 \overline{z}_{i,t} + \boldsymbol{\eta}_1' \mathbf{X}_{it} + \phi_{1i} + T_{1it} + \varepsilon_{1it} \qquad i = 1, \ldots, n \tag{2.8}$$

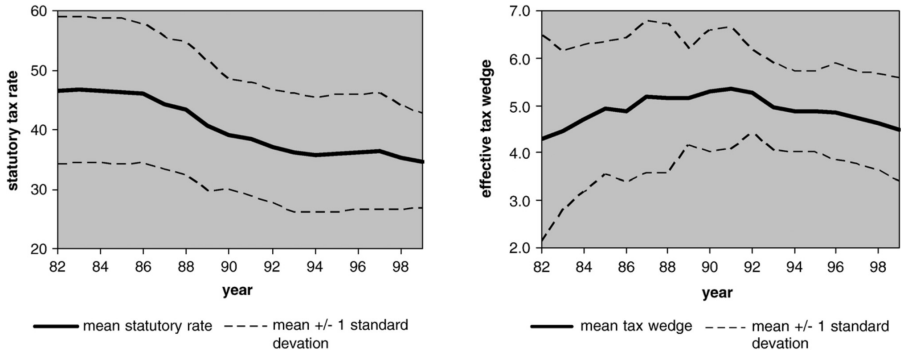
$$z_{i,t} = \beta_2 \overline{\tau}_{i,t} + \gamma_2 \overline{z}_{i,t} + \boldsymbol{\eta}_2' \mathbf{X}_{it} + \phi_{2i} + T_{2it} + \varepsilon_{2it} \qquad i = 1, \ldots, n \tag{2.9}$$

where ϕ_{1i}, ϕ_{2i} are country-specific fixed effects, and T_{1it}, T_{2it} are country-specific time trends, both included to account for potential unobserved factors.

2.2.2 Data

To run their empirical model, Devereux, Lockwood, et al. (2008) use panel data for 21 OECD countries between 1982 and 1999.

Figure 2.1: time series for avg. statutory tax rate and tax wedge, Devereux, Lockwood, et al. (2008)



First of all, the authors use the uniform weighted mean of the statutory tax rates, revised for the local statutory rates, in the 21 countries. Next, the EMTR, which typically is ambiguous to measure and, from Eq. 2.2 (ii), is $z - 1 = \frac{f'(k)-r}{r}$. Here the authors decide to refer to it as $f'(k) - r$, the difference between the marginal product of capital and the interest rate, i.e. the tax wedge. The time series of both these measures are shown in Fig. 2.1. On the left of Fig. 2.1, it can be clearly seen how the mean statutory tax rate in the 21 OECD countries fell from nearly 50% in 1982 to close to 35% in 1999. On the other hand, the mean tax wedge, over the same period, slightly increased and reduced its standard deviation. In addition to these two measures, a number of control variables are included to explain better how countries set their rates.

2.2.3 Econometric issues

Before presenting the regression results, the endogeneity of $\overline{\tau}_{i,t}$ and $\overline{z}_{i,t}$ in Eq. 2.8 and 2.9, needs to be tackled and here, the authors implement an instrumental variable approach.

The chosen instruments are the weighted means of the control variables in other countries, e.g. $\overline{\tau}_{i,t} = \sum_{j \neq i} \omega_{ij} \tau_{jt}$. Weights related either to the size of the other countries

(measured in GDP units) or to FDI flows are shown to be endogenous by Devereux, Lockwood, et al. (2008). Therefore, in the Section below, only the results based on uniform weights are displayed. To sum up, using as instrumental variables the (uniform) weighted average of the controls leads to an R^2, in the first stage regression, between 0.87 and 0.99 for both rates, confirming the validity of the instruments.

2.3 Empirical results

2.3.1 Regression results

Table 2.1: regression results, Devereux, Lockwood, et al. (2008)

	Statutory rate, τ_{it}	**Eff. tax wedge**, w_{it}
$\overline{\tau}_{it}$	0.678	-0.012
	(2.5)	(0.19)
$\overline{w}_{it}$	-1.362	0.766
	(1.04)	(2.35)
Income tax rate	0.16	0.007
	(2.95)	(0.84)
Size	0.54	-0.02
	(2.55)	(0.22)
Public cons./GDP	0.007	0.07
	(0.03)	(0.99)
Observations	378	378
R-squared	0.93	0.77

Table 2.2: comparison between hypothetical Nash eq. rates with fixed capital controls and actual ones, Devereux, Lockwood, et al. (2008)

Control variable data	1983	1997	1997	1983
Capital control data	1983	1997	1983	1997
Actual average tax rates	46.60%	36.30%	n.a.	n.a.
Nash eq. avg. stat. tax rates	44.20%	35.80%	44.50%	36.70%

In Table 2.1, the estimated coefficients resulting from the regression are reported, together with the t-statistics. Starting from the statutory rate, τ_{it}, the main effects come from $\overline{\tau}_{it}$, the income tax rate and the size. As backed by similar results in the literature, e.g. Slemrod (2004), the corporate income statutory tax rate plays a key role as "backstop" for individual income tax. The lack of a corporate income tax rate would encourage individuals to "incorporate" (shift) their personal income, to avoid the tax. Here, the presence in the country of a higher top-income tax has a positive effect on τ_{it}, however, it has no effect on the tax wedge. Likely, the country's size leads to a higher τ_{it}, confirming the general view in the literature that smaller countries levy lower tax rates. Nevertheless, the biggest correlation comes from the uniform weighted average tax rate of the other countries, $\overline{\tau}_{it}$, with a coefficient of 0.678. On the tax wedge's side, only the average of the other countries' tax wedge has a (positive) significant effect on country i, w_{it} stops at 0.766.

The main two assumptions derived from the theoretical model are reflected in the results. First, the "own-tax" effects are positive, i.e. $\frac{\partial \tau}{\partial \tau^*} > 0$, $\frac{\partial z}{\partial z^*} > 0$, because both

reactions are mainly correlated with the other countries' choices with respect to the same rate. Second, the "cross-tax" effects are smaller, however, this result is not rock solid and depends on the weight used.

2.3.2 Can the model explain the evolution of taxes over time?

The results in Table 2.1 reveal an interaction over statutory tax rates and effective tax wedges between countries, however, the authors further investigate, excluding it, another possible source of variation in taxation levels. Does yardstick competition, as suggested by Besley and Case (1995), also play a role in the strategic interaction between countries? They further expand Eq. 2.8 and 2.9 allowing country i to react differently to other countries' rates whether there are strong capital controls between the two or not. Devereux, Lockwood, et al. (2008) find clear evidence that between countries without capital controls in place, the competition over statutory tax rates is stronger. More simply, the lack of capital controls between two countries, and consequently larger (and freer) capital flows, triggers competition (over the statutory rate) between countries to attract corporate profits. On the other hand, capital controls do not appear to be particularly significant for the interaction over effective tax wedges.

Devereux, Lockwood, et al. (2008) conclude their analysis with one last striking result. To further emphasize the role of capital controls in causing tax competition, which ultimately results in lower statutory tax rates, they compare the actual average tax rates with hypothetical Nash equilibrium ones built fixing the capital control levels. In other words, they build an hypothetical statutory tax rate for 1997 keeping the capital controls in place in 1983, and conversely. The outcomes confirm the impact of capital controls on tax rates: if in 1997 there had been the capital control of 1983, the equilibrium statutory rate would likely have remained high, 44.5%. Vice versa, in 1983, with the (more relaxed) capital controls of 1997, the equilibrium statutory rate would probably have been 36.7%.

Overall, the model and the results suggest that governments of more open jurisdictions strategically interact over tax rates with the intent of not losing capital inflows. Non-participation would incentives firms to relocate their assets. It is therefore credible to think that they will continue this competition, preventing the harmful effects of a "race to the bottom" while offsetting with broader tax bases and strengthening international tax coordination efforts. This is the background to the OECD's BEPS plan, discussed below.

3 | Corporate tax revenues in OECD countries

So far, it has been described how governments are influenced in setting their corporate tax rates as part of a strategic game with other countries. Over time, the relaxation of capital controls has increased tax competition between states, ultimately resulting in lower statutory tax rates. That said, I have wondered about the effects of such a sharp reduction in tax rates on governments' tax revenues. This second paper, titled "Corporate tax revenues in OECD countries" by Clausing (2007), investigates tax revenue trends by breaking down their components.

3.1 The elements that build up tax revenues

In an international context with downward pressure on tax rates, the author's ultimate goal is to make policymakers aware of the determinants of tax revenues. Indeed, tax revenues are certainly determined by tax rates, but not only, and Clausing (2007) builds them, in GDP terms, as a function of:

$$\frac{CorporateTaxRevenue}{GDP} = T \times f \times \Pi \times CS \tag{3.1}$$

where T is the statutory tax rate $T = \frac{TaxesDue}{TaxBase}$, f is the extent of the tax base $f = \frac{TaxBase}{CorporateProfits}$, Π is the profitability of firms $\Pi = \frac{CorporateProfits}{CorporateValueAdded}$, and CS their size in the economy $CS = \frac{CorporateValueAdded}{GDP}$. Later in the empirical analysis, this simple model will be expanded with other key components, such as the structure of the tax system, international interactions and the size of the country, which may also have an effect on fiscal revenues.

By deriving Eq. 3.1 for T and taking advantage of the chain rule, it can be generalized the effect of a change in the statutory tax rate on the corporate tax revenues of the state:

$$\frac{\partial Revenue}{\partial T} = \underbrace{f \times \Pi \times CS}_{(1)} + \underbrace{T \times \frac{\partial f}{\partial T} \times \Pi \times CS}_{(2)} + \underbrace{T \times f \times \frac{\partial \Pi}{\partial T} \times CS}_{(3)} + \underbrace{T \times f \times \Pi \times \frac{\partial CS}{\partial T}}_{(4)} \tag{3.2}$$

where the first term represents the marginal increase in revenues due to the higher T,

however, firms behave to increased tax rates, and the following terms describe their behaviour. The second term captures firms' efforts to reduce their tax base. The third deals with firms' profits and, for instance, may capture a decrease in taxable profits caused by a shift of profits to countries with lower tax rates. The last term relates to firms' participation in the economy, and, for example, a high tax rate may cause a firm to relocate or reduce its production, ultimately shrinking its contribution to national GDP. To sum up, the last three terms represent the tax avoidance efforts a company may undertake subsequently a tax increase. However, Clausing (2007) suggests that the overall effect of Eq. 3.2 is ambiguous, because, ultimately, the outcome depends both on the size of the direct effect, first term, and on the strength of the firms' tax avoidance activities.

3.2 Testing the theory

3.2.1 An empirical model

So far, Clausing (2007) decomposes the components of tax revenues, and emphasises the consequences of a tax rise on firms' behaviour. A company may respond by changing its long-term strategy or by initiating tax avoidance and, at the extreme, evasion practices.

To empirically estimate the effects of all the components just described on tax revenues, the author constructs the following regression equation:

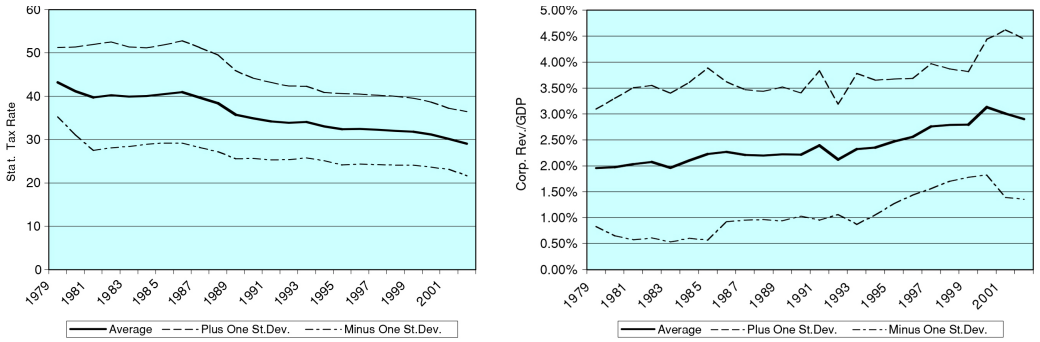
$$\begin{aligned}\left(\frac{CorporateTaxRevenue}{GDP}\right)_{it} = \alpha &+ \beta_1 TaxRate_{it} \\ &+ \beta_2 TaxRate_{it}^2 \\ &+ \beta_3 CorporateProfitability_{it} \\ &+ \beta_4 SizeCorporateSector_{it} \end{aligned} \tag{3.3}$$

Eq. 3.3 mirrors Eq. 3.1 with two additional adjustments. Firstly, as in Devereux, Lockwood, et al. (2008), where the authors do not find an unambiguous measure for the EMTR, ultimately using a measure for effective tax wedge, likewise Clausing (2007) decides to omit the variable about the tax base, f, in the regression equation, Eq. 3.3. On the other hand, an extra variable, $TaxRate_{it}^2$, is included, whose intent is to capture any nonlinear effects between tax rate and tax revenues.

3.2.2 Data

To estimate the coefficients of Eq. 3.3, Clausing (2007) uses panel data from 29 OECD countries between 1979 and 2002. This paper handles very similar data to the previous article of Devereux, Lockwood, et al. (2008), helping us build an analysis with similar basis. Certainly, both also chose OECD data because of its high availability and reliability too.

Figure 3.1: time series for avg. statutory tax rate and corporate income rev./GDP, Clausing 2007



Before delving into the regression results, let us illustrate the context from which the data used for the regression comes. On the left, Figure 3.1 shows the trend for the average statutory tax rate over the 24 years time frame. Similarly to Devereux, Lockwood, et al. (2008), also here is clear the downward movement of the tax rate, specifically from almost 45% in 1979 to slightly below 30% in 2002. On the right side, Figure 3.1 represents the average corporate tax revenues (in GDP terms) over the years. Interestingly and almost counterintuitively, although the fall of the tax rates set by the governments, the average of the fiscal revenues grows over time, from 2% in 1979 to almost 3% in 2002. This outcome may come from a series of factors. Firstly, Clausing (2007) reports that the closest data on corporate profitability of firms over the period examined increased from 33% to 39%. Secondly and more importantly, the states increased their tax base over this time frame. This assumption is also supported by another article by Michael P. Devereux, specifically Devereux, Griffith, et al. (2002). There, the authors examine data from 16 OECD countries between 1982 and 2001, taking governments' tax base broadening reforms as a given.

3.3 Empirical results

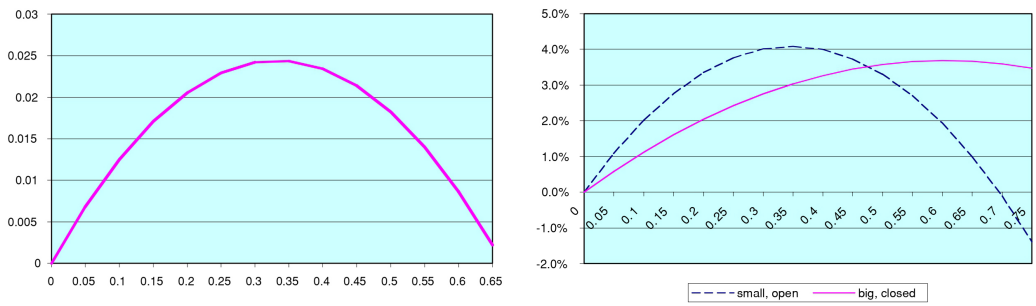
In Table 3.1, the estimated coefficients for Eq. 3.3 are displayed. In all three specifications,

Table 3.1: regression results, Clausing (2007)

	(1)	(2)	(3)
Tax	0.147	0.186	0.154
	(0.022)**	(0.025)**	(0.026)**
Tax^2	-0.221	-0.236	-0.185
	(0.039)**	(0.051)**	(0.052)**
Profit rate		0.106	0.105
		(0.014)**	(0.013)**
Corp. share		0.053	0.042
		(0.011)**	(0.009)**
Credit			0.005
			(0.002)**
Mixed			-0.000
			(0.001)
Constant	0.002	-0.077	-0.067
	(0.003)	(0.011)**	(0.009)**
Observations	587	282	282
R-squared	0.13	0.43	0.46

the statutory tax rate plays the biggest role. An increase in the tax rate is correlated to an increase in tax revenues/GDP between 0.147 and 0.186. Moreover, with the estimated coefficient for the tax rate in Equation (1), Clausing (2007) is able to estimate the hypothetical revenues/GDP for every tax rate. Plotting it on a graph becomes very intriguing, as the left side of Figure 3.2 reveals that this relationship is parabolic and the tax rate that maximizes tax revenue/GDP would be about 33%. In any case, this value is not to be read as optimal, neither for the government nor the households, since it is derived from hypothetical revenues. However, it would be a curious exercise for jurisdictions to find their profit-maximizing tax rate, compare it with the current one, and see if there is room for improvement, with the ultimate goal of having a larger fiscal budget and being able to better provide public goods and address social problems.

Figure 3.2: estimated revenue-tax curves, Clausing 2007



In Table 3.1, Equation (2) includes two more regressors: corporate profitability and the size of the corporate sector. The estimated coefficient about the firms' profits, β_3, appears

Table 3.2: regression results for extended equations, Clausing (2007)

	(1)	(2)	(3)
Tax	0.133	0.214	0.182
	(0.020)**	(0.026)**	(0.026)**
Tax^2	-0.156	-0.320	0.250
	(0.035)**	(0.045)**	(0.047)**
...	...	...	...
Intl * tax	0.053		0.055
	(0.018)**		(0.017)**
Intl * tax^2	-0.088		-0.096
	(0.044)*		(0.041)*
Big * tax		-0.060	-0.054
		(0.016)**	(0.016)**
Big * tax^2		0.149	0.137
		(0.040)**	(0.038)
Constant	-0.026	-0.039	-0.031
	(0.010)*	(0.011)**	(0.011)**
Observations	513	513	513
R-squared	0.27	0.23	0.28

to have a relevant force towards higher tax revenues. Intuitively, the higher the firms' profits, and therefore the taxable income, the higher the government's revenues. Finally, Equation (3) once again extends the regression by including two dummy variables on the structure of the tax system, depending on whether the country has in place a credit or mixed (credit and territorial) tax system. Although the economic significance may not be substantial, the effect of the dummy variable on credit systems is statistically significant and implies that countries that allow tax credits on taxes paid abroad on foreign incomes can expect a 5% increase in their revenues/GDP. The limited economic relevance of this outcome confirms why, nowadays, most jurisdictions adopt a territorial system. As a matter of fact, the main problem of a tax credit system is that foreign income is taxed locally only when it is repatriated. To overcome this problem, governments have preferred the territorial system while strengthening international tax coordination.

Before concluding the analysis, Clausing (2007) extends one more time the regression, and two additions are noteworthy. In Table 3.2, equations are all built on Equation (3) of Table 3.1, and here, for the sake of readability, only part of the regressors are listed. First, in Equation (1), two terms interact: the tax rate and a dummy variable, *international*, taking value one if the country is particularly open to trade, meaning that its FDI relative to GDP are above average. The regression captures that more open economies face a steeper revenues-tax rates curve and, therefore, higher tax revenues from a tax increase.

Second, Equation (2) includes another interaction term between the size of the country and the tax rate. The dummy variable *big* is set to one if the country's population size is above average. Assume bigger countries deal with less elastic capital, and conversely, smaller countries, the negative estimated coefficient confirms that large countries have a less steep revenue curve.

Using together the controls of Equations (1) and (2) gives Equation (3). Here, the last curious result confirms the previous outcomes, in other words, bigger and more close economies have a less steep revenue curve than smaller and opener ones. Conversely, small and open countries, at low tax rates, can obtain higher revenue gains from a tax rise than their larger counterparts. The two revenue curves of both kinds of countries can be seen on the right side of Figure 3.2. From this last result, countries can form their expectations on changes in revenues when adjusting their tax policies. If smaller and more open countries can be more ambitious in their revenue targets at low tax levels, the same cannot be said for their opposite, which must carefully touch rates, particularly if it needs to maintain a stable budget in the short term.

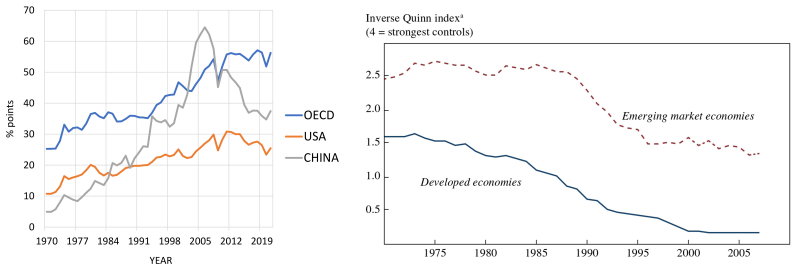
4 | Comparison and further discussion

This Section reviews and discusses the touch points of the two articles just described, along with a final glance at current policy actions on the topic.

4.1 Links and notes

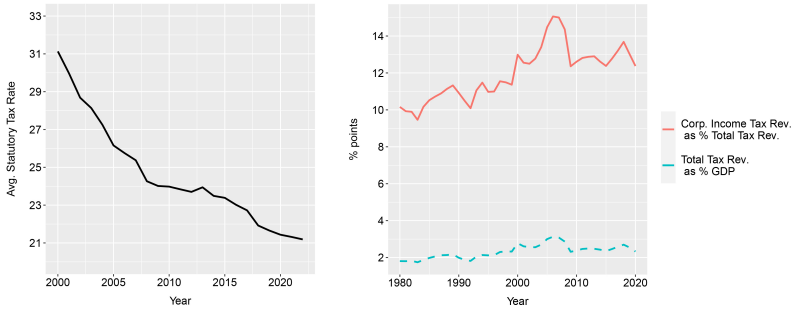
We live in a world that is the result of many decades of intensified globalization and internationalization, both economically and culturally. The establishment of international organizations such as the World Trade Organization in 1995 promoted international cooperation and economic integration. Supporting this, the left side of Figure 4.1 illustrates trade intensity, measured as the sum of exports and imports of goods and services in % GDP terms, between 1970 and 2021 for three entities. All three, over the years, have opened their economies, moving from being closed countries to open countries.

Figure 4.1: left: time series for trade/GDP, own work on World Bank data
right: time series for the inverse Quinn index for capital controls intensity, Klein et al. (2012)



As part of this internationalization process, to encourage capital inflows and facilitate international trade and investments, countries have loosened their capital restrictions. Formalizing and capturing a general measure for capital controls is quite challenging, and most of the literature, including Devereux, Lockwood, et al. (2008), relies on Quinn's 1997 measure for the intensity of capital controls. On the right side of Figure 4.1, it is shown an updated 2011 version of the index, and unquestionably, over time, capital controls have actually been lowered. However, their relaxation also poses risks, such as a higher vulnerability to external shocks, that, in the context of strategic tax interaction, as argued by Devereux, Lockwood, et al. (2008), leads to a lower corporate income statutory tax rate. While this result is considered a given also in Clausing (2007), other authors come to different conclusions. For instance, Swank (1998) rejects the general view that increased capital mobility has directly forced governments to lower their tax burdens and, instead, suggests that tax cuts actually result from a shift in tax policy paradigms.

Figure 4.2: left: time series for avg statutory tax rate 2000-2022, own work on OECD data
right: time series for corporate income and total tax revenues, own work on OECD data



Since the analysis of Devereux, Lockwood, et al. (2008) is based on data from only 21 OECD countries between 1982 and 1999, on the left of Figure 4.2, I present an extension of the time series. Using OECD data, I plotted the average corporate income statutory tax rate for 29 OECD states between 2000 and 2022. The fall in tax levels has continued in the last two decades, falling from 31.13% to 21.19%. Between 2008 and 2013, the reduction slowed down, and this may be due to stress on governments' fiscal budgets, which were eroded by stimulus measures following the global financial crisis of 2008-2009, ultimately to prevent short-term revenue losses. A particularly weak point of the first paper is that the authors, in order to measure the change in the marginal tax following a change in the capital stock (EMTR), decided to use a simpler measure, the tax wedge. The reason they adopted this alternative variable is that they observed large standard errors using an EMTR index directly. In my opinion, in order to still use the main measure, ultimately obtaining more reliable results, some possible solutions could be as follows. First, increase the sample size by collecting data over a longer period from reliable data sources. Secondly, add lagged variables which can control for autocorrelation and capture the effect of past observations on the current value.

In her paper, Clausing (2007) estimates a revenue-maximizing corporate income tax rate of around 33%. Although this result may have been reasonable in the period she analyzed, 1979-2002, current rates are considerably distant from that threshold. In this regard, it would be interesting to investigate what is the current profit-maximizing corporate income tax rate for OECD countries. Despite that, with such low tax rates, how can governments continue to provide public goods? Firstly, both Devereux, Lockwood, et al. (2008) and Clausing (2007) agree that, over time, policymakers have broadened tax bases by eliminating tax exemptions and reducing deductions or credits. Secondly, as modelled by Clausing (2007), a tax cut inevitably reduces fiscal revenues as a direct effect but also

triggers firms' reaction, in terms of their strategic decisions, profitability and size. Lastly, the right side of Figure 4.2 illustrates the size and trend for corporate income tax revenues in GDP terms and as a ratio over total tax revenues. The data regards 29 OECD countries between 1980 and 2020 and shows how, in the end, the tax base widening has fully offset the direct loss of tax cuts. Furthermore, tax revenues generated from corporate income represent only a small portion of the whole, only around 12%, while more significant is the contribution coming from personal income taxes.

4.2 Policy intervention

To conclude, here is a glimpse into the future of international taxation. So far, to explain the fall in corporate income tax rate, we modelled tax competition as a strategic "game". However, in the real world, this interaction on tax rates between countries may be hostile, clashing with political and economic interests. A well-known example is the existence of tax havens, even within OECD and EU jurisdictions (such as Ireland and Hungary, with a CIT of 12.5% and 9%, respectively), to which firms shift their profits to benefit from the more favourable taxation. Nevertheless, on a large scale, this phenomenon brings fairness problems to the system since, for instance, the law generally requires profits to be taxed in the country where they are generated. With this in mind, since 2013, OECD has intensified its tax coordination efforts with the ambitious Base Erosion Profit Shifting (BEPS) two-pillar project. Among the others, Pillar Two of this directive introduces a global minimum tax of 15% on profits of organizations, and their subsidiaries, that have a consolidated group revenue over €750 mln. Having said that, and recalling the assumptions and results of Devereux, Lockwood, et al. (2008), it would be interesting to investigate the consequences of the global minimum tax over the statutory tax levels. To my mind, the introduction of such a low tax rate, indeed lower than the current average in the OECD area, will likely increase the tax burden in jurisdictions where the rate is below 15%. Clearly, for states joining the pact, having a tax rate below the 15% threshold would no longer be worthwhile, as the revenues generated by the difference between the two tax rates would be redistributed to other countries. On the other hand, countries with a higher tax burden than 15% may act ambiguously or more likely not react. In this way, they would still apply higher tax rates to companies not concerned by the BEPS and hopefully gain new revenues from the new directive.

5 | Conclusions and policy implications

Fascinated by the public debate and the clamour for upcoming disruptive tax policies, I decided to analyze two papers in the field of corporate taxation.

The first, "Do countries compete over corporate tax rates?" by Devereux, Lockwood, et al. (2008). With a theoretical model first, and with empirical results later, the authors argue that jurisdictions strategically interact in setting their corporate income tax rate, with the ultimate goal not to lose taxable corporate income (profits). Notably, this interaction occurs among countries where capital controls are lower, eventually exerting downward pressure on taxation levels. To achieve these results, Nash equilibrium tax rates are calculated, and reaction functions are constructed for the government's choice of tax levels. It closes an analysis of the regression results with robust standard errors, and a final consideration by which the role of a yardstick competition in the rates setting is ruled out.

The long-lasting decline in tax levels sparked my curiosity about its effects on governments' fiscal revenues, and here, the article "Corporate tax revenues in OECD countries" by Clausing (2007) comes into play. The author breaks down the government's fiscal revenues into four terms and highlights the role of firms' behaviour in determining tax revenues. In doing so, for her sample, she finds that the profit-maximizing corporate income tax rate is around 33% and that, over time, the average corporate income tax revenues have remained almost constant thanks to policies that broadened the tax base.

Both discussions draw attention to the need for international tax coordination and harmonization efforts. An unregulated and irrational tax competition would sooner or later bring rates to the bottom and, therefore, in the short term, damage governments' fiscal budgets. As a matter of fact, in recent years, international organizations, such as the OECD, have strengthened their relationships with countries and supranational entities. A result of such activities is the upcoming Base Erosion Profit Shifting working project, which, among others, will introduce a breakthrough 15% global minimum tax on the corporate income of given firms.

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