Profit Shifting and Destination-Based Taxes

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Abstract

We study the choice between source-based corporate taxes and destination-based corporate taxes in a two-country model, allowing multinational firms to use transfer pricing to allocate profits across tax jurisdictions. We show that source-based taxation is a Nash equilibrium tax revenue maximizing jurisdictions if both domestic and foreign firms generate large revenues. Otherwise, the equilibrium involves destination-based taxes. We also show that a country has an incentive to unilaterally adopt destination-based taxes if it is much larger than the Foreign country.

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Multinational Firms (MNF) locate their profits in the different tax jurisdictions in which they operate in order to reduce their tax liability.[1] The choice of a tax policy in a country will therefore trigger a reaction from those firms.[2] The tax policy, in our framework, is composed of a statutory tax rate, a tax base and a tax enforcement level.[3] Zooming in on the tax base, countries can decide to implement either a source-based (SB) tax system or a destination-based (DB) system. The source system allows a government to tax profits if production occurs on its territory while the destination system allows to tax profits if production is sold on the territory, irrespective of the location of the production.

In the main strand of the literature studying the choice between source-based and destination-based taxes, the tax policy, either the choice of tax rates or tax base, is mostly exogenous. In both the tax competition literature and the recent literature on destination-based taxes, statutory tax rates are rarely tax instruments governments choose optimally (Lockwood [2001], Auberbach and Devereux [2018]). We also observe that, in the corporate tax competition literature, tax bases are also almost never chosen endogenously (Devereux et al. [2008]).

This paper endogenizes the tax rate, tax base and tax enforcement responses of governments to study the uncooperative equilibrium and optimal choice between source-based and destination-based taxes.[4] It aims to shed light on a puzzle in which all countries, in practice, currently use source-based corporate taxes while this tax system is considered suboptimal (Keen and Wildasin [2004], Lockwood [2001]). This choice between source-based and destination-based taxes gained some strength in 2016 when the US Congress proposed to shift the US source-based corporate tax system to a Destination Based Cash-Flow Tax (DBCFT),[5] which is considered optimal.

[1] For example, "Apple Sales International (ASI), [is] an entity that has acquired certain economic rights to Apple's intellectual property. Apple Inc. has used those rights of ASI to shift billions in profits away from the United States to Ireland, where it pays a corporate tax rate of 2% or less." Memo of the Permanent Subcommittee on investigations, 2013 (https://www.hsgac.senate.gov/subcommittees/investigations/hearings/offshore-profit-shifting-and-the-us-tax-code_-part-2)

[2] Apple has, for example, moved part of its paper profits from Ireland to Jersey, another tax haven, after the US Subcommittee on Investigations raised the alarm on Apple's profit shifting behavior in Ireland (https://www.hsgac.senate.gov/subcommittees/investigations/media/subcommittee-to-examine-offshore-profit-shifting-and-tax-avoidance-by-apple-inc).

[3] We abstract here from the role of deductions for capital expenses.

[4] The focus of this paper is on the choice between source and destination bases. We let aside all considerations regarding the choice between income taxation and cash-flow taxation.

[5] Tax Reform Task Force, 2017, A Better Way: Our Vision for a Confident America. (Initial version 2016)

To rationalize this puzzle, we build a tax competition model with the presence of multinational firms (MNF). We model two asymmetric countries that differ in terms of size (proxied by the exogenous number of firms) that have three levels of decision: they choose the tax base, the revenue-maximizing tax rate and the revenue-maximizing tax enforcement level.[6] Multinational firms can engage in profit shifting by manipulating the transfer price of their intra-firm trade. This is the first paper, to the best of our knowledge, that gathers all three tax instruments endogenously.

We find that source-based taxation is the best-response to source-based taxes when both domestic and foreign corporate revenues are large. Large profits entail a high source-based tax rate, which allows a source-based country to generate higher tax revenues than if it unilaterally adopted destination-based taxes. This high tax rate is possible because under source-based taxes, countries introduce a strict enforcement, thereby increasing the cost for firms to shift profits and thus to react to a high tax rate. We also find that for small values of corporate revenues, the best-response to source-based taxation is destination-based taxation. Smaller domestic profits trigger a lower tax rate under a universal use of source-based taxes than that under a unilateral use of DB taxes, which makes destination-based taxes more attractive. Considering the best-response to destination-based taxes, we find that source-based taxes dominate in the Home country when domestic corporate revenues are large. Otherwise, the best-response is source-based taxation.

This implies that when both domestic and foreign corporate revenues are large, source-based taxation is a Nash equilibrium. When domestic firms do not generate enough revenue, destination-based taxation is a Nash equilibrium that is fiscally optimal. We also observe that when domestic and foreign corporate revenues are of medium range, both source-based taxation and destination-based taxation arise in equilibrium.

Finally, we show that, if there exists a strong asymmetry between both countries, an equilibrium with a unilateral adoption of DB taxes can arise. This is the case if both corporate revenues

https://www.novoco.com/sites/default/files/atoms/files/ryan_a_better_way_policy_paper_062416.pdf.

[6] We develop the model with the monitoring of outbound profit shifting in the appendix.

are small. Since there is a strict tax enforcement under source-based taxation, profit shifting opportunities are limited and source-based countries can almost tax the "full amount" of taxable profits. A large country moving to destination-based taxes looses the ability to tax foreign firms but this opportunity cost is lower since a DB country can tax the full amount of domestic corporate revenues, which is not subject to profit shifting and which increases with the number of firms in the country. The "lost" tax revenue stemming from the foreign affiliates is potentially quite small in comparison since there are much less foreign firms compared to domestic firms.

The results of this paper have strong implications for tax policy. We find that it is optimal under source-based taxes to implement a strict enforcement of profit shifting. This strict monitoring enables governments to set high statutory tax rates, while limiting profit shifting, thereby reducing the opportunity cost of being a high-tax country. Currently, we observe in many countries very low levels of profit shifting monitoring, which implies that source-based taxation is more distortive, and hence not necessarily optimal. One policy recommendation would be to increase the monitoring of profit shifting, if countries decide to remain under source-based taxation. We also show that the size of countries is important in the choice of tax system. A move toward destination-based taxation is rational either if the asymmetry between the countries is important or if we consider two small and symmetric countries.

This paper first contributes to the literature regarding the optimality of source-based taxes relative to destination-based taxes. Destination-based taxes are often considered optimal. One argument put forward regarding corporate taxation is that destination-based taxes eliminate profit shifting (Auerbach et al. [2017]). More generally, the normative theory of international taxation agrees on three main tenets, one of which states that the destination system dominates the source system (Keen and Wildasin [2004]). Lockwood [2001] also gives some insights on the suboptimality of source-based taxes. However, some works have also shown that source-based taxes can dominate when taxes are set non-cooperatively as it is in this paper (Lockwood [1993] with commodity taxation), or in the presence of imperfect competition (Keen and Lahiri [1998]). We work here on the equilibrium and optimal properties of both tax bases in a tax competition framework, with trade within multinational firms.

It then contributes to the literature formalizing the implementation of a destination-based corporate tax. The debate about DB taxes started in the 1990s but gained interest recently.[7] Auberbach and Devereux [2018] and Becker and Englisch [2019] offer a formal analysis of the unilateral adoption of destination-based taxes. They investigate the production location and resource allocation under both tax systems. Bond and Gresik [2021] use the Auberbach and Devereux [2018] framework to study whether countries have a unilateral incentive to deviate from a multilateral DBCFT system using three tax policy parameters: the corporate tax rate, the level of deduction for capital expenditures, and the degree of border adjustment. They find that if countries are identical, each has an incentive to move to source-based taxation. We extend the approach of the above papers by introducing endogenous transfer price manipulation and strategic tax competition. It is crucial to take profit shifting through the use of transfer prices into account to study the strategic choice of tax policy since it represents enormous losses of tax revenues for most developed countries.[8] Finally, Bond and Gresik [2020] study the economic effects of unilateral adoption of corporate tax policies in a heterogeneous firm model with transfer pricing. We first depart from all those papers by endogenizing the tax rate,[9] the tax base and the tax enforcement level, which are assumed exogenous in the literature. We also depart by focusing on the impact of the destination-based tax on tax revenues. Another difference with the literature is that we do not have endogenous capital accumulation which would naturally imply endogenous profitability. In this paper, the profitability of the input is exogenous.

This paper is also related to the literature on tax competition. Standard models focus on source-based taxation (Bucovetsky [1991], Klemm and Liu [2019], Devereux et al. [2008], Krautheim and Schmidt-Eisenlohr [2011]).[10] In tax competition models as Zodrow and Mieszkowski [1986], Wilson [1986], Devereux et al. [2008], governments use the tax rate (both statutory and effective) as a tax

[7] It started with (Avi-Yonah [1993]) and Bond and Devereux [2002] first provided insights on the location and investment decisions of an MNF under both a source-based and a destination-based tax system without profit shifting or heterogeneity.

[8] In a recent contribution, Clausing [2020] shows that profit shifting costs the United States about $100 billion a year (at 2017 tax rates). We also have evidence that profit shifting was responsible for a $8 billion reduction of the tax base in France in 2008 (Vicard [2015]).

[9] Bond and Gresik [2021] also endogenize the statutory tax rate.

[10] See Wilson [1999], Devereux and Loretz [2013] and Heimberger [2021] for a literature review.

instrument. The literature does not necessarily account for the profit shifting behavior of firms (Davies and Eckel [2010]). In this paper, we partly inspire from Devereux et al. [2008]. We not only analyze the complementarity of statutory tax rates but also pin down the expression of the best-response and optimal tax rates with respect to different tax systems, as well as optimal tax enforcement behaviors. Since we do not have capital accumulation, we do not introduce depreciation allowances and therefore, our statutory tax rate is the same as the effective tax rate.

The rest of the paper is organized as follows. Section 1 sets out the model assumptions. Section 2 solves the tax competition model for the equilibrium tax rates. Section 3 derives optimal enforcement levels and optimal tax revenues for the three different scenarios that we consider. Section 4 develops the uncooperative equilibrium and optimal choice of tax system. Section 5 concludes.

1 The model

We build a two-country model (a Home and a Foreign country) with multinational firms. We denote the Foreign variables with an asterisk. Both countries are endowed with multinational firms, each composed of a parent firm and an affiliate. There are N MNF in the Home country. The parent of a Home MNF is located in Home while its affiliate is in the Foreign country. The structure is similar for a Foreign MNF. We assume that the Foreign country has N^* MNF.

Governments choose the tax system: it can either be source-based or destination-based. They can also choose their statutory tax rate $(\tau, \tau^*) \in [0,1]$ and the level of monitoring of profit shifting $\alpha, \alpha^* \in [0,1]$. The tax enforcement level α applies only to domestic firms: the Home country sets a tax enforcement level α, that specifies the level of monitoring of Home-headquartered firms only. Foreign MNF are subject to a monitoring proxied by α^*.[11]

In this model, multinational firms invest in their own affiliate to produce an input whose quantity we normalize to 1.[12] The marginal cost of investment is c for Home MNF and c^* for Foreign

[11] We focus on inbound profit shifting monitoring but we show the results with outbound profit shifting monitoring in appendix.

[12] The word "input" throughout the text refers to the outcome that results from the investment in the affiliate.

MNF. We can think of this investment as a location-specific investment. The outcome of that investment is then sold to the Parent firm at a transfer price q (respectively q^* for trade within the Foreign MNF). We can consider this transfer price as a royalty in the case of the input being an intangible asset or as a regular transfer price otherwise. Using this input, the Parent firm generates a revenue π (respectively π^* for the Foreign MNF) that we assume fixed. We assume that MNF choose the transfer prices q and q^* to maximize profits. We know that firms deviate from arm's length prices, especially with differentiated goods (Davies et al. [2018]). We impose a cost of deviating from the arm's length price c (respectively c^* for the foreign MNF). The cost is quadratic in the deviation and depends on the enforcement levels. MNF therefore bear a concealment cost $\alpha(q-c)^2$ (respectively $\alpha^*(q^*-c^*)^2$ for Foreign firms), that is not tax-deductible but that is deducted from the consolidated MNF profits.[13]

We consider that the tax enforcement level is mostly a structural parameter of the economic policy and can be considered more medium-run while the statutory tax rate is more of a short-run policy instrument. The timeline of events is thus the following. Countries non-cooperatively choose between source-based and destination-based corporate taxation. They then choose their optimal level of tax enforcement. Last, they derive their equilibrium tax rates: τ_H^{ij} and τ_F^{ij} for the Home and Foreign countries respectively, where $i, j = \{S, D\}$, S representing the use of source-based taxes and D of destination-based taxes. τ_H^{SD} represents the Home country optimal tax rate if Home uses a source-based tax and Foreign uses a DB tax. Finally, firms decide on their transfer price. The model is solved backwards.

2 Equilibrium tax rates

We give an overview of the theoretical modelling and provide a characterization of the equilibrium tax rates for the various tax systems. We start by characterizing the profit of a multinational firm headquartered in the Home country. The profit is composed of the affiliate's profit, the Parent's profit, the concealment cost and a border adjustment.

[13] We can also interpret the concealment cost as in Devereux et al. [2008] where firms receive a fine with probability $p = (q-c)$, that is proportional to the deviation $\alpha(q-c)$.

The Parent firm buys an input at price q from its affiliate and generates a revenue π by using this input. The Home Parent profit $\pi - q$ is taxed in the Parent country at rate τ (line (1a)), irrespective of whether the Home country uses source-based or destination-based taxes. The Home affiliate invests at a cost c and sells the input to the Home Parent at a price q. The Home affiliate operating in Foreign therefore has profits $q - c$. If Foreign uses source-based taxes, then the whole affiliate profit is taxed at a rate τ^*. When the Foreign country uses destination-based taxes, the revenue stemming from selling the input to the Parent firm is untaxed, because it is not sold within the borders of the Foreign country, while the cost is still subject to the foreign tax (line (1b)). The MNF can also face a border adjustment tax when the Home country uses destination-based taxation. With a border adjustment, imports are taxed while exports are left out of the tax base. This is represented in line (1c). When the Home country uses source-based taxes, there exists no border adjustment. Finally, the MNF also bears a concealment cost as explained above (line (1d)). We introduce four parameters $\gamma, \gamma^* = \{0, 1\}$ and $\beta, \beta^* = \{0, 1\}$ that represent the tax system. When the Home (Foreign) country uses a source-based tax, $\gamma = 0, \beta = 1$ ($\gamma^* = 0, \beta^* = 1$). When it uses a destination-based tax, $\gamma = 1, \beta = 0$ ($\gamma^* = 1, \beta^* = 0$). γ (γ^*) is a parameter that determines whether we are in a situation in which the Home (Foreign) country uses a destination-based tax and therefore applies a border adjustment tax on its imports. β determines whether the profits of the affiliate are taxed, which is not the case when a country uses destination-based taxes since the input is not sold in its country of production. Adding all the terms mentioned above, we obtain equation (1) below. As said, the MNF maximizes profits with respect to the transfer price, taking both tax rates and the enforcement level as given.

$$
\begin{aligned}
Max_q \ \Pi = & (1-\tau)[\pi - q] && \text{(1a)} \\
& + (1 - \beta^*\tau^*)q - (1-\tau^*)c && \text{(1b)} \\
& - \gamma\tau q && \text{(1c)} \\
& - \alpha(q-c)^2 && \text{(1d)}
\end{aligned}
$$

Maximizing the consolidated profit in (1) gives us an expression of the transfer price that

depends on τ and τ^*.

$$q(\tau, \tau^*) = c + \frac{(1-\gamma)\tau - \beta^*\tau^*}{2\alpha} \tag{2}$$

We plug the new $q(\tau, \tau^*)$ back into the profit function (1) (for the Home MNF):

$$\Pi(q(\tau, \tau^*)) = (1-\tau)\pi + [(1-\gamma)\tau - 1 + (1-\beta^*)\tau^*]c + \frac{[(1-\gamma)\tau - \beta^*\tau^*]^2}{4\alpha} \tag{3}$$

Given the tax system, a government taxes corporate profits. Countries can always tax the Parent firm profits stemming from selling the output as can be seen from (4a) which does not depend on γ or β. They can also tax the Foreign affiliate profits only if countries use source-based taxation (4c). Finally, countries levy a border adjustment tax on the amount of the imports Nq (respectively N^*q^* for the Foreign MNF) if they impose a destination-based tax. We also observe that when the Home country uses destination-based taxes, the tax deduction of the transfer price in the Parent profit (line (4a)) cancels out with the border adjustment (line (4b)). The government of a country first maximizes tax revenues (TR) with respect to its tax rate, taking the tax rate of the other country as given. We assume that governments only tax positive taxable profits. Therefore, if a country uses a destination-based corporate tax, it does not tax at all the foreign affiliates. The revenue that arises from selling the input is necessarily out of the tax base since it is not sold on the DB territory. The cost deduction which would entail a negative tax base for the foreign affiliates is thus exempt of corporate tax as shown below.[14] This explains why β is multiplicative of both the revenue and the cost in the foreign affiliate profits in (4).

[14] We abstract from tax provisions to offset losses against future positive taxable profits.

$$
\begin{aligned}
Max_{\tau} \ \text{TR} = & N\tau[\pi - q(\tau, \tau^*)] && (4a)\\
& + \gamma N\tau q(\tau, \tau^*) && (4b)\\
& + N^*\tau\beta[q^*(\tau, \tau^*) - c^*] && (4c)\\
\text{S.t.} \ & (1-\tau)[\pi - q] - \gamma\tau q - \alpha[q-c]^2 = 0 \\
& \tau, \tau^* \in [0,1] \\
& \alpha, \alpha^* \in [0,1] \\
& \gamma, \gamma^* = \{0,1\} \ \text{and} \ \ \beta, \beta^* = \{0,1\}
\end{aligned}
$$

Plugging the expression of $[q(\tau, \tau^*), q^*(\tau, \tau^*)]$ back into the tax revenue equation, we have:

$$
\begin{aligned}
Max_{\tau} \ \text{TR} = & N\tau\pi && (5a)\\
& + (\gamma - 1)N\tau \left[c + \frac{(1-\gamma)\tau - \beta^*\tau^*}{2\alpha}\right] && (5b)\\
& + N^*\tau\beta \left[\frac{(1-\gamma^*)\tau^* - \beta\tau}{2\alpha^*}\right] && (5c)\\
\text{S.t.} \ & (1-\tau)[\pi - q] - \gamma\tau q - \alpha[q-c]^2 = 0 && (5d)\\
& \tau, \tau^* \in [0,1] && (5e)\\
& \alpha, \alpha^* \in [0,1] && (5f)\\
& \gamma, \gamma^* = \{0,1\} \ \text{and} \ \ \beta, \beta^* = \{0,1\} && (5g)
\end{aligned}
$$

Therefore, when the Home country uses DB taxes, the tax revenue equation pins down to $\text{TR} = N\tau\pi$, which is linear in τ. In that case, we bind the constraint (5d) and assume that the Home country chooses τ so as to reduce the after-tax profit of its domestic MNF down to zero. Since we assume territorial taxation, the government takes into account the profit of the Parent and the costs that are not taxed in other countries, such as the border adjustment and the concealment cost.

From equation (5), we can derive best-response tax rates, conditional on given enforcement levels $\tau(\alpha, \alpha^*)$. If the Home country uses source-based taxes, irrespective of the tax system of the

Foreign country, the best response tax rate of Home is:

$$\tau_S(\alpha, \alpha^*) = \left[\frac{\alpha\alpha^*}{\alpha^* N + \alpha N^*}\right]\left[N(\pi - c) + \frac{\tau^*}{2}\left(\frac{N^*(1-\gamma^*)}{\alpha^*} + \frac{N\beta^*}{\alpha}\right)\right] \tag{6a}$$

We observe here that a source-based country best-response tax rate is positively correlated to the foreign country tax rate if the foreign country uses source-based taxation as well. This is the well-know result of tax competition with source-based taxes: countries compete over statutory tax rates, which can lead to the race to the bottom (Devereux et al. [2008]). Otherwise, when the Foreign country uses destination-based taxes, the source-based country tax rate is independent of the tax rate of the Foreign country. The source-based country best-response tax rate is thus a dominant strategy. This is due to the fact that the input production of the Home affiliate is not taxed in Foreign, since it is not sold in Foreign. The Home affiliate only faces taxes in Home. On the other hand, the Foreign affiliate is taxed in Home as before but the border adjustment cancels out with the input cost deduction as said above. The input is therefore only taxed in Home. Firms from both countries will thus decide on their transfer price depending on the tax rate in Home, irrespective of the tax rate in Foreign.

If the Home country uses destination-based taxes, irrespective of the tax system of the Foreign country, the best response tax rate of Home is:

$$\tau_D(\alpha, \alpha^*) = 1 - \frac{c}{\pi} + \frac{\beta^*\tau^*}{2\alpha\pi}\left(1 - \frac{\beta^*\tau^*}{2}\right) \tag{6b}$$

We can see here that when both countries use destination-based taxes, the best-response tax rate is independent of the tax rate of the other country. There is therefore no tax competition between countries, which makes sense since there is no profit shifting under such a tax system. All firms trade at arm's length. The universal use of destination-based taxes could therefore act as a backstop to tax competition. When the Home country unilaterally uses destination-based taxes, its tax rate however depends on the source-based country tax rate. This comes from the fact that firms are only taxed in the source-based country as said above. The higher the tax rate in Foreign, the lower the Home MNF transfer price. Since the transfer price enters the profit function (and

thereby equation (5d)) as a deduction, the lower transfer price yields higher profits. This explains the positive dependent relationship between both tax rates in (6b).

The equilibrium tax rate of the Home country taking the enforcement level $\tau_H(\alpha, \alpha^*)$ as given writes as follows:

$$\tau_H(\alpha,\alpha^*) = \beta\beta^*\left(\frac{4\alpha\alpha^*}{3(\alpha^*N+\alpha N^*)}\left(N(\pi-c)+\frac{N^*(\pi^*-c^*)}{2}\right)\right) \tag{7a}$$

$$+\gamma\beta^*\left(1-\frac{c}{\pi}+\left(\frac{\alpha^*N^*[\pi^*-c^*]}{2\pi(\alpha^*N+\alpha N^*)}\right)\left[1-\frac{\alpha\alpha^*N^*(\pi^*-c^*)}{2(\alpha^*N+\alpha N^*)}\right]\right) \tag{7b}$$

$$+\gamma^*\beta\left(\frac{\alpha\alpha^*N^*}{\alpha^*N+\alpha N^*}[\pi^*-c^*]\right) \tag{7c}$$

$$+\gamma\gamma^* \tag{7d}$$

From line (7a), we can see that the equilibrium tax rates are increasing functions of the enforcement levels α, α^*. When all countries use source-based taxation, profits are shifted to low-tax countries. If countries strictly monitor profit shifting, firms have less room for setting unreasonable transfer prices, which allows governments to set higher tax rates without loosing tax revenues to the benefit of low-tax countries.

We also see that the optimal tax rate in the DB country is an increasing function of the enforcement level in the source-based country (line (7b)). More Foreign monitoring implies a higher Foreign tax rate, which in turn implies a lower Home transfer price. Since the transfer price enters the profit function (1) negatively, a lower transfer price implies a larger tax base, thereby increasing the tax rate. Finally, we observe that the Home tax rate is first increasing in α and then decreasing. It changes sign at $\alpha = \frac{\alpha^*N[\alpha^*[\pi^*-c^*]+2}{N^*[\alpha^*[\pi^*-c^*]-2]}$. This corresponds to the expression of the best-response level of monitoring of the Home country to α^* (as can be seen below). The relations are the same when we consider the Home country tax revenues. As α is low and below the optimal level, tax revenues increase. Above the optimal threshold, tax revenues start to decrease. More monitoring of the Home country firms means that they will struggle more to shift profits toward the Home country.

We can also note from line (7c) that the equilibrium tax rate of a source-based country facing

destination-based taxes abroad is an increasing function of both α and α^*. This comes from the fact that profits are shifted towards the destination-based country. We know that the source-based country suffers from profit shifting towards the destination-based country, irrespective of its tax rate. The stronger the monitoring in both countries, the smaller the profit shifting magnitude. This allows the source-based country to increase its tax rate while limiting the losses stemming from profit shifting.

Finally, the equilibrium tax rates are identical and reach the upper bound when both countries use DB taxes (line (7d)). We can note here that the tax rate of one country is independent of the tax rate of the other country, contrary to the two previous cases. The best-response tax rate is therefore also a dominant strategy. When both countries use a destination-based tax, countries can only tax sales less the cost of production, to which adds up the concealment cost which is 0 since $q = c$. We can also note that tax rates are independent of the size of the countries. Finally, both optimal tax rates and the expression of tax revenues are independent of α, α^* since there is no profit shifting.

3 Equilibrium enforcement levels

The countries then maximize tax revenues with respect to the tax enforcement level α, α^*:

$$\begin{aligned} Max_\alpha \quad \text{TR} =& \tau(\alpha,\alpha^*)N\pi + (\gamma-1)\tau(\alpha,\alpha^*)Nq(\tau(\alpha,\alpha^*),\tau^*(\alpha,\alpha^*)) \\ &+ \tau(\alpha,\alpha^*)N^*\beta[q^*(\tau(\alpha,\alpha^*),\tau^*(\alpha,\alpha^*)) - c^*] \end{aligned} \tag{8}$$

We observed that the equilibrium tax rate is an increasing function of α, α^* when the Home country uses source-based taxes (lines (7a) and (7c)). We will therefore have that $\frac{\partial TR}{\partial \alpha} > 0$ when the Home country uses source-based taxes, irrespective of the tax system in the Foreign country. This entails $\alpha_H^{SS} = \alpha_H^{SD} = 1$. Countries decide to strictly monitor profit shifting and incentivize firms to trade at arm's length by setting a prohibitively high cost of deviating. Under a universal use of source-based taxes, this can be explained by the fact that countries compete on statutory tax rates. The high-tax country looses since firms shift profits to the low-tax country. Under a

unilateral use of SB taxes, since the DB country has the same gravitational power as a tax haven, the source-based country will suffer from profit shifting, irrespective of its tax rate. The optimal solution is to prevent profit shifting by thoroughly controlling intra-firm trade. One limitation of this model is that firms do not decide where to locate production and countries do not take into account the impact of having very high tax rates on attractiveness or very low tax rates on public opinion (Peralta et al. [2006]). We also do not introduce a cost of monitoring. This can explain why in reality countries do not strictly monitor transfer prices.

When the Home country unilaterally uses DB taxes, we noted that the equilibrium tax rate is increasing in α up to $\alpha = \frac{\alpha^* N[\alpha^*[\pi^* - c^*]+2}{N^*[\alpha^*[\pi^* - c^*]-2]}$ and is then decreasing (line (7b)). We thus find that under a unilateral adoption of DB taxes, $\alpha_H^{DS} = \frac{N[\pi^* - c^* + 2]}{N^*[\pi^* - c^* - 2]}$. The destination-based country sets a tax enforcement level that is increasing in N and decreasing in N^*. This comes from the fact that the Home country tax rate is increasing in N and decreasing in N^*. We can also see that a destination-based country has a lower level of enforcement than a source-based country, ie. $\alpha < 1$, if $N^*[\pi^* - c^* - 2] > N[\pi^* - c^* + 2]$, which we can approximate by $N^* > N$.

Finally, under a universal use of DB taxes, since there is no profit shifting, the tax rates are independent of the tax enforcement levels (line (7d)), implying that α, α^* can be set at any level.

4 Equilibrium and optimal choice of tax system

The main innovation of our paper is to allow countries to choose their tax system. We therefore now turn to the question of whether a country has an incentive to be the first adopter of the destination-based tax, but also if there is any rationale for a universal adoption of destination-based taxes. We compare the equilibrium tax revenues for each country, taking as given the tax system of the other country. We consider the Home country's decision, without loss of generality. The solutions are similar for the Foreign country.

4.1 Best-response to source-based taxes

We compare the tax revenues of the Home country when it uses source-based taxes and when it uses destination-based taxes, to find the best-response to the Foreign country using source-based taxes.

$$TR_H^{SS} - TR_H^{DS}|_{\text{Foreign uses S}} = \frac{2}{9}\left(\frac{[2N(\pi - c) + N^*(\pi^* - c^*)]^2}{N + N^*}\right) - N[\pi - c] + \frac{N^*}{16}[\pi^* - c^* - 2]^2 \tag{9}$$

We see from equation (9) that the difference is increasing in both the net revenue generated by the Home multinationals $[\pi - c]$ and the net revenue generated by the Foreign multinationals $[\pi^* - c^*]$. This means that, all else equal, higher net revenues, either through higher domestic revenue or higher Foreign revenue, increase the attractivity of source-based taxation compared to destination-based taxation when the Foreign country uses source-based corporate taxes.

Equation (9) is the equation of an ellipse. We show the graphical representation of the above tax difference in figure (1) in a $(\pi - c,\ \pi^* - c^*)$ plan for different values of N and N^*.[15] The region within the ellipse represents the range of values of $(\pi - c,\ \pi^* - c^*)$ where the tax revenue difference in equation (9) is negative, which implies that DB taxes are a best-response to SB taxes. All points outside the ellipse are combinations of $(\pi - c,\ \pi^* - c^*)$ where source-based taxes dominate. The ellipse itself represents the solutions to the equation $TR_H^{SS} - TR_H^{DS}|_{\text{Foreign uses S}} = 0$.

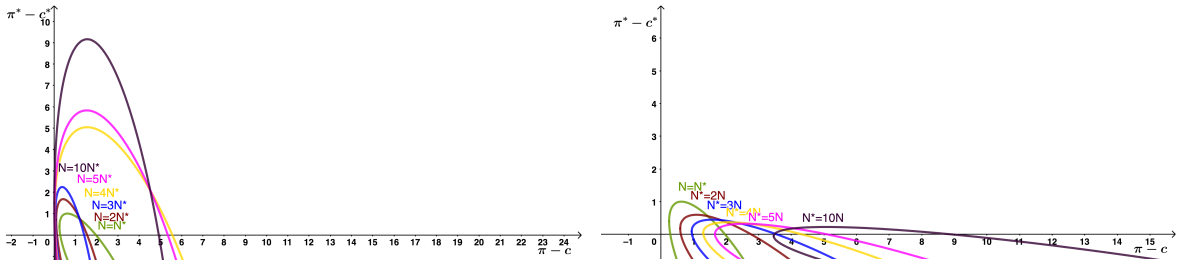
We consider first the symmetric case with $N = N^*$. For small, yet strictly positive, values of $\pi - c$, and small values of $\pi^* - c^*$, the Home country chooses destination-based taxes as a best-response to source-based taxes. The Foreign country reacts in a symmetric way. We thus observe that for large values of $\pi - c$ and $\pi^* - c^*$, source-based taxation is an equilibrium. We also find a source-based equilibrium for values of both $\pi - c$ and $\pi^* - c^*$ close to zero.

When considering the asymmetric case with N larger than N^* (figure (1a)), we see that the

[15] The shape of the ellipse only depends on the ratio $\frac{N}{N^*}$.

Figure 1: Best-response of the Home country to source-based taxes

(a) $\frac{N}{N^*} \geq 1$ (b) $\frac{N}{N^*} \leq 1$



Note: Graphical representation of the tax revenue difference from equation (9) when $\frac{N}{N^*} \geq 1$ and when $\frac{N}{N^*} \leq 1$. $\pi - c$ is represented on the horizontal axis and $\pi^* - c^*$ is on the vertical axis. Inside the ellipse, the best-response to source-based taxes is destination-based taxes. Outside the ellipse, the best-response is source-based taxes. On the ellipse, the tax revenues are equal.

larger N relative to N^*, the larger $\pi^* - c^*$ can be in order to have destination-based taxes as a best-response to source-based taxes for the Home country. This does not mean that we need large foreign corporate revenues to adopt destination-based taxes. This simply means that the range of values for which it is profitable for the Home country to unilaterally choose DB taxes as a best-response to SB taxes increases as the asymmetry increases in favor of the Home country. This comes from the fact that moving to DB taxes implies giving up the right to tax exporting (an in our case Foreign) firms. As the Home country gets larger compared to the Foreign country, the smaller the opportunity cost of giving up that right. The larger the Home country, the more it can "compensate" for this loss of foreign revenue. We also find that values of $\pi - c$ close to zero imply a choice in favor of destination-based taxes as a best response to source-based taxes at $\pi^* - c^* = 0$ as the asymmetry increases. Overall, the area where DB taxes are the best-response to SB taxes increases. As in the symmetric case, large values of $\pi - c$ and $\pi^* - c^*$ entail a source-based equilibrium.

When we consider the case where N^* is larger than N (figure (1b)), the values of $\pi - c$ and $\pi^* - c^*$ that imply that destination-based taxes are a best-response to source-based taxes respectively increase (move away from the origin) and decreases. With a large asymmetry, we find that source-based taxes is almost always an equilibrium since $\pi^* - c^*$ need to tend to zero for DB to dominate.

We can explain the above results as follows. A tax system that offers both a larger tax base

and a higher equilibrium tax rate than the other tax system will be preferred. If the tax base is smaller, the tax rate needs to be high enough to compensate for the narrow tax base. Conversely, if the equilibrium tax rate is lower under one system, this system can still be more profitable is the tax base is wide enough. In this case of best-response to source-based taxes, we know that the tax rate difference between SB taxation and DB taxation is increasing in both $N[\pi - c]$ and $N^*[\pi^* - c^*]$. Higher Home or Foreign net profits entail a larger source-based tax rate compared to that under a unilateral adoption of DB taxes (from the comparison of (6a) and (6b)). We also know that the tax base under source-based taxes is larger than that under destination-based taxes if Home is the low-tax country under source-based taxation (and the tax rate difference is sufficiently large) since Home attracts more profits by being a low-tax country. This tax rate difference $\tau_H^{SS} < \tau_F^{SS}$ comes from having $N[\pi - c] < N^*[\pi^* - c^*]$. A combination of both a higher tax rate and a larger tax base obviously entails a choice in favor of source-based taxes. A smaller tax base under source-based taxes could also result in larger tax revenues with source-based taxation if τ_H^{SS} is high enough, i.e. if both $N[\pi - c]$ and $N^*[\pi^* - c^*]$ are large and $N[\pi - c] > N^*[\pi^* - c^*]$, to compensate for the narrow tax base.

Moreover, with endogenous tax enforcement, we know that source-based countries will implement a strict control of intra-firm trade, thereby forcing firms to trade at almost arm's length. With little profit shifting, source-based taxation is much less distortive and countries can both tax "the full amount" of tax revenues from the domestic parent and the foreign affiliate. The opportunity cost of implementing high tax rates is in this case lower since there is a strict enforcement.

Proposition 1 With endogenous levels of tax enforcement and tax rates, source-based taxation is the best-response to source-based taxes when both foreign profits and domestic profits are large. Otherwise, the best-response to the foreign country using source-based taxes is the use of destination-based taxes.

4.2 Best-response to destination-based taxes

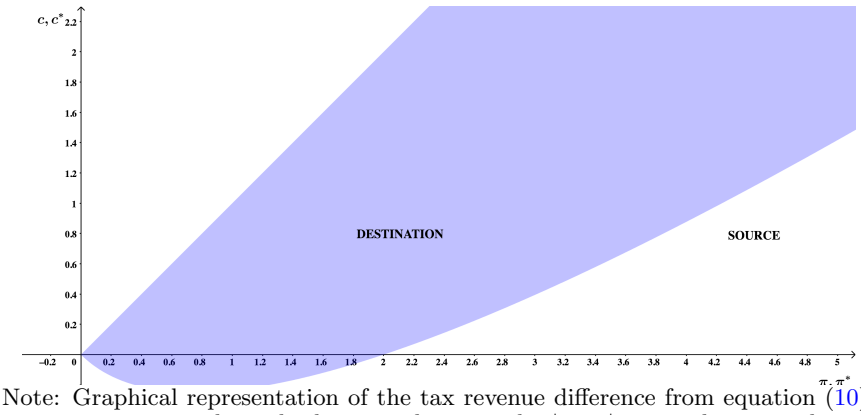
We now turn to the question of whether a universal adoption of destination-based taxes is possible. We study the tax revenue difference when the foreign country uses destination-based taxes:

$$TR_H^{SD} - TR_H^{DD}|_{\text{Foreign uses D}} = \frac{N}{4}[\pi - c][\pi - c + 2] - N\pi \tag{10}$$

From eq. (10), we can see that the tax revenue difference only depends on π (π^*) and c (c^*) for the Home (Foreign) country. This is again the equation of an ellipse and this equation is independent of the size of the countries.

This represents a long ellipse, almost centered around the 45 degree line. Since we impose that $\pi - c > 0$ and $\pi^* - c^* > 0$, we only consider the area below the line $y' = x'$. The area within the ellipse represents values of (π, c) and (π^*, c^*) for which destination-based taxes are a best-response to destination-based taxes. This means that if both (π, c) and (π^*, c^*) are within the ellipse, destination-based taxes are an equilibrium. This is only the case when $(\pi - c, \pi^* - c^*)$ are not too large. Below the ellipse is the area where source-based taxes are a best-response to destination-based taxes.

Figure 2: Best-response to destination based taxes



Note: Graphical representation of the tax revenue difference from equation (10). $\pi - c$ is represented on the horizontal axis and $\pi^* - c^*$ is on the vertical axis. Inside the ellipse, the best-response to source-based taxes is destination-based taxes. Outside the ellipse, the best-response is source-based taxes. On the ellipse, the tax revenues are equal.

We know that the tax base under a unilateral use of SB taxes is smaller than the tax base under

a universal adoption of DB taxes because of profit shifting under the unilateral use of source-based taxes. However, the tax rate τ_H^{SD}, increasing in $\pi - c$, is always larger than or equal to τ_H^{DD} (always equal to 1). The larger tax rate can compensate for the fact that under a unilateral use of source-based taxes, profits are being shifted out of the source-based country, irrespective of its tax rate. Moreover, the strict tax enforcement in that case with $\alpha^{SD} = 1$ increases the cost for firms to shift profits, which allows the source-based country to raise larger tax revenues compared to the situation in which firms could shift profits in a less restrained way.

Proposition 2 With endogenous levels of tax enforcement and tax rates, source-based taxes are the best-response (of the Home country) to destination-based taxes if domestic net revenues are large enough. Otherwise, when the domestic net corporate revenues are small, destination-based taxes are the best-response.

4.3 Equilibrium

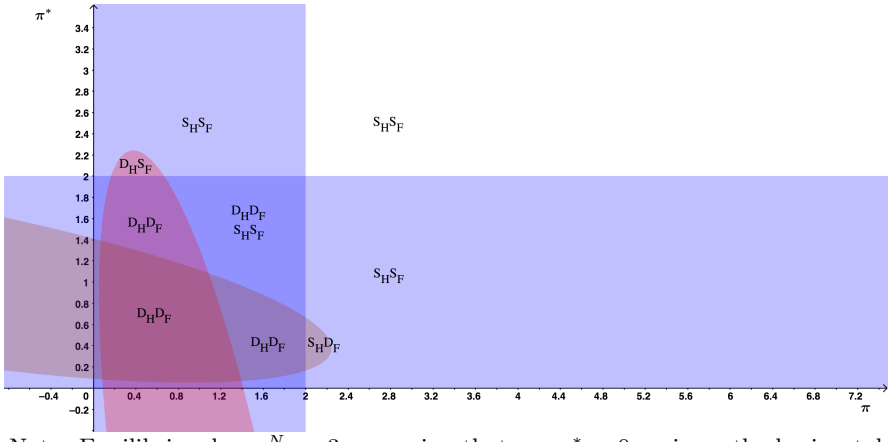
We first show the solution when we assume that $c = c^* = 0$. This simplification does not impact our results but simplify the expression of the equilibrium. We show these equilibria for $\frac{N}{N^*} = 3$ in figure (3).[16]

We observe that for large values of both domestic and foreign corporate revenues, or large values of either one of the two, source-based taxation is a Nash equilibrium. We also observe that destination-based taxes are a Nash equilibrium when both domestic and foreign corporate revenues are small. For an intermediate range of values of both domestic and foreign corporate revenues, we find multiple equilibria: both source-based and destination-based taxation arise. Finally, and this is only the case if $\frac{N}{N^*} > 2$, we find that there exists an equilibrium with a unilateral adoption of DB taxes ($D_H S_F$ or $S_H D_F$).

The general case can be seen on figure (4). Source-based taxation is a Nash equilibrium when both domestic and foreign corporate revenues are large. Large $\pi - c$ and $\pi^* - c^*$ imply a high tax rate under a universal use of source-based taxes, complemented with a strict tax enforcement,

[16] We observe the same patterns for $\frac{N}{N^*} > 3$.

Figure 3: Equilibria when $\frac{N}{N^*} = 3$ with $c = c^* = 0$



Note: Equilibria when $\frac{N}{N^*} = 3$, assuming that $c = c^* = 0$. π is on the horizontal axis and π^* is on the vertical axis. The red areas correspond to the ellipse derived from equation (9). The red areas therefore correspond the the values of π, π^* where destination-based taxes are a best-response to source-based taxes. The blue areas represent the area where destination-based taxes are a best-response to destination-based taxes for each country when $c = c^* = 0$. "$D_H S_F$" means that there exists a unilateral equilibrium in which the Home country adopts destination-based taxes and the Foreign country uses source-based taxes.

thereby making it beneficial to use source-based taxes as a response to the other country using source-based taxes.

We also know that for some values of $(\pi - c,\ \pi^* - c^*)$, the best-response to source-based taxes is destination-based taxes (figure (4a)). We investigate whether in that situation, the Foreign country best-response to destination is to use source-based taxes. We observe on figure (1) that when either $N = N^*$ or $N = 2N^*$, the Home country chooses DB as a response to source-based taxes when $\pi^* - c^*$ is below 2. When we focus on the best-response to destination (figure (**??**)), we observe that when $\pi^* - c^* \leq 2$, the Foreign country best-response to destination is always destination. Therefore, there exists no equilibrium with a unilateral adoption of DB taxes. However, when $\pi^* - c^* > 2$, we observe that the Foreign country best-response to DB taxes can be source-based taxes. This is represented by the triangular-like area delimited by the ellipse, the vertical axis and the purple line. From figure (1), we can see that Home (Foreign) chooses destination as a best-response to source-based taxes for values of $\pi^* - c^*$ between 0 and 2.2426 for $\frac{N}{N^*} = 3$. In this range of values, the equilibrium is the unilateral use of DB taxes by the Foreign (Home) country. This triangle-like area is bigger, implying larger possible values of $\pi - c$ $(\pi^* - c^*)$, as the ratio $\frac{N}{N^*}$ increases.

For this unilateral equilibrium to arise, the destination-based adopting country needs to be much larger than the source-based country. This comes from the fact that since there is a strict tax enforcement under source-based taxation, profit shifting opportunities are limited and source-based countries can almost tax the "full amount" of taxable profits. Moving to destination-based taxes implies loosing the ability to tax foreign firms and hence loosing opportunities to generate tax revenues. If the DB country is much larger that the source-based country, the opportunity cost of loosing this ability to tax foreign firms is lower since a DB country can tax the full amount of domestic corporate revenues, not subject to profit shifting, that increases with the number of firms in the country. The "lost" tax revenue stemming from the foreign affiliates is potentially quite small in comparison since there a few foreign firms compared to domestic firms. The complete characterization of equilibria can be seen on figures (4) and (3) for the case $\frac{N}{N^*} = 3$.

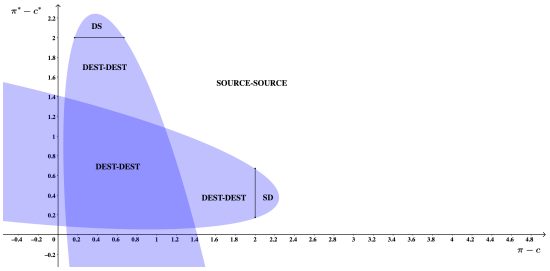
Finally, when firms do not generate enough revenue, destination-based taxes dominate and represent a Nash equilibrium that is fiscally optimal (as can be seen on both figures (4a) and (4b). Smaller domestic and foreign corporate revenues trigger a lower tax rate under a universal use of SB taxes than that under a unilateral use of DB taxes, which makes destination-based taxes more attractive. The smaller $\pi - c$ also entails a smaller tax rate advantage of source-based taxation over destination-based taxation (under the universal adoption of DB taxes). Since we know that the tax base is always larger under destination-based taxation, it appears that firms are better off universally adopting destination-based taxes. We thus observe that there can be multiple equilibria when $(\pi - c,\ \pi^* - c^*)$ are of medium range (figure (4b)).

Proposition 3 Source-based taxes are a Nash Equilibrium when both domestic and foreign corporate revenues are large. Destination-based taxes are a Nash Equilibrium when both domestic and foreign corporate revenues are small. We have multiple equilibria with source-based and destination-based taxes when both domestic and foreign corporate revenues are of medium range. Finally, a Nash Equilibrium with a unilateral adoption of destination-based taxes by the Home (Foreign) country can arise for specific values of firms' revenues if $\frac{N}{N^*} > 2$ ($\frac{N^*}{N} > 2$).

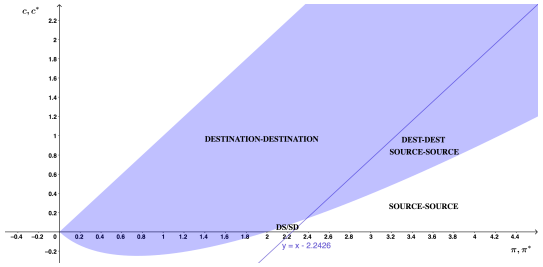
Proof: See appendix.

Figure 4: Best-responses and equilibria when $\frac{N}{N^*} = 3$

(a) Best-response to source



(b) Best-response to destination



Note: Graphical representation of the tax revenue difference from equation (9) on the left and (10) on the right when $\frac{N}{N^*} = 3$. On figure (4a), $\pi - c$ is on the horizontal axis and $\pi^* - c^*$ is on the vertical axis. On figure (4b), π, π^* is represented on the horizontal axis and c, c^* is on the vertical axis. Inside the ellipse, the best-response to destination-based taxes is destination-based taxes. Outside the ellipse, the best-response is source-based taxes. On the ellipse, the tax revenues are equal.

4.4 Policy implications

We show that source-based taxation dominates when corporate revenues are large. This domination comes from the strict enforcement of profit shifting policies, that allows a high tax rate under a source-based system. This strict monitoring is key because it increases the concealment cost borne by multinational firms when they deviate from the arm's length principle. Moving to destination-based taxes for a small country would entail a high opportunity cost of giving up the right to tax foreign affiliates.

We also show that two symmetric countries with large revenues have incentives to use source-based taxation, while two symmetric countries with small revenues have an incentive to move to destination-based taxes. In the case of a large asymmetry, with the big country having many firms that do not generate much revenues and a small country with firms that generate more revenues, but not too much, we observe that the large country should unilaterally move to destination-based taxes as explained above. Considering the European Union as one entity, this can explain the choice to remain under source-based taxation. However, considering each country as one independent competitor of a large country, say the US, this could rationalize the proposition of the US Congress to move to destination-based taxes.

The idea of the US to move to a destination-based tax could be both related to the large number of firms in the US, creating a large asymmetry relative to most other nations and to the

level of tax enforcement being low. With low tax enforcement, being a high-tax country makes it hard to raise tax revenues from multinational firms that try to escape taxation. The US, with a statutory corporate tax rate of 35% before the 2017 TCJA reform, had one of the highest tax rate within OECD. Together with their low level of tax enforcement, this could explain their interest in moving toward destination-based taxation. There is evidence that auditing of multinational firms has decreased in several major countries. For the fiscal year 2017, the Internal Revenue Service (IRS), the governmental auditing institution in the US, audited only 331 of 616 corporate giants down from 431 audits in 2010.[17] The number of agents working for that agency has also been reduced by a third in the last decade.[18] The same trend is at play in France with fewer agents auditing multinational firms. In the rest of the EU, the number of auditors has either decreased or roughly stabilized. However, in 2016, Country-by-Country Reporting (CbCR) was introduced in the US. This new requirement was expected to strengthen the tax enforcement already in place in the US. We know that the dominance of source-based taxes mostly comes from the fact that a stricter tax enforcement lowers profit shifting. The introduction of CbCR could potentially increase enforcement, thereby rationalizing the decision of remaining under a source-based tax system.

5 Conclusion

This paper focuses on the equilibrium and optimal choice of tax policy in a context of tax competition with transfer price manipulation by multinational firms. This aims to shed light on the following puzzle: source-based taxes are considered suboptimal in the literature but all countries use source-based corporate taxes. The Ryan proposition in 2016 to shift the US corporate tax system to a destination-based cash-flow tax boosted the debate. To solve this puzzle, we develop a model of tax competition in which countries optimally choose their tax policy.

Our findings show that the optimal response of countries that use source-based taxes is to implement a strict monitoring of profit shifting. This strict monitoring lowers the distortions that are

[17] The audit rates for largest corporations with inputs of $250 million or more kept decreasing since the 1990s to reach 14% in 2018, against 72% in 1990 (https://trac.syr.edu/tracirs/highlights/current/auditrate.html).

[18] https://www.cbsnews.com/news/2019-taxes-irs-audit-the-odds-are-with-you/

well known under source-based taxation, and hence the race to the bottom.

We find that with endogenous levels of tax enforcement and endogenous tax rates, source-based taxation is the best-response to source-based taxes if both domestic and foreign revenues are large, which entails a high source-based tax rate. We also find that source-based taxes are the best-response to DB taxes also if domestic revenues are large, because of a high tax rate under source-based taxes which compensates the fact that a source-based country is penalized by the profit shifting behavior of firms. Overall, the universal use of source-based taxes is a Nash Equilibrium if both domestic and foreign corporate revenues are large. For small levels of corporate revenues, the universal adoption of DB taxes is a Nash equilibrium. We find that when both domestic and foreign corporate revenues are of medium range, both source-based and destination-based taxation are an equilibrium. Finally, we show that when countries are sufficiently asymmetric, the unilateral use of DB taxes can be an equilibrium. In all cases, the equilibrium is optimal.

This has strong tax policy implications. Source-based taxation can be optimal because of the strict tax enforcement. Currently, we observe a decreasing and now low level of tax enforcement in many developed countries. This paper shows that governments should increase the level of monitoring of profit shifting when using source-based taxes. It also helps rationalize which countries should use source-based taxation and which should move toward DB taxation.

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Appendices

A Details of sections (2) and (3)

A.1 Universal use of source-based taxes

Optimal tax rates for given levels of tax enforcement are obtained by (**??**) and (**??**). We plug the tax rate expressions in the tax revenue equation and maximize it with respect to α. We get the following optimal tax rates with $\alpha_H^{SS} = \alpha_F^{SS} = 1$:

$$\tau_H^{SS} = \frac{4}{3(N+N^*)}\left(N(\pi - c) + \frac{N^*(\pi^* - c^*)}{2}\right)$$
$$\tau_F^{SS} = \frac{4}{3(N+N^*)}\left(N^*(\pi^* - c^*) + \frac{N(\pi - c)}{2}\right)$$

We observe that $\frac{\partial \tau_H^{SS}}{\partial N} > 0$ and $\frac{\partial \tau_H^{SS}}{\partial N^*} < 0$. When both countries use source-based taxation, they can tax their domestic Parent profits and the profits of the Foreign affiliates. When the number of domestic firms increases, the tax base increases, keeping the number of Foreign firms constant. They can always tax $\pi > 0$, proportional to N, which is the revenue stemming from selling the output, not subject to profit shifting. This explains why the Home tax rate increases when N increases. On the other hand, when the number of Foreign firms increases, the tax base does not necessarily increase. The profits of the Foreign affiliate is not always positive ex-post (because of profit shifting). The lower (but positive) the tax rate differential between the Foreign and the Home tax rate, the lower the transfer price. Therefore the Home country will lower its tax rate when the number of Foreign firms increases to try to ensure a positive Foreign affiliate profit.

So far, we know that source-based taxation with profit shifting can lead to a race to the bottom. We also know that a high-tax country will be loosing tax revenues in favor of the other, low-tax, country. Specifically, the Home country is the "high-tax country" if

$$\frac{4}{3(N+N^*)}\left(\frac{N(\pi - c) - N^*(\pi^* - c^*)}{2}\right) \geq 0$$

This means, a country has a higher tax rate if its domestic firms create more net profits than

the firms headquartered in the other country.

Finally, optimal tax revenues write:

$$TR_H^{SS} = \frac{2}{9}\left(\frac{[2N(\pi - c) + N^*(\pi^* - c^*)]^2}{N + N^*}\right)$$

$$TR_F^{SS} = \frac{2}{9}\left(\frac{[N(\pi - c) + 2N^*(\pi^* - c^*)]^2}{N + N^*}\right)$$

A.2 Unilateral adoption of destination-based taxes

Tax revenues are defined by (5). We compute the tax rates with τ_H^{DS} defined by (6b) and τ_F^{DS} defined by (6a). We then obtain the enforcement levels α_H^{DS} and α_F^{DS} in (**??**).

Optimal tax rates write:[19]

$$\tau_H^{DS} = 1 - \frac{c}{\pi} - \frac{N^*[\pi^* - c^* - 2]^2}{16\pi N}$$
$$\tau_F^{DS} = 1 + \frac{\pi^* - c^*}{2}$$

Hence, optimal tax revenues are as follows:

$$TR_H^{DS} = N[\pi - c] - \frac{N^*}{16}[\pi^* - c^* - 2]^2$$
$$TR_F^{DS} = \frac{N^*}{4}[\pi^* - c^*][\pi^* - c^* + 2]$$

We can see that the tax revenues in both countries are increasing in the number of firms headquartered on their territory. This comes from the fact that governments can always tax the revenues stemming from selling the output (5a). We can also see that the tax revenues in Foreign do not depend on the number of firms in the Home country. This reflects the fact that, since the destination-based country acts as a sort of tax haven and has the same gravitational power with profits as a tax haven, firms will shift profits out of the source-based country. Therefore, the

[19] We check the robustness of our results if we bind the constraint on the statutory tax rate and assume that $\tau_F^{DS} = 1$. A note can be found in the next section.

source-based country tax revenues only depend on N^*. However, the tax revenues in Home are a decreasing function of the number of Foreign firms because, even though the DB attracts profits through its status of "tax haven", the increasing number of Foreign firms decreases α, which lowers Home tax revenues.[20]

A.3 Universal adoption of destination-based taxes

Tax revenues in the Home country are of the form (5). With $\tau_H^{DD} = \tau_F^{DD} = 1$, we get that the optimal tax revenues write :

$$TR_H^{DD} = N\pi$$
$$TR_F^{DD} = N^*\pi^*$$

Countries earn the amount of profits net of profit shifting, border adjustment and concealment cost.

B Proof of section 4.3

We start from eq. (9). We set for simplicity $x = \pi - c \geq 0$ and $y = \pi^* - c^* \geq 0$. We have

$$F(x,y) = \frac{(2Nx+y)^2}{9(N+N^*} - Nx + \frac{N^*}{16}(y-2)^2$$

This is the equation of a conic section. We know that this conic section is an ellipse since the term in front of x^2 and the one in front of y^2 are non zero, have the same sign and are not equal to each other.

Setting $F(x,y) = 0$, we find that the solutions to this equation are of the form:

$$y = 2\frac{(9N^* + 9N - 32N^*x)}{41N + 9N^*} \pm \frac{12}{N}\frac{\sqrt{-8N^3 - 25N^2N^*x + 8N^2N^* + 8N^{*2}Nx^2 - 34NN^{*2}x + 8N^{*3}x^2 - 9N^{*3}x}}{(41N+9N^*)^2}$$

[20] The relation between the Home country tax revenues and α is an inverted U-shape.

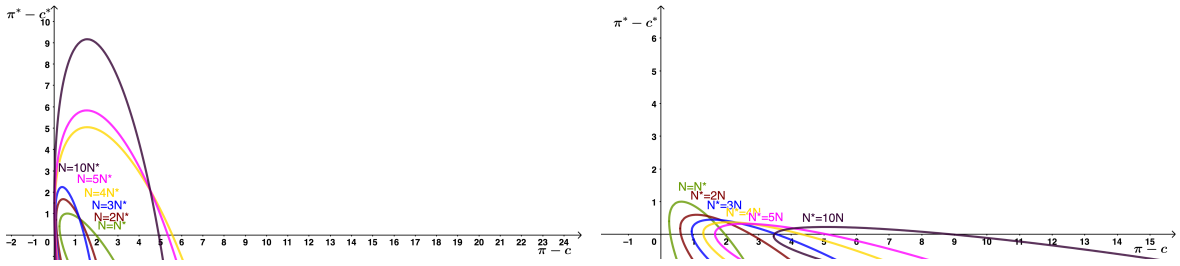
$F(x,0)$ has always two real solutions and $F(0,y)$ has no real solution. We also know that for any (x,y) inside the ellipse, $F(x,y) < 0$ which implies that $TR^H_{SS} - TR^H_{DS} < 0$. This corresponds to the case where the Home country chooses destination-based taxes as a response to source-based taxes.

By symmetry of the tax revenue equation of the Foreign country facing a choice between source-based and destination-based taxation when the Home country uses source-based taxes, we find that $F(x,y) = 0$ entails solutions of the form:

$$x = 2\frac{(9N^* + 9N - 32Ny)}{41N^* + 9N} \pm \frac{12}{N^*}\frac{\sqrt{-8N^{*3} - 25N^{*2}Ny + 8N^{*2}N + 8N^2N^*y^2 - 34N^*N^2y + 8N^3x^2 - 9N^3y}}{(41N^* + 9N)^2}$$

Figure 5: Best-response of the Home country to source-based taxes

(a) $\frac{N}{N^*} \geq 1$ (b) $\frac{N}{N^*} \leq 1$



Note: Graphical representation of the tax revenue difference from equation (9) for both the Home and the Foreign countries when $\frac{N}{N^*} = 1$. $\pi - c$ is represented on the horizontal axis and $\pi^* - c^*$ is on the vertical axis. Inside the ellipse, the best-response to destination-based taxes is destination-based taxes. Outside the ellipse, the best-response is source-based taxes.

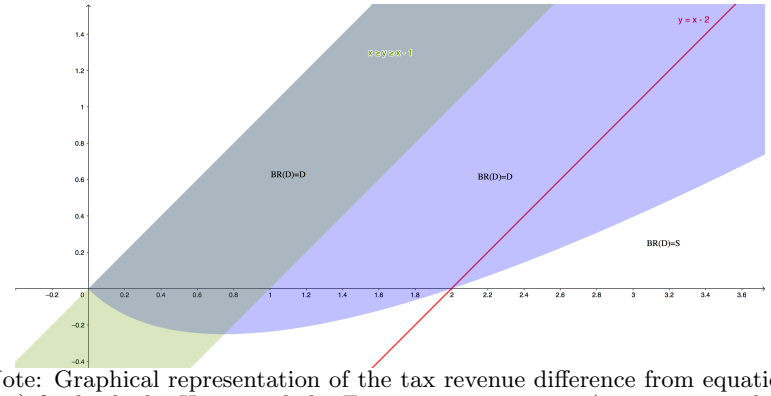
This represents an ellipse that crosses twice the vertical axis and never crosses the horizontal axis. Plotting both ellipses together, we find that any (x,y) outside both ellipses correspond to an source-based equilibrium. Inside either one or both ellipses, the best-response to source-based taxes is destination-based taxes. We therefore need to investigate from equation (10) if the best-response to destination-based taxes can be source-based taxation.

We know that the equation (10) $TR^H_{SD} - TR^H_{DD} = 0$ is that of an ellipse of the form:

$$y' = x' + 1 - \sqrt{4x' + 1} \tag{11}$$

where $x' = \pi, \pi^*$ and $y' = c, c^*$. We only consider half of the ellipse because we need to have $\pi - c > 0$ ($\pi^* - c^* < 0$) $F(x, 0)$ has always two real solutions and $F(0, y)$ has real solutions that are not considered here because they assume $\pi - c < 0$ ($\pi^* - c^* < 0$). We also know that for any (x, y) inside the ellipse, $F(x, y) < 0$ which implies that $TR^H_{SS} - TR^H_{DS} < 0$. This corresponds to the case where the Home country chooses destination-based taxes as a response to destination-based taxes.

Figure 6: Best-response to destination-based taxes



Note: Graphical representation of the tax revenue difference from equation (10) for both the Home and the Foreign countries. π, π^* is represented on the horizontal axis and c, c^* is on the vertical axis. Inside the ellipse, the best-response to destination-based taxes is destination-based taxes. Outside the ellipse, the best-response is source-based taxes.

We can see on figure (5) that when the Home country chooses destination-based taxes as a best-response to source-based taxes, $\pi^* - c^* \in [0, 1]$. We check on figure (6) that, when $\pi^* - c^* \in [0, 1]$ (in the green zone), the Foreign best-response to destination-based taxes is destination-based taxes. Therefore, there exists no equilibrium with a unilateral adoption of DB taxes. However, we observe on this graph that if $\pi^* - c^* > 2$, the best-response to destination-based taxes can be source-based taxes. Therefore, if we can observe that, for values of $\pi^* - c^* > 2$ (any value at the right of the red line), the Home best-response to source-based taxes is destination-based taxes (which is the case if $\frac{N}{N^*} > 2$), there can exist an equilibrium with a unilateral adoption of destination-based taxes.

Lastly, we observe that there can be a multiplicity of equilibria. Considering the symmetric case with $\frac{N}{N^*} = 1$, we know that for any point outside the ellipses on figure (5), source-based taxes are an equilibrium. Roughly speaking, this is the case for any $(\pi - c,\, \pi^* - c^*)$ above the line $y = 2 - x$. If $\pi^* - c^* > 2$ we know that its best-response to Home using source-based taxes is source-based taxes. But we can also see on figure (6) that if $\pi^* - c^* > 2$, destination-based taxes can be an equilibrium. Therefore, for some values of $(\pi - c,\, \pi^* - c^*)$, both source-based and destination-based taxes are a Nash equilibrium.

C Monitoring of outbound profit shifting

The general expression of the Home MNF profit, which relates to (1) in the version with inbound profit shifting, writes:

$$Max_q \;\; \Pi(q, \tau, \tau^*; \pi, \alpha, \beta, \gamma, c) = (1-\tau)[\pi - q] - \gamma\tau q + (1 - \beta^*\tau^*)q - (1-\tau^*)c - \alpha^*(q-c)^2 \quad (12)$$

All results regarding tax revenues and tax rates in section (2) apply here. The only difference is that all α (α^*) need to be replaced by α^* (α).

C.1 If both countries use source-based taxation

Maximizing the tax revenues with respect to the tax enforcement levels, we find again that

$$\alpha = \alpha^* = 1$$

Hence optimal tax rates and hence tax revenues write as before:

$$\tau_H^{SS} = \frac{4}{3(N+N^*)}\left(N(\pi - c) + \frac{N^*(\pi^* - c^*)}{2}\right)$$
$$\tau_F^{SS} = \frac{4}{3(N+N^*)}\left(N^*(\pi^* - c^*) + \frac{N(\pi - c)}{2}\right)$$

$$TR_H^{SS} = \frac{2}{9}\left(\frac{[2N(\pi - c) + N^*(\pi^* - c^*)]^2}{N + N^*}\right)$$
$$TR_F^{SS} = \frac{2}{9}\left(\frac{[N(\pi - c) + 2N^*(\pi^* - c^*)]^2}{N + N^*}\right)$$

C.2 Unilateral adoption of destination-based taxes

We plug the optimal tax rates back into the tax revenue equation and maximize it with respect to tax enforcement levels. This yields:

$$\alpha_H^{DS} = \frac{N^*}{N^*[\pi^* - c^*] - N} \tag{13}$$
$$\alpha_F^{DS} = 1$$

α_H^{DS} depends positively on N and negatively on N^* as with inbound profit shifting monitoring.

Optimal tax rates therefore write:

$$\tau_H^{DS} = 1 - \frac{c}{\pi} + \frac{1}{4\pi} \tag{14}$$
$$\tau_F^{DS} = 1 \tag{15}$$

One notable difference with the results with inbound profit shifting monitoring is that the destination-based country tax rate no longer depends on the the number of firms in each country. With the monitoring of outbound profit shifting, the DB country monitors profit shifting of firms headquartered in the source-based country. However, since it uses a destination system, it cannot tax the profit of those foreign firms, which means that the monitoring has no direct impact on its tax revenues and hence on its optimal tax rate. On the other side, the Foreign country monitors the DB country headquartered firms. These firms will try to shift as much profit as they can toward the DB country, irrespective of τ_H^{DS}. This explains why τ_H^{DS} is independent of N and N^*.

Hence, optimal tax revenues are as follows:

$$TR_H^{DS} = N\left[\pi - c + \frac{1}{4}\right]$$
$$TR_F^{DS} = \frac{N^*}{2}[\pi^* - c^*]$$

The tax revenues of each country now only depend on the number of firms headquartered on its own territory, as opposed to previously where the tax revenues of the DB country depended on both N and N^*.

C.3 Universal adoption of destination-based taxes

The tax enforcement parameters do not enter either the transfer price equation, or the tax rate or the tax revenue equations. The results therefore remain as with inbound profit shifting monitoring.

C.4 Equilibrium and optimal choice of tax system

Best-response to source-based taxes

We compare the tax revenues of the Home country when it uses source-based taxes and when it uses destination-based taxes, to find the best-response to the Foreign country using source-based taxes.

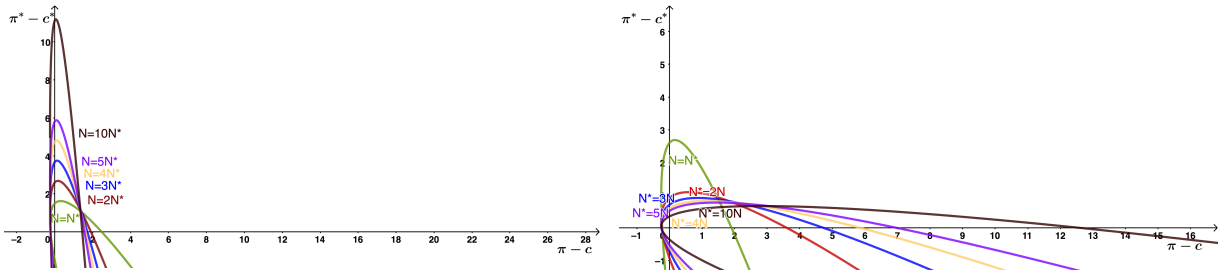
$$TR_H^{SS} - TR_H^{DS}|_{\text{Foreign uses S}} = \frac{2}{9}\left(\frac{[2N(\pi - c) + N^*(\pi^* - c^*)]^2}{N + N^*}\right) - N\left[\pi - c + \frac{1}{4}\right] \tag{16}$$

This equation is that of an ellipse. We show in figure (7) the shape of these ellipses for different values of $\frac{N}{N^*}$.

We can see that, as before, the tax revenue difference is increasing in both the foreign and the domestic profits. The ellipse is still more vertical as the ratio of $\frac{N}{N^*}$ increases and more horizontal as is decreases. We still have that when both the domestic and foreign corporate revenues are large, source-based taxes are an equilibrium. The use of outbound profit shifting does not really impact the results regarding the incentives to unilaterally adopt destination-based corporate taxes. Inside

Figure 7: Best-response to destination based taxes

(a) $\frac{N}{N^*} \geq 1$ (b) $\frac{N}{N^*} \leq 1$



Note: Graphical representation of the tax revenue difference from equation (9) when $\frac{N}{N^*} \geq 1$ and when $\frac{N}{N^*} \leq 1$. $\pi - c$ is represented on the horizontal axis and $\pi^* - c^*$ is on the vertical axis. Inside the ellipse, the best-response to source-based taxes is destination-based taxes. Outside the ellipse, the best-response is source-based taxes. On the ellipse, the tax revenues are equal.

the ellipse, the best-response to source-based taxes is destination-based taxes. This area grows as $\frac{N}{N^*}$ increases.

Best-response to destination-based taxes

We compare the tax revenues of the Home country when it uses source-based taxes and when it uses destination-based taxes, to find the best-response to the Foreign country using DB taxes.

$$TR_H^{DS} - TR_H^{DD}|_{\text{Foreign uses D}} = -\frac{N[\pi + c]}{2} < 0 \tag{17}$$

In this case, the results differ from the ones with inbound profit shifting. We find that the best-response to DB taxes is always the use of destination-based taxes. There can therefore exist no equilibrium with a unilateral adoption of destination-based taxes. We can still have multiple equilibria when both ($\pi - c$, $\pi^* - c^*$) are of values outside the ellipse on figure (7). We now find that a country is always better off with destination-based taxes as a response to the other country using destination-based taxes. This comes from the fact that a country that unilaterally uses source-based taxes while only monitoring the profit shifting of the foreign affiliates will be hurt by the profit shifting behaviour of its domestic Parent firms, that are less monitored and that will try to reduce their taxable profits in Home.