

# Mobile tax base as a global common

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**Abstract** If countries anticipate international Bertrand competition in tax rates, they may expend effort that makes some of their taxpayers less mobile or increases the mobility of taxpayers elsewhere. Piecemeal evidence on what activities countries use is provided. Such activities are analyzed that interact with Bertrand tax competition if the size of the groups of loyal and nonloyal citizens or investors is endogenous. Further, the implications of tax harmonization and minimum taxes for these types of nonprice competition are considered. Home attachment reduces the intensity of tax competition, but generates a strategic disadvantage for the country that invests much in such home attachment. Harmonization of taxes and high minimum taxes can intensify countries' investment in home attachment.

**Keywords** Tax competition · Common pool · Advertising · Nation brands · Instilling preferences · Home bias · Patriotism · Mixed strategies

**JEL Classification** H77 · F21 · F22

## 1 Introduction

Public finance has analyzed competition for direct investment, financial capital, and human capital<sup>1</sup> with a focus on tax rates as the instrument of competition. There

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<sup>1</sup>Foreign direct investment and financial capital are the more prominent targets in tax competition. However, competition for human capital has a long tradition. Bhagwati and Dellarf (1973), Bhagwati (1976), and Raymond (1973) were among the first to discuss the downsides of this competition.

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are notable exceptions, but the general validity of the claim becomes evident if one recalls the Wildasin (1988) or the Zodrow and Mieszkowski (1986) frameworks of tax competition that have become the workhorses for analyzing tax competition.<sup>2</sup> In this respect, much of this analysis is structurally similar to what would be considered as Bertrand or price competition in the context of the competition between firms. Other types of “price” competition for capital have also been explored: standard auctions (Black and Hoyt 1989; Besley and Seabright 1999), monopolistic competition (Kind et al. 2000), Hotelling location competition (Hohaus et al. 1994; Justman et al. 2002, 2005). Prices govern the allocation of resources also in these approaches.

Countries can use other means of competition by which they can try to acquire a larger share of the tax base, and some of these competition modes make the tax base a common pool resource.<sup>3</sup> A common pool resource is defined here as a resource that is rival in its use, for which property rights are not (yet) well defined, with players rivaling regarding the allocation of property rights. Tax rates or investment subsidies are clearly important determinants as variables that govern the allocation of the internationally mobile tax base. But the extent to which a country can impose taxes on a given tax base without making it move away is governed by activities which are structurally similar to appropriation effort or effort in establishing property claims.<sup>4</sup> Major categories of such appropriation efforts are *advertising*, *branding*, and the *investment in tax payer loyalty*.

Countries widely advertise, trying to attract foreign direct investors. This advertising is partially informative. Informative advertising was used in Austria’s campaign in 2005. The full-page advertisement that appeared in the *Economist* displayed a comparison between the corporate tax rates of 25% in Austria and 38% in Germany. The advertisement also emphasized that Austria and Germany are very similar along other dimensions that are relevant determinants for investment decisions, including access to the German market.<sup>5</sup>

This type of advertisement weakens the loyalty of citizens or investors in other countries, by informing them about other alternatives. Other types of advertising may aim at building up a particular image, making the country different from other countries in the eyes of the investors or taxpayers. An example for this type of advertising is a recent campaign<sup>6</sup> by the International Marketing Council (IMC) of South Africa

<sup>2</sup>Any list of seminal contributions to this capital tax competition literature will notoriously be unfair to some authors, but should include Zodrow and Mieszkowski (1986), Wilson (1986), Wildasin (1988), Gordon (1986, 1992), and Sinn (1990). Excellent surveys are by Wilson (1999), Wildasin and Wilson (2004), Fuest et al. (2005), and Sørensen (2007).

<sup>3</sup>Tax base as a common pool resource has been considered in the context of vertical tax externalities, where a tax base in one location is subject to taxation by multiple, vertically ordered, and independently acting fiscal authorities, as in Keen (1998), Keen and Kotsogiannis (2002), and Wrede (1997, 2000). Wrede (1999) explicitly uses the term “fiscal common” in this context.

<sup>4</sup>Activities that generate or change the loyalty of taxpayers are the equivalent in the tax-competition context to activities that define or re-define property rights in natural resource common pool problems. Sinn (1984), e.g., addressed this problem formally, in the context of oil extraction from a common pool and considered the option to separate the resource from the common pool.

<sup>5</sup>See *The Economist*, 2005, 3-5/05.

<sup>6</sup>See, e.g., *The Economist*, 21 October 2006.

by which a public-private partnership tries to give the country the image described on their home page, “South Africa, a country at the southern tip of Africa, inspires the world to a new way of doing things, because our unique combinations create refreshing possibilities.”

Finally, Germany launched a major advertising campaign for attracting foreign direct investment in 2006, labeled *Germany, Land of Ideas*. As part of this campaign, German fashion top model Claudia Schiffer volunteered to pose. Pictures of her have been displayed prominently on advertising boards in the subway stations of London and New York. On these pictures she is partially wrapped in a German flag and the headline says, “Invest in Germany, boys.”<sup>7</sup>

The idea that this type of “persuasive” advertising is a common pool problem where firms expend effort for attracting a larger share in a given pool of customers is very old. It is the basic underlying hypothesis for much of the formal game theory on advertising in the business literature and can be traced back at least to Friedman (1958) or Schmalensee (1976). Countries play these games as well.<sup>8</sup>

Much like firms, countries also invest in their brand names. *The Anholt Nation Brands Index*, for instance, publicizes the brand values of 30 major nations on a quarterly basis. According to this index, in 2006, the brand value of the United States of America was more than 17 trillion USD. The value of Germany as a brand was lower, but still 100 times the market value of Coca-Cola. The factors that influence the brand value are partially known. A nation’s relative success along many dimensions, including economics, science, or sports matters. Also, public attention gained from hosting major events such as the Olympics or the World Soccer Championships matter. Expenditure by which politicians try to persuade the members of the IOC, or expenditure that promotes national sports programs, can be seen as marketing expenditure or investment in the nation brand.

Similar to firms, countries also try to build up what would be called a “base of loyal customers” in business language. Countries may try to make citizens, tax payers, or the tax base immobile. Along this dimension, countries may have even more powerful instruments than firms. Social security systems and the payment structure for civil servants are, for instance, ways to generate a lock-in for some share of the population. Countries also choose or strongly influence the content of primary and secondary education. They can and do use this to instill patriotism as a particular type of emotional home attachment. Many examples for this type of policy can be given. The prototype of education policy could be observed in Nazi-Germany which very actively pursued an education policy with rather extreme goals. This example also shows that this is a very powerful instrument, and one that is rather unappealing. But more moderate versions of loyalty building education with a clear shift in intentions can be traced in virtually all countries even today. The American Boy Scouts, like many other youth organizations, explicitly mention patriotism as one of their ed-

<sup>7</sup><http://www.land-der-ideen.de/MEDIA/6449,0.zip>.

<sup>8</sup>Similarly, when politicians travel, they advertise national firms and their products, but also promote their countries for attracting investors. While such activities are difficult to measure, Rose (2007), for instance, documents that the foreign service heavily engages in trade policy.

educational goals.<sup>9</sup> Japan just passed a bill according to which patriotism is a declared goal of the compulsory educational system and similar developments emerged recently in Poland where “patriotism” was discussed as a possible subject to be learned at school.

In what follows, an effort of this third type is considered: investment in the loyalty of citizens and tax payers.<sup>10</sup> It will be left open on what instruments are used when pursuing these goals, but assume that the application of these means is costly. First, we will allow for countries using both modes of competition: investments in loyalty of citizens, followed by price competition in terms of setting tax rates. Then we will restrict tax competition by way of a minimum tax and by tax harmonization.

The option to use instruments that increase taxpayers’ loyalty may explain why a general downward trend in tax rates has only partially been observed.<sup>11</sup> The low pressure on tax rates may have a partial explanation in such activities that moderate what would otherwise be a cut-throat competition.

Loyalty investment, advertising, and nation branding has not been the subject of tax-competition theory, but the analysis of competition for tax base or mobile capital as a common pool problem has a number of precursors who focused on public expenditure on public goods or infrastructure as the means of nonprice competition. Taylor (1992) considers jurisdictions which compete for foreign direct investment in a race regarding their speed of infrastructure investment. Menezes (2003), applying auction theory to this type of fiscal competition, considers several variants of auctions, including an all-pay auction that involves public investment expenditure at multiple locations and causes wasteful duplication of public infrastructure. Jayet and Paty (2006) consider a similar problem when jurisdictions decide whether or not to build up the infrastructure for a business area, hoping to win or attract lumpy investment. The same type of overinvestment problem is less immediately obvious in a framework with smooth capital flows as in Keen and Marchand (1997). They also find that public expenditure on infrastructure inputs may be excessive, in particular, compared to their alternative use for public consumption goods.<sup>12</sup> Also, Sinn’s (1997) analysis on systems competition, particularly on the possible malfunctioning in the

<sup>9</sup>Their official aims are stated in their federal charta of 15 June 1916: “. . . to teach them patriotism, courage, self-reliance, and kindred virtues, using the methods which are now in common use by Boy Scouts.”

<sup>10</sup>The role of home attachment has received attention in the literature on decentralized decision making in federations (e.g., Mansoorian and Myers 1993) and in the context of tax competition (e.g., Andersson and Konrad, 2001; Ogura 2006).

<sup>11</sup>Investors react to taxes. This is well documented by now, starting with early work by Hartman (1984) and surveyed and evaluated in a meta-study by De Mooij and Ederveen (2003). However, the literature seemingly fails to come up with unanimous evidence on a general downward trend of the fiscal burden (see, e.g., Devereux et al. 2002). Stewart and Webb (2006, p. 191) draw an even more striking conclusion, “Corporations are undoubtedly sensitive to taxation, just as homeowners are sensitive to property taxes. Yet this sensitivity does not give rise to a race to the bottom in corporate taxation any more than it does to property taxes. The fact that Altshuler and Goodspeed find no evidence of any intensification of strategic interaction in capital taxation policies during the post-1980 globalization era is entirely consistent with our results.”

<sup>12</sup>Several researchers took up this type of competition. Bucovetsky (2005) considers infrastructure investment in a context with agglomeration. Benassy-Quere et al. (2007) allow for both tax competition and public input competition. Wildasin (1988) and Wilson (2005) consider the role of expenditure competition. Matsumoto (2000) adds labor mobility and Matsumoto (2004) disaggregates public inputs into inputs

context of provision of public infrastructure goods in the context of tax competition, hints at this problem. These approaches essentially consider the problem of attracting desirable investment as a rent-seeking or contest problem. Excessive infrastructure expenditure may occur due to several reasons. First, regions or countries may invest and sometimes fail to attract investment, due to the lumpiness of investment projects. Second, even if the allocation of desirable investment is a smooth function of public infrastructure investment, competition directs too many resources into infrastructure competition, compared to its alternative use.

The analysis in this paper uses results from Bertrand competition with shares of loyal “customers,” as in Narasimhan (1988) and Deneckere et al. (1992), but endogenizes the choice of the set of “loyal customers,” with governments competing for tax revenues from their citizens taking the roles of firms competing for sales revenues from their customers.<sup>13</sup> A paper that considers formally the endogeneity of the sets of loyal customers is Roy (2000). He considers firms’ decisions to advertise their existence to different sets of potential customers. If a customer knows one firm only, he buys from this firm for any price lower than his reservation price. If the consumer knows both firms, this makes him perfectly price sensitive. If he knows none of the firms, he does not buy at all. Advertising in this framework may generate or destroy loyalty, depending on whether advertising informs a customer who already knows another firm or not. This type of investment in loyalty has its counterpart in the context of countries’ advertising policy as well. It differs, however, from the type of investment that will be considered by which countries may expose their citizens to an activity that may instill a home attachment in a subgroup of the population.

In Sect. 2, Narasimhan’s analysis of price competition is adapted with loyal customers to the context of countries’ competition. In Sect. 3, endogenous choices are considered regarding the policy to instill home attachment. Sections 4 and 5 consider minimum taxes and harmonized taxes as possible constraints on the tax rates that countries can choose and how they affect the countries’ investment in loyalty. Sect. 6 concludes.

## 2 Tax competition with loyal taxpayers

Consider two countries,  $A$  and  $B$ . In each country, there is a set of initial residents, described by an interval of length 1. They can be firms, firm owners who may move with their firms, or individuals with human capital. We will refer to them either as “citizens” or “taxpayers.” These tax payers constitute the “common pool.” In stage 1, the governments  $i \in \{A, B\}$  choose how large a set  $n_i \in \{0, n\}$  with  $0 < n < 1$  of their initial residents should be made “loyal,” i.e., turned into taxpayers with strong

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that are complementary to the mobile factor or to the immobile factor of production in this context. Wehke (2006) analyzes how coordination on taxes will affect this second channel of competition. Feld (1997) considers the role of the political process and the electoral system for tax rate choices in tax competition.

<sup>13</sup>In the tax competition context, mixed strategy equilibrium has been analyzed by Andersson and Konrad (2001) and by Marceau et al. (2007). The analysis here is closely related to the literature on Varian’s (1980) “model of sales.” See, in particular, Narasimhan (1988), Deneckere et al. (1992) and Baye et al. (1992), and Baye et al. (2006) for an overview.

home attachment. The cost of these policies are  $C_i(0) = 0$  and  $C_i(n) = c_i > 0$ . The set of individuals of size  $2 - n_A - n_B$  remains mobile. The governments maximize their tax revenues net of investment cost.<sup>14</sup> They choose per-head taxes  $t_A$  and  $t_B$  from the interval  $[0, r]$  with  $r$  a finite, exogenously given maximum tax. This choice constitutes stage 2.

In stage 3, individuals react to the taxes. They choose their country of residence and pay taxes. Loyal citizens are attached to their country. They simply pay the tax that applies in their country. Nonloyal citizens are perfectly and costlessly mobile and locate in the country with lower taxes. If both countries have the same tax, they locate in each country with the same probability. Depending on  $(n_A, n_B, t_A, t_B)$ , country  $A$ 's tax revenues are

$$T_A(\mathbf{n}, \mathbf{t}) = \begin{cases} n_A t_A & \text{if } t_A > t_B, \\ (1 + \frac{n_A - n_B}{2}) t_A & \text{if } t_A = t_B, \\ (2 - n_B) t_A & \text{if } t_A < t_B \end{cases} \quad (1)$$

and analogously for  $B$ . Note that (1) implicitly defines a tie-breaking rule: the tax base  $2 - n_A - n_B$  that is not home-attached has an equal chance to locate in each of the countries.<sup>15</sup> Taking also into consideration the cost of  $n_i$ , the payoffs can be stated as

$$\pi_i(\mathbf{n}, \mathbf{t}) = T_i(\mathbf{n}, \mathbf{t}) - C_i(n_i). \quad (2)$$

The payoffs in the taxation subgame are structurally equivalent to the profits in Narasimhan's (1988) price leadership game with loyal customers and simultaneous choices of prices. Note that this game has no equilibrium in pure strategies if  $\max\{n_A, n_B\} > 0$ . A proof is by contradiction.<sup>16</sup> Narasimhan shows that this game has a unique subgame perfect equilibrium for given  $n_B \geq n_A$  in mixed strategies that are described by the following cumulative distribution functions:

$$F_A(t_A) = 1 + \frac{n_B}{2 - n_A - n_B} - \frac{n_B r}{(2 - n_A - n_B) t_A} \quad \text{for } t_A \in \left( \frac{n_B r}{2 - n_A}, r \right) \quad (3)$$

and with  $F_A(t_A) = 0$  for  $t_A < \frac{n_B r}{2 - n_A}$  and  $F_A(t_A) = 1$  for  $t_A \geq r$ , and

$$F_B(t_B) = 1 + \frac{n_A}{2 - n_A - n_B} - \frac{(2 - n_B)}{(2 - n_A)} \frac{n_B r}{(2 - n_A - n_B) t_B} \\ \text{for } t_B \in \left( \frac{n_B r}{2 - n_A}, r \right) \quad (4)$$

<sup>14</sup>This objective function is compatible with a Leviathan view of government as well as with a welfarist government which gives capital owners a low weight in its welfare function, or has a sufficiently high shadow price of public funds, for instance, because it places sufficient weight on redistribution.

<sup>15</sup>This assumption is made throughout in order to avoid optimization problems on open sets.

<sup>16</sup>Let  $n_B = n$ . Suppose  $(t_A, t_B)$  is an equilibrium. Then  $t_B > 0$ , as  $t_B n > 0$ . Let  $t_A = t_B > 0$ . Then  $t_A$  is not an optimal reply to  $t_B$ . For instance,  $t_A = t_B - \epsilon$  for sufficiently small positive  $\epsilon$  yields higher tax revenue for  $A$ . Let  $t_A = t_B + \delta$  for a given finite positive  $\delta$ . Then  $t_B$  is not an optimal reply to  $t_A$ , as  $t_B = t_A - \epsilon$  for sufficiently small  $\epsilon$  yields higher tax revenue; similarly, for  $t_B = t_A + \delta$  and player  $A$ .

with  $F_B(t_B) = 0$  for  $t_B < \frac{n_B r}{2-n_A}$  and  $F_B(t_B) = 1$  for  $t_B \geq r$ . Note that  $F_B$  dominates  $F_A$  in the sense of first-order stochastic dominance. Both distributions have the same support, but  $F_B(t) \leq F_A(t)$  for all  $t \in (\frac{n_B r}{2-n_A}, r]$ . Moreover, only  $F_B$  may possibly have a mass point and this mass point is at  $t_B = r$ .

The payoffs as functions of the own tax choice that emerge from these mixed strategies can be obtained by inserting them into the payoff function (2) as

$$\pi_A(t_A) = F_B(t_A)n_A t_A + (1 - F_B(t_A))(2 - n_B)t_A - C_A(n_A) \tag{5}$$

$$= \frac{(2 - n_B)}{(2 - n_A)} n_B r - C_A(n_A) \tag{6}$$

and

$$\pi_B(t_B) = F_A(t_B)n_B t_B + (1 - F_A(t_B))(2 - n_A)t_B - C_B(n_B) \tag{7}$$

$$= n_B r - C_B(n_B) \tag{8}$$

for all  $t_A \in [\frac{n_B r}{2-n_A}, r)$  and  $t_B \in [\frac{n_B r}{2-n_A}, r]$  and smaller than this equilibrium payoff for tax choices from outside this interval. This shows why these mixed strategies constitute optimal replies to each other and proves that (3) and (4) constitute an equilibrium at stage 2. Deneckere et al. (1992) provide more intuition on this result. By definition, country  $B$  has more loyal citizens than country  $A$ . The country benefits from having more loyal citizens if it attracts and taxes only this group. This advantage turns into a disadvantage in the strategic tax competition game. Each country gains the same additional tax base  $2 - n_A - n_B$  by undercutting the other country. Country  $B$  has higher cost of undercutting  $A$  than vice-versa, as  $B$  has the larger set of loyal citizens who pay  $B$ 's tax in any case. Because of this disadvantage, country  $B$  has an equilibrium payoff that is equal to  $r n_B$ . This is the minimum amount of taxes which  $B$  can obtain, irrespective of  $t_A$ , and is called the *stand-alone payoff* of country  $B$ . Summarizing, the finding is

**Proposition 1** (Narasimhan 1988) *Let  $n_A \leq n_B$ . Then the tax competition equilibrium with simultaneous choices of tax rates is characterized by mixed strategies (3) and (4) and payoffs*

$$\pi_A^* = \frac{(2 - n_B)}{(2 - n_A)} n_B r - C_A(n_A) \quad \text{and} \quad \pi_B^* = n_B r - C_B(n_B). \tag{9}$$

Note that the country with more loyal taxpayers receives an expected tax revenue that is equal to the revenue from taxing the loyal tax payers only. If both countries have chosen to invest in loyal taxpayers, due to the symmetry in the size of these groups, both countries end up with tax revenue  $T_i = nr$ . The country with the smaller set of loyal taxpayers has an expected tax revenue that exceeds the tax revenue  $n_A r$  it could obtain from simply taxing its own taxpayers at the maximum, as  $n_B r(2 - n_B)/(2 - n_A) > n_A r$  for  $0 \leq n_A < n_B < 1$ . Hence, if country  $A$  has chosen  $n_A = 0$ , then this country also benefits from the group of patriots in country  $B$ . This can be seen from (9) as  $\pi_A^*$  is increasing in  $n_B$ .

The equilibrium has interesting comparative static properties. First, consider taxation and tax revenue.

**Proposition 2** (Baye et al. 1992) *The country with the larger group of loyal citizens chooses higher expected taxes.*

*Proof* Use of  $n_B = n$  and  $n_A = 0$  yields

$$Et_B = \int_{t=\frac{nr}{2}}^{t=r} t dF_B \quad \text{and} \quad Et_A = \int_{t=\frac{nr}{2}}^{t=r} t dF_A, \tag{10}$$

respectively. However,  $F_A(t_A) \geq F_B(t_B)$ , i.e.,  $F_B$  dominates  $F_A$  in the sense of first-order stochastic dominance. By Theorem 1 by Hadar and Russell (1969), this implies that  $Et_B \geq Et_A$ . □

Countries which have a larger group of loyal citizens may charge higher taxes in the equilibrium in expectation. For this outcome, the particular reason for citizens' loyalty does not need to be specified. Patriotism and other reasons of emotional attachment to one's home country serve similarly as language barriers or institutionally created barriers to migration such as travel restrictions or closed and strictly guarded borders. A key assumption for this result is, of course, that the government aims at high tax revenue. But this is an assumption which is justified both for countries with policy failure and a Leviathan government and for welfarist countries in which the tax proceeds are used to finance subsistence for a group of (completely immobile and) very poor citizens, and for which the group of citizens considered here is the target group for raising revenues for redistributinal purposes.

Empirically, one should observe, for instance, that countries with closed borders, isolated countries, and countries with an overwhelmingly patriotic population may charge higher taxes.

A further comparative static problem relates to the size of the group of citizens who can be made immobile, for instance, by instilling patriotism or by other means. Globalization may be seen as a process that either increases the cost of turning citizens into loyal citizens or as a process that reduces the set of people who could be made loyal. The cost effect will be considered later. The effect that makes the set of potentially loyal citizens smaller is as follows:

**Proposition 3** *An increase in  $n$  increases the equilibrium tax revenues for all situations with  $\max\{n_A, n_B\} = n$ .*

*Proof* Consider the payoffs in (9) for the case with  $n_A = n_B = n$ . In this case,  $ET_A^* = ET_B^* = nr$ , and this is increasing in  $n$ . Consider the case  $n_A = 0$  and  $n_B = n$ . In this case,  $ET_A^* = \frac{2-n}{2}nr$ , and  $ET_B^* = nr$ . Hence,

$$\frac{\partial(ET_A^*)}{\partial n} = \frac{\partial(\frac{2-n}{2}nr)}{\partial n} = (1 - n)r > 0 \tag{11}$$

and

$$\frac{\partial(ET_B^*)}{\partial n} = \frac{\partial(nr)}{\partial n} = r > 0. \tag{12}$$

□

### 3 Instilling loyalty

Firms build up brands and make customers acquainted with these brands by means of advertising and other marketing means, including the attempt to build up customer relationships with the influx of new customers. Nations seemingly pursue similar strategies. They advertise the characteristics of their countries in newspapers, use other channels for building up relationships with investors or with citizens with much human capital, and may use their influence on primary and secondary education to instill home attachment. This shows that loyalty  $n_i$  as defined in Sect. 2 is endogenous.

Roy (2000) considered marketing investment by which firms can invest resources to make firms’ product price known to subsets of a given set of customers. “Being known” in his context means that these customers will hear about this firm’s product price, once this is chosen later on. This type of competition may also apply for tax competition. However, the focus here will be on marketing and advertising that is used to build up brand value and reputation toward their own citizens and capital owners and make their own citizens “loyal.” This choice will be restricted of  $n_i$  to  $n_i \in \{0, n\}$ . A country either invests in loyal citizens or it does not.

Consider the payoffs from the different combinations of actions as in the matrix below.

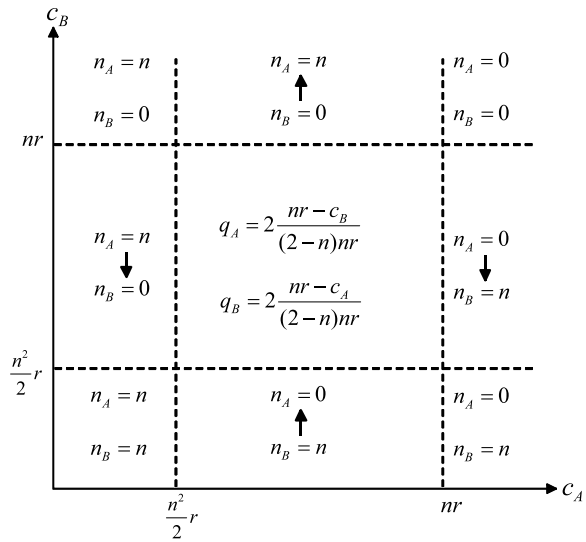
	$n_B = 0$	$n_B = n$	
$n_A = 0$	$\pi_A = 0$ $\pi_B = 0$	$\pi_A = \frac{2-n}{2}nr$ $\pi_B = nr - c_B$	(13)
$n_A = n$	$\pi_A = nr - c_A$ $\pi_B = \frac{2-n}{2}nr$	$\pi_A = nr - c_A$ $\pi_B = nr - c_B$	

It leads to the following properties of optimal investment in stage 1:

**Proposition 4** *If  $c_i \in [0, \frac{n}{2}nr)$ , then it is optimal for country  $i$  to invest in loyalty. If  $c_i > nr$ , then  $i$  does not invest in the loyalty of its citizens. If  $c_i \in [\frac{n}{2}nr, nr]$ , then it is optimal for country  $i$  to invest (not invest) in loyalty if the other country does not invest (invests) in loyalty.*

*Proof* Consider country  $i$ . Let  $q_j$  be the probability that the other country  $j$  invests. Then the payoff of country  $i$  is equal to  $(1 - q_j) \cdot 0 + q_j(\frac{2-n}{2}nr)$  if  $i$  does not invest, and equal to  $(1 - q_j)(nr - c_i) + q_j(nr - c_i) = (nr - c_i)$  if  $i$  invests. Country  $i$  invests if  $nr - c_i > q_j(\frac{2-n}{2}nr)$ , or  $q_j < \frac{2-n}{2}(1 - \frac{c_i}{nr})$ . As  $q_j \geq 0$ , this shows that  $n_i \equiv 0$  for  $c_i > nr$ . Also, if  $c_i < \frac{1}{2}n^2r$ , as  $q_j \leq 1$ , this implies that  $n_i \equiv n$  for  $c_i < \frac{1}{2}n^2r$ . Finally, if  $c_i \in [\frac{n}{2}nr, nr]$  for both countries,  $(q_A, q_B) = (0, 1)$  and  $(q_B, q_A) = (1, 0)$  are probability pairs that are optimal replies to each other. But also  $q_A = 2 \frac{nr - c_B}{(2-n)nr}$

**Fig. 1** Equilibrium investment in loyal taxpayers for different combinations of  $c_A$  and  $c_B$



and  $q_B = 2 \frac{nr - c_A}{(2-n)nr}$  are optimal replies to each other for this range of costs, as  $q_A = 2 \frac{nr - c_B}{(2-n)nr}$  makes  $B$  indifferent whether to invest or not, and  $q_B = 2 \frac{nr - c_A}{(2-n)nr}$  makes  $A$  indifferent about whether to invest or not.  $\square$

The characterization of optimal replies can be used to describe the investment equilibria for different ranges of investment cost as in the nine areas in Fig. 1. At very low and very high values of  $c_A$  and  $c_B$ , both countries have dominant strategies. These are the areas in the corners (Northwest, Northeast, Southeast, Southwest) in the matrix in Fig. 1. For instance, if both countries have a very small cost of loyalty investment, they both invest, such that  $n_A = n_B = n$ . If only one of the countries has a dominant strategy, this strategy choice induces a choice for the other country. The respective areas are in the South, North, East, and West of Fig. 1. If both countries have an investment cost in the intermediate range  $c_i \in [\frac{n}{2}nr, nr]$ , then both  $(q_A = 0; q_B = 1)$  and  $(q_A = 1; q_B = 0)$  are mutually optimal replies. However, there is also an equilibrium in mixed strategies with  $q_A = 2 \frac{nr - c_B}{(2-n)nr}$  and  $q_B = 2 \frac{nr - c_A}{(2-n)nr}$  in this case. These combinations occur in the center of the matrix in Fig. 1. For this mixed strategy equilibrium, the values of  $q_A$  and  $q_B$  are both increasing in  $n$ . If the technology of making citizens loyal becomes more effective in terms of the same amount of cost making a larger share of the own population loyal, then such an investment becomes more valuable for the country:

$$\frac{\partial(2 \frac{nr - c_i}{(2-n)nr})}{\partial n} = 2 \frac{n^2r - 2nc_i + 2c_i}{n^2(2-n)^2r} > 0. \tag{14}$$

Both the numerator and the denominator are strictly positive for  $n \in (0, 1)$  for  $c_i \in (\frac{n}{2}nr, nr)$ . In order to counterbalance the increased incentive to invest and to make a country  $B$  just indifferent between investing and not investing, it is required that  $A$

increases its probability of also investing in loyal customers because this reduces the expected benefit for  $B$  from investing.<sup>17</sup>

Intuitively, investment in citizen loyalty is costly, and its beneficial effect for tax revenues depends on the investment choice of the other country. If both countries do not invest in citizen loyalty, then the tax competition that emerges is very strong and the tax revenue that remains in the equilibrium is zero. Hence, if one country does not invest, the benefit of investing in citizen loyalty is high for the other country, and even the country that does not invest benefits from this investment: The investment makes the countries asymmetric and causes a strategic disadvantage for the country that invested in stage 1. There is a wide range of parameters for which a country would like to free ride on the loyalty investment made by the other country, and this yields the mixed strategy equilibrium as regards investment in loyalty in stage 1 in which both countries are just indifferent between investing or not, because the respective other country invests with a probability that generates this indifference. If the cost of investment becomes very small, then both countries may prefer to invest. The tax equilibrium in stage 2 is then in mixed strategies. The country that invested in citizen loyalty has a higher expected tax revenue in the equilibrium, and if this difference outweighs the investment cost, both countries prefer the outcome in which they invest in stage 1. In this outcome, both countries compete for the mobile tax base in a mixed strategy equilibrium in stage 2, but they receive an expected tax revenue that is equal to the stand-alone tax revenue  $nr$ . Finally, if the cost of making citizens loyal in stage 1 is higher than what can be gained in terms of tax revenue in stage 2, then both countries abstain from such activities.

The characterization of equilibria also reveals that loyalty investment becomes generally more useful if the set of citizens who can be made loyal by this investment is larger. If some new technology or means of nonprice competition affects the size of  $n$  positively, this increases the probability for such investment to take place, and also increases the expected tax revenue in the equilibrium. Globalization may affect size of  $n$  negatively. This will reduce the probabilities of investment in the mixed strategy equilibrium, and also reduces the range in which investing is a dominant strategy for countries.

The cost of rent-seeking effort is equal to  $c_A + c_B$  in the equilibrium in which the choice of such effort becomes a dominant strategy, i.e., for  $c_i \in [0, \frac{n}{2}nr]$  for  $i = A, B$ . In the coordination equilibrium for  $c_i \in [\frac{n}{2}nr, nr]$ , the cost of effort is simply  $c_A$  or  $c_B$ , depending on which of the two equilibria is chosen, and in the mixed strategy equilibrium for this parameter range the expected cost of such effort is

$$q_A c_A + q_B c_B = \frac{2}{(2-n)} \left( c_A + c_B - \frac{2c_A c_B}{nr} \right). \tag{15}$$

This expected effort is increasing in  $n$  and in  $r$ . This suggests that globalization, interpreted as a decrease in the effectiveness of investment in loyalty, will generally reduce the effort which is invested in such activities. If such efforts are seen as efforts

<sup>17</sup>Note further that the equilibrium probability of investing in citizen loyalty is also decreasing in the cost of such investment for the respective other country. However, this effect is an artefact of the nature of the mixed strategy equilibrium in which the investment probability must be chosen to generate indifference.

for attracting a larger share in a global common, then this aspect is a beneficial aspect of globalization. However, as a consequence of this reduction in rent-seeking, the tax revenue in the tax competition stage will also fall in expectation, in line with the standard view on globalization and tax competition.

#### 4 A minimum tax

Suppose now that countries cannot choose taxes  $t_i < t_{\min}$  for some exogenous  $t_{\min}$ .<sup>18</sup> If countries anticipate that the tax competition in stage 2 is constrained from below by a minimum tax, this will change the tax competition outcome and also has implications for the choice of the countries' efforts in their investment in loyalty. Proposition 5 considers cases of sufficiently large minimum taxes.

**Proposition 5** *Let  $n_B = n_A = 0$ . Any minimum tax  $t_{\min} > 0$  yields an equilibrium with  $t_A = t_B = t_{\min}$ . Let  $n_A = n_B = n$ . A minimum tax with  $t_{\min} \in [nr, r]$  yields an equilibrium in pure strategies with  $t_A = t_B = t_{\min}$ . Let  $\min\{n_A, n_B\} = 0$  and  $\max\{n_A, n_B\} = n$ . Then a minimum tax with  $t_{\min} \in [\frac{2rn}{n+2}, r]$  yields an equilibrium with  $t_A = t_B = t_{\min}$ .*

*Proof* Consider  $n_A = n_B = 0$ . Let  $A$  choose  $t_A = t_{\min} > 0$ . For all  $t_B > t_A$ ,  $B$  will not attract any tax base and the corresponding tax revenue is zero. Accordingly, the optimal reply to  $t_A = t_{\min}$  is  $t_B(t_{\min}) = t_{\min}$ , as this yields a tax revenue equal to  $t_{\min} \cdot \frac{2}{2} = t_{\min} > 0$  for  $t_{\min} > 0$ .

Consider next  $n_A = n_B = n$ . Let  $A$  choose  $t_A = t_{\min} \geq nr$ . For all  $t_B > t_A$ , the country  $B$  receives tax revenue  $t_B n$ , which is maximal for  $t_B = r$ . Accordingly, the optimal reply to  $t_A = t_{\min}$  is either  $t_B = t_{\min}$  with tax revenue equal to  $t_{\min}[n + \frac{2-n}{2}]$  or  $t_B = r$  with tax revenue equal to  $rn$ . As the tax revenue  $t_{\min} \cdot 1 \geq nr$ , the optimal reply is  $t_B(t_{\min}) = t_{\min}$ . For symmetry, the same condition applies for  $t_A$  to be an optimal reply to  $t_B = t_{\min}$ .

Consider finally  $n_A = 0$  and  $n_B = n$ . Country  $B$ 's optimal reply to  $t_A = t_{\min} \in [\frac{2rn}{n+2}, r]$  is either  $t_B = r$ , yielding tax revenue equal to  $rn$ , or  $t_B = t_{\min}$ , which yields tax revenue equal to  $t_{\min}(n + \frac{2-n}{2})$ . For  $t_{\min}$  to be optimal requires  $t_{\min}(n + \frac{2-n}{2}) \geq rn$ , which is equivalent with  $t_{\min} \geq \frac{2rn}{n+2}$ . In turn, country  $A$ 's optimal reply to  $t_B = t_{\min}$  is either  $t_{\min}$ , which yields tax revenue  $t_{\min}[\frac{2-n}{2}]$ , or  $t_A = r$  which yields tax revenue of zero. Accordingly, for  $A$  the choice of  $t_A = t_{\min} > 0$  dominates any  $t_A > t_B$  due to  $n_A = 0$ . (The same argument holds if the roles of  $A$  and  $B$  are reversed.)  $\square$

Proposition 5 characterizes a minimum tax that is so high that the tax revenue that each country has if both charge the minimum tax is higher than what a country can obtain from deviating and choosing any other tax rate higher than this minimum tax. Such a deviation will leave this country with a tax revenue  $t_i n_i$ , as the other

<sup>18</sup>For a survey also on the role of minimum taxes and tax harmonization see Fuest et al. (2005), and Peralta and van Ypersele (2006) for a recent contribution.

country receives the tax revenue from its loyal citizens, plus the tax revenue from all mobile citizens. This tax revenue from deviating is, therefore, maximal if the country  $i$  chooses the highest possible tax rate,  $r$ . The conditions regarding the minimum tax that are stated in Proposition 5 make this tax revenue (weakly) smaller than the tax revenue if the countries both charge the minimum tax.

Turning next to the implications of a sufficiently high minimum tax for the choices of  $n_A$  and  $n_B$ , the following proposition holds:

**Proposition 6** *If the minimum tax is  $t_{\min} \geq nr$ , then a subgame perfect equilibrium exists with country  $i$  choosing*

$$n_i = \begin{cases} n & \text{if } t_{\min} \frac{n}{2} > c_i, \\ 0 & \text{if } t_{\min} \frac{n}{2} \leq c_i. \end{cases} \tag{16}$$

*Proof* Both countries anticipate that  $t_A = t_B = t_{\min}$ . Accordingly, the payoff of country  $A$  is  $t_{\min} \frac{2-n_B}{2}$  if  $n_A = 0$ , and equal to  $t_{\min} \frac{2-n_A-n_B}{2} + t_{\min}n_A - c_A$  if  $n_A = n$ , and similarly for  $B$ . The optimality of  $n_i$  as characterized in the proposition follows from comparing these payoffs.  $\square$

Note that  $nr \geq \frac{2rn}{n+2}$ . The minimum tax  $t_{\min} \geq nr$  is, therefore, sufficiently high such that the equilibrium tax is  $t_{\min}$  for all combinations of loyalty investment in stage 1. Indeed, as this is not true for the  $t_{\min} \in [\frac{2rn}{n+2}, nr]$ , this parameter range is more cumbersome and not treated formally here.

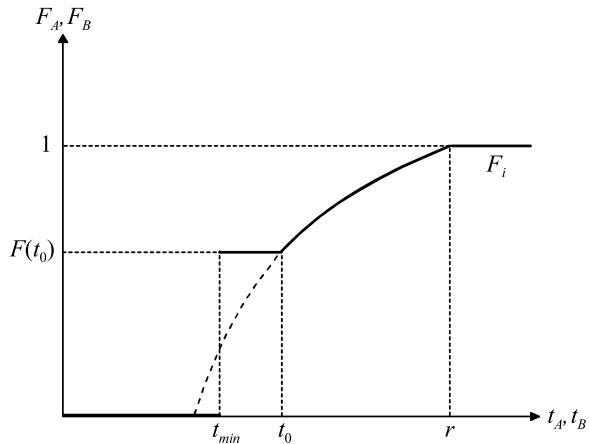
Intuitively, if the minimum tax rate is sufficiently high, both countries choose a tax rate equal to this minimum tax rate in the stage-2 equilibrium. As they can charge this tax rate on all their loyal citizens, but have to share the mobile citizens with the other country, the investment in loyalty of a set of  $n$  citizens is worthwhile if the cost of this investment is lower than the additional tax revenue that results from this investment, which is equal to  $t_{\min}n/2$ . A sufficiently high minimum tax turns the problem into a pure common pool problem: the common pool is shared equally between the competitors, unless they expend effort trying to appropriate a larger share of the common pool for themselves. This is what is accomplished by the investment in loyalty.

Cases with a lower minimum tax rate yield a more colorful picture. The way the taxation equilibrium is affected by the minimum tax depends on the choices  $(n_A, n_B)$ . Three cases need to be distinguished.

*Case 1:  $n_A = n_B = 0$*  In this case, any positive minimum tax leads to a tax equilibrium with  $t_A = t_B = t_{\min} \leq nr$  and tax revenues  $T_A(t_{\min}) = T_B(t_{\min}) = t_{\min}$ .

*Case 2:  $n_A = n_B = n$*  If  $t_{\min} \leq nr/(2 - n)$ , then the equilibrium tax strategies as in Sect. 2 are still feasible and mutually optimal replies. Hence, the tax equilibrium is unaffected. If  $t_{\min} \in (\frac{nr}{2-n}, nr)$ , then the equilibrium is in mixed strategies, with the cdfs of tax rates that are characterized by Fig. 2 being optimal replies to each other. This mutual optimality can be checked as follows. We observe that given  $F_B$  as in Fig. 2, the expected tax revenue of country  $A$  is equal to  $nr$  for all

**Fig. 2** The equilibrium cumulative distribution functions for  $n_A = n_B = n$  and  $t_{\min} \in (\frac{nr}{2-n}, nr)$  for numerical values  $n = 0.5$ ,  $r = 1$  and  $t_{\min} = 0.4$



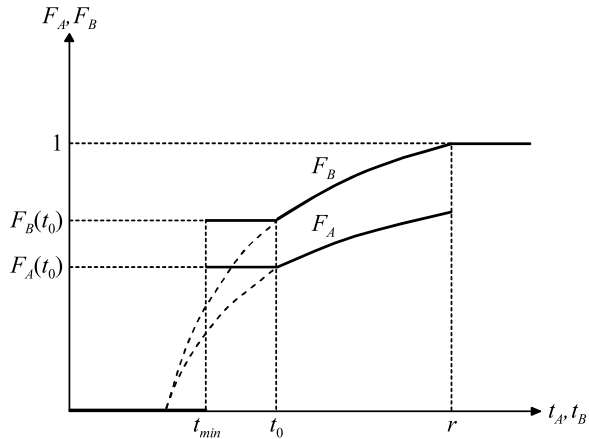
$t_A \in \{t_{\min}\} \cup [t_0, r]$  by inserting in the payoff functions, taking into consideration that  $t_0 = \frac{nr t_{\min}}{n t_{\min} - 2 t_{\min} + 2nr}$ . Intuitively,  $A$ 's payoff along the interval  $t_A \in (t_0, r)$  is the same as in the absence of a minimum tax. However, once the tax rate which  $A$  may choose drops further and comes sufficiently close to the minimum tax, the minimum tax becomes more attractive than this tax: unlike without this minimum tax,  $A$  cannot undercut at the minimum tax. Both players have a mass point at the minimum tax. In turn, this implies that if they both choose the minimum tax, they have to share the mobile tax base equally. If  $A$  increases  $t_A$  just slightly above  $t_{\min}$ , this increases  $A$ 's tax revenue on  $n_A = n$ , but  $A$  loses the tax revenue on  $\frac{2-2n}{2} F_B(t_{\min})$  as all the mobile tax base stays with  $B$  with probability  $F_B(t_{\min})$ . Hence, small increases in  $t_A$  compared to  $t_A = t_{\min}$  are inferior. Only if  $A$  chooses a sufficiently high tax rate, the gain on the loyal taxpayers compensates for this expected loss in the mobile tax base. The tax rate  $t_0$  and the mass point it generates at  $t_{\min}$  just balance in the sense that the payoff from choosing  $t_0$  (or any other  $t_A \in (t_0, r)$ ) is equal to the payoff from choosing  $t_{\min}$ . By symmetry, the same reasoning applies for  $B$ . Finally, note that any feasible choices of  $t_A$  or  $t_B$  from  $(t_{\min}, t_0)$  outside the equilibrium support  $\{t_{\min}\} \cup [t_0, r]$ , yield lower tax revenue.

The expected tax revenue of each country in this equilibrium is  $T_A = T_B = nr$ , and the size of the mass point at  $t_{\min}$  is obtained from inserting  $t_0$  into the cdf:

$$F_i(t_0) = 1 + \frac{n}{2-2n} - \frac{nr}{(2-2n)t_0} = \frac{(2-n)t_{\min} - nr}{(1-n)t_{\min}}. \quad (17)$$

*Case 3:*  $n_A = 0$ ,  $n_B = n$  (Note that there is also an analogous Case 4 which is obtained from Case 3 by  $A$  and  $B$  changing roles.) If  $t_{\min} \leq nr/2$ , then the equilibrium tax strategies as in Sect. 2 are still feasible and mutually optimal replies. Hence, the tax equilibrium is unaffected. If  $t_{\min} \in (\frac{nr}{2}, \frac{2rn}{n+2})$ , then the equilibrium is in mixed strategies in tax rate choices, with the cdfs that are characterized in Fig. 3, with  $t_0 = \frac{nr t_{\min}}{2(nr - t_{\min})}$ , and  $F_A(t_0)$  and  $F_B(t_0)$  obtained by inserting this into (3) and (4), respectively. The cumulative distribution functions  $F_A$  and  $F_B$  in Fig. 3 coincide with the equilibrium mixed strategies in the case without a minimum tax in the range

**Fig. 3** The equilibrium cumulative distribution functions for  $n_A = 0, n_B = n$  and  $t_{\min} \in (\frac{nr}{2}, \frac{2rn}{n+2})$  for numerical values  $n = 0.5, r = 1$  and  $t_{\min} = 0.4$



$t_i \in (t_0, r)$ . However, both players have a mass point at the minimum tax and do not choose taxes in the range  $(t_{\min}, t_0)$ . The mutual optimality of these strategies can be confirmed as follows: First, it can be verified by inserting into the equation that determines A’s expected tax revenue for given  $F_B(t)$ , that the expected tax revenue for country A is equal to  $\frac{nr}{2}(2 - n)$  for any choice  $t_A \in \{t_{\min}\} \cup [t_0, r]$ , and strictly lower for any feasible  $t_A$  from outside this set. Second, it can be verified by inserting into the equation that determines B’s expected tax revenue for given  $F_A(t)$ , that the expected tax revenue for B is equal to  $nr$  for any choice  $t_B \in \{t_{\min}\} \cup [t_0, r]$ , and strictly lower for any feasible  $t_B$  from outside this set.

The mixed strategy equilibrium that emerges for the intermediate range of minimum taxes  $t_{\min} \in [(nr/2, 2nr/(n + 2))]$  is structurally similar to the mixed strategy equilibrium that emerges in all-pay auctions if players face an upper limit on their individual bidding efforts. The latter problem has been studied by Che and Gale (1998). In their context, they show that the equilibrium is generically unique, but for some particular combinations of parameters further equilibria can emerge.

Consider now the choice of investment in citizens’ loyalty in stage 1. Recall that  $\frac{2rn}{n+2} \leq nr$ . Accordingly, for the range  $t_{\min} < \frac{2rn}{n+2}$ , the following equilibrium payoffs emerge from the different investment choices according to the three cases that have been outlined:

	$n_B = 0$	$n_B = n$
$n_A = 0$	$\pi_A = t_{\min}$ $\pi_B = t_{\min}$	$\pi_A = \frac{2-n}{2}nr$ $\pi_B = nr - c_B$
$n_A = n$	$\pi_A = nr - c_A$ $\pi_B = \frac{2-n}{2}nr$	$\pi_A = nr - c_A$ $\pi_B = nr - c_B$

(18)

The equilibrium choices of investment can be inferred from this matrix along similar lines as in the case without a minimum tax. The optimal investment reply of country  $i$  anticipating equilibrium play in stage 2 depends on  $q_j, t_{\min}$  and  $c_i$ :

$$n_i = \begin{cases} 0 & \text{if } q_j \frac{2-n}{2}nr + (1 - q_j)t_{\min} > nr - c_i, \\ n & \text{if } q_j \frac{2-n}{2}nr + (1 - q_j)t_{\min} < nr - c_i \end{cases} \quad (19)$$

and any  $q_i \in [0, 1]$  is optimal if  $q_j \frac{2-n}{2} nr + (1 - q_j)t_{\min} = nr - c_i$ . This leads to the following

**Proposition 7** (i) *The introduction of a minimum tax  $t_{\min} < \frac{2rn}{n+2}$  increases the range of investment cost for which  $n_i = 0$  is a dominant strategy.* (ii) *The minimum tax decreases the range of a country's cost in which  $n_i = n$  is a dominant strategy.* (iii) *The minimum tax does not affect country  $i$ 's equilibrium payoff if  $q_i > 0$  in the equilibrium.*

*Proof* (i): By (19), the choice  $n_i = 0$  is a dominant strategy for  $i$  if  $c_i > nr - q_j \frac{2-n}{2} nr + (1 - q_j)t_{\min}$  for all  $q_j \in [0, 1]$ . The right-hand side of this inequality is strictly increasing in  $t_{\min}$  for any given  $q_j < 1$  and constant in  $t_{\min}$  for  $q_j = 1$ . (ii): By (19), the choice  $n_i = 1$  is a dominant strategy for  $i$  if  $c_i < nr - q_j \frac{2-n}{2} nr + (1 - q_j)t_{\min}$  for all  $q_j \in [0, 1]$ . The right-hand side of this inequality is strictly increasing for all  $q_j < 1$  and constant in  $t_{\min}$  for  $q_j = 1$ . (iii) If  $q_i > 0$ , then  $n_i = n$  is an optimal investment choice and leads to a payoff equal to  $nr - c_i$ , which is independent of  $t_{\min}$ .  $\square$

A minimum tax increases the payoffs of the two countries in the case where neither invests, but does not affect the payoffs if at least one of the countries invests. The immediate effect of this is that investment in loyalty of citizens becomes less rewarding. A low minimum tax may, therefore, have no impact on the actual tax competition in the case where at least one country invests in loyal citizens, but it may reduce the incentives to invest in loyalty. For some range of parameters, a coordinated minimum tax of intermediate size can, hence, reduce the efforts that countries expend in establishing property rights in their citizens or taxpayers.

## 5 A harmonized tax

Tax harmonization is among the proposals considered by policy makers in the context of tax competition. Some degree of harmonization has been reached, for instance, within the European Union, with respect to import duties. Harmonization is also discussed frequently in the context of corporate taxation. For instance, the Ruding committee (CEC 1992) has made explicit recommendations in this respect. The benefits and costs of tax harmonization have also stimulated considerable interest in the academic literature on tax competition. It has been noticed that harmonization of taxes is often partial in the sense that while it blocks tax competition with respect to some tax instruments, there remains a sufficient number of other instruments that allow for tax competition to continue.<sup>19</sup> The analysis here follows a similar line of argument. Tax harmonization will not remove or block the nonprice competition instruments available to countries.

<sup>19</sup>See, e.g., Fuest (1995), Fuest and Huber (1999), Marchand et al. (2003), and Wehke (2006).

The case with perfect tax harmonization turns the competition problem between countries into a *pure common-pool problem*. The countries will try to acquire a high share in the tax base and then tax it according to the rate they have agreed upon.

Consider nonprice competition, assuming that the tax rate that is chosen by both countries is uniform and equal to  $t^h$ . The following proposition describes the equilibrium in stage 1.

**Proposition 8** *If  $\frac{1}{2}t^hn \geq \max\{c_A, c_B\}$ , then both countries invest in home attachment of their citizens. If  $\min\{c_A, c_B\} < \frac{1}{2}t^hn < \max\{c_A, c_B\}$ , then only the country with the smaller cost invests. If  $\min\{c_A, c_B\} > \frac{1}{2}t^hn$ , then none of the countries invests in the home attachment of their citizens.*

*Proof* For a proof, note that the payoffs from different investment strategies are as in the following payoff matrix:

	$n_B = 0$	$n_B = n$	
$n_A = 0$	$\pi_A = t^h$ $\pi_B = t^h$	$\pi_A = \frac{2-n}{2}t^h$ $\pi_B = \frac{1}{2}nt^h + t^h - c_B$	
$n_A = n$	$\pi_A = \frac{1}{2}nt^h + t^h - c_A$ $\pi_B = \frac{2-n}{2}t^h$	$\pi_A = t^h - c_A$ $\pi_B = t^h - c_B$	(20)

Let  $c_A \geq c_B$ . Then the equilibrium is in pure strategies with  $n_A = n_B = n$  if  $c_B \leq c_A \leq \frac{1}{2}t^hn$ , as this implies that both players prefer to invest regardless whether the other player invested or not. Second, if  $c_B < \frac{1}{2}t^hn < c_A$ , then an equilibrium exists in which only  $B$  invests and  $A$  prefers not to invest. This can also be seen from the matrix in (20):  $B$  prefers to invest, as the additional profit from investing is  $\frac{1}{2}t^hn - c_B > 0$ , independent of whether  $A$  invests or not, and for  $A$ , the cost of investing exceeds the benefits in terms of additional tax returns, independent of whether  $B$  invests or not. Hence, this asymmetric equilibrium is an equilibrium in dominant strategies. Finally, if  $c_A \geq c_B > \frac{1}{2}t^hn$ , then a comparison of the payoffs in (20) reveals that both players prefer not to invest, independent of the other player’s investment decision. □

Proposition 8 shows that there are threshold levels for the harmonized tax rate. If the harmonized tax rate is very low, this low level of the tax removes the incentives to generate home-attachment. If the tax rate is above some level, at least one of the countries starts to invest, and if the tax rate is sufficiently high, both countries prefer investment compared to the option not to invest. This structure is equivalent to a most simple version of a rent-seeking contest for a common pool resource. It is, however, a rent-seeking contest in which investment effort can take only a discrete number of levels, and the contest is initiated only if what can be gained from expending contest effort is sufficiently great. The outcome with both countries investing in home attachment of their citizens constitutes a prisoners’ dilemma. Both players expend wasteful effort to define “property rights” in part of this tax base, i.e., to protect part of their home tax base from possibly floating out of the country.

## 6 Conclusions

In a globalized economy with vanishing physical cost of crossing borders for human capital, financial capital, and direct investment, the stock of mobile capital can be seen as a global common: all countries would like to graze on this common. They would like to attract a large share of this capital and levy taxes on it or its returns. Unfortunately, capital is a shy species, and has a tendency to flee from high-tax countries to low-tax countries. This relationship has been studied intensively in the context of the tax competition literature.

The common resource property aspect of the global tax base becomes visible from observing that competition for capital is not only fiscal competition. Countries use other activities to generate a favorable bias that relaxes Bertrand competition. The activities include informative or persuasive advertising, political persuasion and influence, and effort that increases the value of the brand name of a country and enables policies that make investors or citizens loyal to this brand. In the context of competition for human capital, these policies may include educational effort that generates home attachment or even patriotism among the own population. This rent-seeking competition closely resembles the competition for a common pool resource in which players expend effort trying to acquire property rights in, or a share of, a common pool resource.

Bertrand competition in tax rates interacts with the appropriation conflict in which countries fight about property rights in the tax base. In the formal part of the paper, it was assumed that countries can generate loyalty of some group of capital owners by expending appropriate effort. Then the outcome of tax competition was considered in a framework in which some or all countries induced loyalty among a subgroup of their citizens. Based on this tax competition outcome, the incentives were analyzed for such loyalty investment. Countries with low cost of such investment have a higher incentive to invest in the loyalty of their own citizens, but higher loyalty among own citizens is a strategic disadvantage in the tax competition game.

Tax harmonization and tax coordination (a minimum tax) were also considered and it was shown that such measures have a tendency to reduce the incentives to engage in appropriation effort.

The welfare implications of this analysis are difficult to assess, given that home attachment may go along with a change in the preferences of citizens. As far as home attachment is simply a means to increase the mobility cost to a prohibitively high level, the investment in such citizen loyalty is wasteful from a global point of view. However, in a second-best world such investment may be beneficial as it allows countries to collect higher tax returns from their citizens in the Bertrand equilibrium. Where the erosion of tax revenue endangers the welfare state, these activities can be seen as second-best reactions of the nation states by which they address the problem of eroding tax revenues.

**Acknowledgements** Financial support by the German Science Foundation (SPP 1142) is gratefully acknowledged. I thank Richard Cornes, Lars Feld, Florian Morath, Alain Trannoy, Jay Wilson, and participants at the IIPF conference in Warwick and seminars at BRUEGEL in Brussels and at the EUI in Florence for valuable comments. The usual caveat applies.

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