Tax Competition and Information Sharing in Europe: A Signaling Game

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Tax Competition and Information Sharing in Europe: A Signaling Game

[This paper is a revised version of "Tax Harmonization versus Tax Competition: A Game Theoretical Approach"]

André FOURCANS and Thierry WARIN*

This paper provides a challenging view to the tax harmonization issue. The literature often proposes tax harmonization to avoid free-riding behaviors in free-trade areas, and more particularly in monetary unions. Countries may decrease their tax rates in order to develop tax competitive advantage and attract capital. Without tax harmonization, tax autonomy may lead to a "race to the bottom." The model proposed here uses a game-theoretical approach to analyze this question. It shows that tax competition may lead to stability. The mechanism leading to this outcome rests upon the impact of the signal given by both players. If a country gives the signal that "friendly" taxation behavior is not its priority, the result can be a "race to the bottom". Conversely, if both countries signal their ability to conduct such a war, this war will not occur, and the stability of the system will be ensured.

Keywords: Monetary union, Economic integration, Tax competition, Tax harmonization, Fiscal competition.
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INTRODUCTION

In Economic and Monetary Unions such as the European Economic and Monetary Union (EMU), countries are highly interdependent. At the European level, monetary policy is managed by taking into consideration the euro-zone as a whole, rather than a particular country. Budget policies are constrained by the Stability and Growth Pact (SGP). At the macroeconomic level, structural and tax policies are more or less the main policies remaining in individual countries' hands.

European countries can make their economies more attractive by diminishing their tax rates? But each country faces twin objectives: follow the SGP (a deficit below the 3% of GDP ceiling and, on the average over the cycle, a zero deficit or a surplus) and seek high employment (or growth). Within this framework, it is important to study whether an "optimal" tax reduction would be better accomplished via competition or harmonization.

Both processes have their costs. Under tax competition, each country's tax policy is independent of the others, and free riding behaviors may occur. A sub-optimal tax equilibrium for the monetary zone as a whole is possible. Tax competition may also create budgetary problems, and the objective of a balanced budget (required, on the average, by the SGP) may not be reached. Finally, the literature generally considers that tax competition could trigger a "race to the bottom", *i.e.* lead to too low a tax rate (the lowest of all member states) and thus to sub-optimal public goods provision, insofar as countries would have to diminish their public spending, because of decreased tax revenue. (Zodrow and Miezkowski 1986), Cremer and Gahvari 2000).

If tax competition is costly, one way to avoid these costs is to forbid competition. The early papers on the subject insist on the gains of implementing some mechanism for tax harmonization (Razin and Sadka 1991b). The largest support for this mechanism comes from models considering endogenously determined return on capital. Bucovetsky and Wilson (1991), and Persson and Tabellini (1992), show that fiscal competition leads to an under-provision of public goods, or to an inefficient redistribution. Others, like Bucovetsky (1991), are concerned about the efficient allocation of capital with a fixed public budget requirement. They show that there is room for some harmonization.

If this literature tries to incorporate possible free-riding problems, it barely takes into consideration the costs of harmonization. It generally limits its analysis to the various mechanisms or procedures to implement such a harmonization (or cooperation), but neglects the economic and political costs of these mechanisms and procedures. The simplest form of cooperation can be a powerful one. It is the exchange of information on capital income accrued by foreign residents by tax

authorities, implying that the residence principle can be applied to capital income taxation. As shown by Bucovetsky (1991), and Razin and Sadka (1991b), the use of the residence principle leads to a Pareto efficient outcome, making further attempts to cooperate superfluous. Yet even though information sharing generally leads to efficiency, it is not guaranteed that all countries will be ready to participate in such tax cooperation. A given country can be better off under tax competition (e.g. because of asymmetries between member states) than under the efficient outcome. In this case, other forms of tax cooperation, like joint determination of tax rates, may be applicable. Another coordination mechanism may be built through a central fiscal authority (Cardarelli, Taugourdeau and Vidal 2000), or through a capital control mechanism. In that case, Razin and Sadka (1991a) show that it is optimal, at least for a small open economy that is net capital exporter, to impose such restrictions, once foreign source capital income is tax exempt.

Some analyses introduce the conditions of tax harmonization: for symmetric countries, Cremer and Gahvari (2000) conclude that the equilibrium values of the tax rates are less than optimal, and tax harmonization alone may lead to a less than optimal tax rate. For asymmetric countries, they show that integration may turn an honest country into an evading one. Tax harmonization alone may, therefore, be a bad policy, and make both countries worse off. It may also cause an otherwise honest country to become a tax evader.

Too fast a tax harmonization may also create a strong economic shock, by changing the budget structure of a country. Mendoza (2001) presents a case against European tax harmonization: "A European harmonization of capital income taxes (...) yields large capital outflows and a significant erosion of tax revenue for Continental Europe while the opposite effects benefit the United Kingdom."

In spite of these shortcomings, most of these papers are in favor of harmonization, mostly to help avoid free-riding possibilities under competition. Other research challenges the likelihood of a race to the bottom and discusses the implications – positive and negative – of tax competition. For instance Janeba (1998), Ludema and Wooton (2000), Kind, Midelfart-Knarvik and Schjeldeberup (2000), and Janeba and Smart (2001), study the conditions under which targeted tax competition is less harmful than its remedies, and Krugman and Baldwin (2000) suggest that the tax game is something more subtle than a "race to the bottom."

Tax competition may have some positive impacts.. Firstly, member states' freedom in establishing their tax policy may be one of their last national tools to fight asymmetric shocks. Secondly, it may be an effective way to correct market distortions. Thirdly, as mentioned by Brennan and Buchanan (1980), the pressure that tax competition may exert on government expenditures may help to avoid

waste and inefficiencies in the public sector. Finally, tax competition might lead countries to develop better tax systems; every country could learn from the experiences of others.

All arguments considered, is it still possible to say that tax harmonization, as it is usually presented, is really the best way to organize the European tax system? The model proposed here analyses such a question. It is based on a game between two European governments. In such a model, it is not obvious that the lack of tax harmonization may lead to a "race to the bottom" between countries. Why is this so? A primary answer may come from the dynamics of the game and the appearance of commitment tactics. A secondary answer may come from the initial conditions and the original signal sent by participating countries.

The proposed game is played within two different configurations. The first one is a one-shot game with no information sharing before the game starts. A signal is introduced in the second configuration while the game is repeated. It captures the signal sent by a country to the other player about its own ability - or desire - to enter into a "race to the bottom." The model questions the free-riding assumption, and challenges the idea that it could lead to a "race to the bottom." After an introduction, to the model, the first section presents the model's assumptions. The second section discusses the unrealistic conditions for free riding behaviors, and the third section demonstrates the unlikelihood of a "race to the bottom." The fourth section highlights the policy implications, and the concluding section addresses the main lesson from this type of model.

THE MODEL

The proposed model is inspired by Barro and Gordon (1983), and Solow (1990). It is a game-theoretical model where the union consists of two countries producing a homogeneous good using capital and labor, and where each government follows tax and unemployment objectives.

The model is original compared to the usual modeling in the tax literature; it uses a reduced form approach where the public sector does not need to be explicitly modeled. Country sizes are identical, as well as initial tax rates, so that the outcome is not to be predetermined by assumptions of cross-country differences.

The tax rate used is the total tax burden of a country. The purpose of this approach is to capture the theoretical dynamics of tax *changes* (not tax *levels*) rather than the impact of specific taxes.

Each country has a fixed amount of immobile labor and a fixed endowment of capital per worker. Technologies are identical in both countries and

exhibit constant returns to scale. Capital (financial and physical) flows freely between member states to equalize after tax returns.

This original design aims to capture the strategic behavior between countries in an open-economy model. In other words, the emphasis is put more on countries' strategies than on the structural effects of changes in tax policy. This approach leads to a new look at tax policy as a strategic game between countries.

The change (in logarithm) in the country tax rate, t_i, with $i = \{1,2\}$ is the decision variable. The "race to the bottom" means a decrease in this variable *i.e.* $t_i < 0$. Assets movements between countries are linked to changes in variations in the tax rate.

A decrease in the tax rate in one country increases the employment rate in this country, and has a negative impact on employment (and growth) in the other country, because of capital (financial and physical) outflows from the latter country. The economic structure is defined through:

$$\begin{cases} u_1 = \bar{u} - b\left(t_2 - t_1\right) \\ u_2 = \bar{u} - b\left(t_1 - t_2\right), \end{cases} \tag{1}$$

where $\bar{u}$ is the equilibrium unemployment rate - countries' sizes are assumed to be the same - and u_i is the unemployment rate in country i.

In order to compensate the decrease in tax receipts that will probably occur, a country has to cut off spending or accept a wider budget deficit. Both countries have the following loss functions:

$$\begin{cases} L_1 = \left(u_1\right)^2 + a\left(t_1\right)^2 \\ L_2 = \left(u_2\right)^2 + a\left(t_2\right)^2, \end{cases} \tag{2}$$

where a is the relative weight of the two partial objectives.
By substituting eq. (1) into eq. (2), the functions become:

$$\begin{cases} L_1 = \left(\bar{u} - b\left(t_2 - t_1\right)\right)^2 + a\left(t_1\right)^2 \\ L_2 = \left(\bar{u} - b\left(t_1 - t_2\right)\right)^2 + a\left(t_2\right)^2 \end{cases} \tag{3}$$

In the next section the conditions for free-riding behaviors are presented. The discussion highlights the theoretical argument used in the literature in favor of harmonization policies.

PERFECT INFORMATION AND NO PENALTY POSSIBILITY: UNREALISTIC CONDITIONS FOR FREE-RIDING BEHAVIORS

At the international level, there are two types of possible strategies: each player can choose to implement a "race to the bottom" strategy, *i.e.*, to decrease its tax rate, or a "no-change" strategy. In the one-shot game, four occurrences are then possible:

1. both players do not play a race to the bottom game: $t_1 = 0$ and $t_2 = 0$. In such a case, $L_1 = \overline{u}^2$;
2. player #1 plays a race to the bottom game whereas the other does not want to play such a game: $t_1 < 0$ and $t_2 = 0$. The tax rate variations that minimizes the player's loss function are $\left\{t_1 = -\overline{u}\,b\,/\left(a + b^2\right), t_2 = 0\right\}$, and the loss functions are:

$$\begin{cases} L_1 = \overline{u}^2 - \overline{u}^2 b^2 \Big/ \left(a + b^2\right) \\ L_2 = \overline{u}^2 \left(a + 2b^2\right)^2 \Big/ \left(a + b^2\right)^2, \end{cases} \tag{4}$$

3. player #2 plays a race to the bottom game, whereas player #1 does not want to play such a game; the loss functions are the symmetrical of the previous ones.
4. both players play a race to the bottom game. The tax rate variations that minimize both players' loss functions are: $t_1 = t_2 = -\overline{u}\,b\,/\,a$. The decreasing tax rate has no impact on unemployment: $u_1 = u_2 = \overline{u}$.[1] This tax bias explains why the literature generally argues that tax competition could trigger a "race to the bottom" - the "bottom" being the lowest sustainable tax rate, *i.e.* the lowest of all member states. Countries would then have to diminish their public spending insofar as tax receipts would decrease.

Each player's loss function is

$$L_1 = L = \frac{\overline{u}^2\left(a + b^2\right)}{a} \tag{5}$$

In a perfect information model, with no cost associated to changes in behavior, the cooperative solution is dominated by the non-cooperative one. The only Nash equilibrium is for both players not to cooperate and to choose occurrence (4), the "race to the bottom."[2] Large countries are likely to suffer revenue losses while small countries may actually gain.[3] The optimal Pareto combination is obtained when both players cooperate. This solution is only possible if both countries agree on a credible rule, for example, a bilateral contract aiming at a stable tax rate. Otherwise, the dominant solution is the discrete one.

PERFECT INFORMATION AND PENALTY: THE UNLIKELY "RACE TO THE BOTTOM"

Here, a new situation is studied: a possible penalty (an unexpected tax decrease by the other country) as in the Barro and Gordon's (1983) model. The model is designed as a repeated game with an infinite horizon and perfect information. The penalty decided by one country – private information – is communicated to the other player before the game starts.

Players' possible strategies

Do players have a real interest in not cooperating? In other words, do they really have an interest in playing the non-cooperative game? The answer depends on the cost of economic distortion resulting from the cooperative solution. The gains or costs of distorting the other player's expectations are evaluated with respect to the best possible result:

$$L_1 = L_2 = \overline{u}^2, \tag{6}$$

Without the penalty possibility, if the optimal Pareto solution is chosen, the above results are obtained:

- if player 1 plays a "race to the bottom" game and player 2 does not, player 1's loss function is $L_1 = \overline{u}^2 - \overline{u}^2 b^2 \Big/ \left(a + b^2\right)$ rather than $L_1 = \overline{u}^2$. His gain is $\left(\overline{u}^2 b \right) \Big/ \left(a + b^2\right)$;
- *Idem* for player 2.

Only a possible penalty may change the results of the model. Player 2 is able to punish player 1 in the following periods. Player 2 gains if he always plays the "race to the bottom" game, and player 1 doesn't play such a race in the following period. Player 2 loses less in the case that player 1 plays the "race to the bottom" strategy. Yet, the latest solution brings about a loss compared to the optimal Pareto situation. It is therefore beneficial for both players to minimize the number of periods where the results are sub-optimal. Both players must quickly establish the penalty period if they do not want to lose continually through the "race to the bottom," where the loss is:

$$\frac{\overline{u}^2\left(a + b^2\right)}{a} - \overline{u}^2 = \frac{\overline{u}^2 b^2}{a} \tag{7}$$

Given this information, both players decide on the duration of the conflict, and, thereby, on their strategies.

Equilibrium with a perfect signal

Before the game is started, both players consider the penalty possibility, and thus, initiate the signals they share just before playing. It represents different values of a. The "signal" consists of the transmission of private information from one player to the other about the duration of the retaliation period in case of a sub-optimal equilibrium.

Proposition *When player 1 gives more and more weight to unemployment, rather than to a decrease in the tax rate - in other words when a decreases - the penalty period decided by player 2 before the game, becomes shorter and shorter.*

Corollary *When less and less weight is given by player 1 to unemployment, the second player's penalty period increases.*

Proof A player plays the "no-change" strategy if the gains resulting from the "race" played at one period are lower than the present value of losses of the penalty decided by player 2.

Let us define $d = (1+R)^{-1} < 1$ as the present value factor and R, the real interest rate. A low d means that the player does not exploit the penalty strategy for too long a period. After substitution, the condition becomes:

$$\frac{\bar{u}^2 b^2}{a+b^2} < \frac{\bar{u}^2 b^2}{a} \sum_{t=1}^{T} d^t , \tag{8}$$

$$\frac{a}{a+b^2} < \frac{d\left(1-d^{T^*}\right)}{1-d} . \tag{9}$$

If T^* is the period where the player can be indifferent between a "race" a "no-change" strategy, eq. (9) implies that:

$$\frac{a}{a+b^2} = \frac{d\left(1-d^{T^*}\right)}{1-d} . \tag{10}$$

When $T > T^*$, the present value of losses is higher than the gains from the "race." The latter will therefore not be adopted. When $T < T^*$, the gains from the "race" are higher than the present value of losses. This strategy will therefore be adopted.

If $f(T,d) = \frac{d\left(1-d^{T}\right)}{1-d}$, with $f(1,d) = d$, $\partial f/\partial T > 0$ and $\partial f/\partial d > 0$, eq. (9) can be written:

$$\frac{a}{a+b^2} < f(T,d) . \tag{11}$$

Let us represent this latter equation through the following figure (for $d = 0.96$ based upon an interest rate of 4% and $b = 1$):

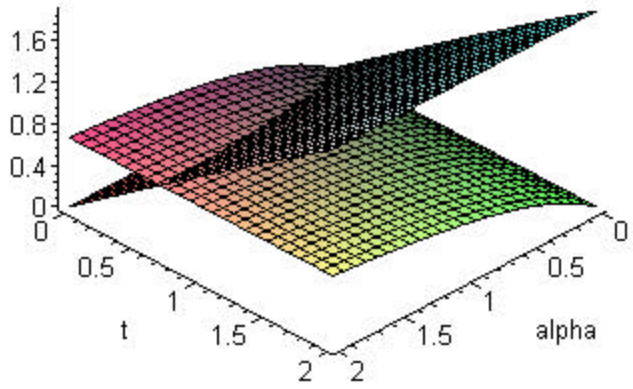

Figure 1. Penalty period and changes in a .

Figure 1 represents the length of the penalty period, based upon the weight given by the players to the tax. When a player gives less weight to a "race" strategy (a decreases), the penalty period becomes shorter. The outcome in a one-shot game may be inefficient, but in a repeated setting with appropriate punishment strategies and discount factors, any individual rational outcome can be an equilibrium outcome (e.g. the folk theorem). With perfect information, the degree of retaliation captured by the transmission of the signal, pushes towards the coordination equilibrium.

By definition, the race to the bottom game implies retaliation, and self-discipline is motivated by the fear of the partners' retaliation policies. Retaliation is completely credible in this context, because it corresponds to a dominant strategy. In light of this analysis, therefore, there is no need to harmonize taxes at the supra-national level in order to avoid a race to the bottom. The fear of a long retaliation period will push a down.

Corollary *The price both players agree to pay for their credibility represents the signal they give before the game begins. In Europe, it may correspond to the possibility that a country may enter into a race to the bottom: does it have sound public finances, etc.?*

POLICY IMPLICATIONS

It is in the interest of each player to address a clear and strong signal to the other about its own strategy. In other words, it is in the interest of each player to let the other know that, if he tries to mislead in his expectations, he will be fired back upon by misleading from the other side. Hence, a strong signal on the part of both players would reduce the duration of the possible conflict, and diminish the volatility of the tax rate.

The theoretical analysis sheds light on the role of tax policy in Europe, and more generally in a monetary union. If tax competition exists, the mechanism driving towards stability in the system rests upon the signal given by both players. If a country gives the signal that tax discipline is not its priority, the result can be a "race to the bottom." Conversely, if both countries signal their ability to enter a tax war, this war doesn't occur. The stability of the system is thus maintained. Considering the former process, it is of a paramount importance for a country to be able to give a strong and credible signal, to the other country, that it can enter a "race to the bottom." For that, the country must have sound public finances. If it does not, then that country cannot engage in a tax war, and the partner country could then implement a free-riding strategy.

This theoretical analysis reinforces the argument that the pressure on government expenditures helps to avoid waste and inefficiencies in the public sector, and that if countries have sound public finances, tax competition will not lead to a "race to the bottom."

CONCLUSION

In the game-theoretical model proposed here, each government follows tax and unemployment objectives. The game is a one-shot game with two different configurations. The first is a true one-shot game with no information sharing before the game starts. A signal is introduced in the second configuration. In this case, one player retaliates following a free-riding strategy played by the other player.

The "one-shot" approach shows that tax harmonization is necessary in terms of system stability. The "repeated" approach, via the possible threat of a government's reprisal, underscores the role of tax competition in reaching stability in the system.

In general, the research relying on the free-riding assumption argues in favor of tax harmonization. Yet, with perfect information, and when penalty

possibilities exist, things are somewhat different. As shown in this paper, free riding may be discouraged through the threat of a government's reprisal.

The model could be improved upon by introducing imperfect information, and by building a signaling game introducing credibility problems. Some countries are in budgetary situations that make them credible in terms of their being able to conduct a "tax war." Others are not. In that respect, some countries have higher incentives not to respect the cooperative equilibrium, and to be free-riders. Yet the simple model studied here is sufficient to show that the free-riding argument is not valid under certain conditions.

Notes

1. It is a traditional result of temporal inconsistency enlightened by Kydland and Prescott (1977) and encompassed in Barro and Gordon (1983)'s formulation.
2. Note also that the equilibrium is symmetric because of the assumption of identical technologies.
3. This is a core result of most models focusing on the issue of size in tax competition. See, for instance, Bucovetsky (1991); Wilson (1991); Kanbur and Keen (1993).

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