Endogenizing leadership in tax competition

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ABSTRACT

In this paper we extend the standard approach of horizontal tax competition by endogenizing the timing of decisions made by the competing jurisdictions. Following the literature on the endogenous timing in duopoly games, we consider a pre-play stage, where jurisdictions commit themselves to move early or late, i.e. to fix their tax rate at a first or second stage. We highlight that at least one jurisdiction experiments a second-mover advantage. We show that the Subgame Perfect Equilibria (SPEs) correspond to the two Stackelberg situations yielding to a coordination problem. In order to solve this issue, we consider a quadratic specification of the production function, and we use two criteria of selection: Pareto-dominance and risk-dominance. We emphasize that at the risk-dominant equilibrium the less productive or smaller jurisdiction leads and hence loses the second-mover advantage. If asymmetry among jurisdictions is sufficient, Pareto-dominance reinforces risk-dominance in selecting the same SPE. Three results may be deduced from our analysis: (i) the downward pressure on tax rates is less severe than predicted; (ii) the smaller jurisdiction leads; (iii) the 'big-country-higher-tax-rate' rule does not always hold.

1. Introduction

Tax competition is often seen as characterized by a downward pressure on tax rates, leading to underprovision of public goods (dubbed "race to the bottom"). This result has been obtained using models that formalize tax competition through a Nash equilibrium with simultaneous moves (see Zodrow and Mieszkowski, 1986; Wilson, 1986; Wildasin, 1988).[2]

In this paper, we challenge this result by endogenizing the timing of decisions by fiscal authorities. The assumption of simultaneous moves of countries when deciding their tax policy, is largely accepted. But, as remarked by Schelling (1960), the viability of the equilibrium with simultaneous moves is dubious as soon as countries' commitment is considered. An obvious way to commit is to decide before the others. Very few articles in the literature on international tax competition

consider the case where tax decisions are sequential[3]: Gordon (1992), Wang (1999) and to a smaller extent Baldwin and Krugman (2004). The first author considers double-taxation conventions between countries. He establishes that capital income taxation can be sustained if the dominant capital exporter country acts as a Stackelberg leader by choosing its tax policy first. Following Kanbur and Keen (1993) who focus on commodity taxation, Wang (1999) assumes that the larger country behaves as a Stackelberg leader. Baldwin and Krugman (2004) highlight the role of economies of agglomeration to explain why tax rates remain higher in the core country than in the periphery, by assuming that the core country moves first. In the empirical literature on tax competition too, few papers deviate from the simultaneous tax competition assumption (see Altshuler and Goodspeed, 2002; Redoano, 2007).

The preceding theoretical works which consider a Stackelberg configuration assume an exogenous timing, each jurisdiction or country having its predetermined role as leader or follower.[4] Given this background, the aim of this paper is twofold: firstly, going beyond the study of the Stackelberg equilibrium, we analyze the endogenous

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[2] This approach has been extended in many directions by taking into account the difference among countries in their size or their initial endowments, by studying several tax instruments, by considering Leviathan governments, and so on. See for instance the surveys of Wilson (1999) or Wilson and Wildasin (2004) among the most recent ones.

[3] Several recent papers on fiscal federalism consider a Stackelberg game where the central government leads. However, the induced vertical tax competition is not encompassed in the definition of tax competition by Wilson and Wildasin (2004). Moreover, the sequence of moves is assumed to be given.

[4] For instance, Wang (1999) writes (p. 974): "It is natural and conceivable that, in a real-world situation of tax-setting, the large region moves first and the small region moves second."

timing of tax-setting and its consequences on the final equilibrium, which becomes a Subgame Perfect Equilibrium (SPE); secondly, since there are several SPEs, we solve the coordination issue that appears by using the notions of Pareto and risk-dominance. This allows us to identify the leader respectively at the efficient equilibrium and at the safest one.

Our analysis is grounded on the standard approach to horizontal tax competition proposed by Wildasin (1988), as formalized by Laussel and Le Breton (1998). This model presents the advantage of focusing exclusively on strategic interactions. Moreover, Laussel and Le Breton (1998) rigorously establish the condition of existence and uniqueness of a Nash equilibrium in the canonical tax competition game.[5] Following the literature on endogenous timing in duopoly games initiated by d'Aspremont and Gerard-Varet (1980) and Gal-Or (1985), we consider the two-period action commitment game proposed by Hamilton and Slutsky (1990): each country has to move in one of two periods; if one player chooses to move early, *i.e.* to fix its tax rate in the first period, while the other moves late, *i.e.* to fix its tax rate in the second period the latter behaves as a Stackelberg follower, the former as a leader; otherwise, choices of tax rates are simultaneous, and countries play the standard tax competition game. This kind of game, which has been called "leadership game" or "commitment game" has been mainly developed in Industrial Organization.[6] Our approach is close to van Damme and Hurkens (2004) and Amir and Stepanova (2006), who develop models of endogenous moves in Bertrand duopoly game where firms' strategies, *i.e.* prices, are complements.

We consider three "basic games" depending on the sequence of moves: one static and two Stackelberg games. In these games inspired from Wildasin (1988) and Laussel and Le Breton (1998), tax rates are strategic complements.[7] This property has been widely documented in empirical works on countries' reaction functions (see for instance Devereux et al., 2008). Morever, besides its realism, this property involves the supermodularity of the standard tax competition game, which insures the existence of equilibria. We rank the equilibrium tax rates obtained for the three basic games, and show that the standard tax competition equilibrium (simultaneous moves) leads to the lowest rates. We highlight a second-mover advantage for at least one of the two countries, which is consistent with the strategic complementarity of the tax rates. We turn into the timing game proposed by Hamilton and Slutsky (1990). The Subgame Perfect Equilibria (SPEs) correspond to the two Stackelberg situations. These equilibrium tax rates are unambiguously superior to these determined in the simultaneous Nash game. The downward pressure on tax rates is less strong than predicted in the standard tax competition analysis.

Since we obtain two SPEs, a new issue appears which concerns the coordination among equilibria: which country chooses to move first? To answer, we determine the conditions under which Pareto (or payoff) dominance of one SPE is guaranteed. However, this criterion fails to apply for all possible situations. It requires sufficient

asymmetry among countries. In addition to the Pareto criterion, we consider the notion of risk-dominance as defined by Harsanyi and Selten (1988) to establish which equilibrium is the more secure.[8] Both the Pareto- and risk-dominance criteria support the view that the smaller (less productive) country leads the tax competition, thus losing the "second-mover advantage". In other words, leading the competition does not translate into a "small country" advantage (see Wellisch, 2000). Indeed, we establish that the "big-country-higher-tax-rate" rule does not always hold, that is the smaller country may fix a higher tax rate. Our findings are direct implications of the existing strategic complementarity in tax competition.

The rest of the paper is organized as follows: Section 2 presents the basic framework and the three simple games depending on the simultaneity or sequentiality of country's moves; in Section 3, we determine the SPEs by ranking the tax rates in the different games, highlighting a second-mover advantage in the extended game, and solving this; in Section 4, we consider the coordination issue among the two possible SPEs, and we use the Pareto-dominance and risk-dominance criteria to solve this issue; and Section 5 concludes.

2. Basic framework

We consider a two-country economy where capital is mobile and the two fiscal authorities set capital taxes. The model is similar to the one proposed by Laussel and Le Breton (1998) as these authors provide a rigorous analysis of the existence and the uniqueness of a Nash equilibrium in a tax competition game inspired from Wildasin (1988). Our main results (Propositions 1 and 2) are based on the strategic complementarity of tax strategies, that is on the super-modularity of the tax competition game.

2.1. The model

The two jurisdictions, or countries, are denoted by A and B. A single homogeneous private good is produced locally. This good can either be consumed or used as an input into the provision of the local public good. The production function used in Country i, denoted by $F_i(K_i, L_i)$, where K_i is the amount of mobile production factor (capital) and L_i the amount of fixed production factor (labor or land), is supposed to be homogenous of degree 1. Assuming an equal endowment in the fixed factor for each country normalized to 1: $L_A = L_B = 1$, the production function of private goods in Country i can be rewritten as $F_i(K_i)$. Following Laussel and Le Breton (1998), we assume the following properties on the function $F_i(K_i)$:

$$F_i'(K_i) > 0 > F_i''(K_i),$$
$$F_i''(0) > -\infty,$$
$$F_i'''(.) \geq 0.$$
(1)

These assumptions ensure the existence of a Nash equilibrium.

In contrast to Laussel and Le Breton (1998) who restrict themselves to the symmetric case, we introduce some asymmetry among countries by considering different production functions $(F_A(.) \neq F_B(.))$. Several other formalizations of asymmetry are available in the literature: Bucovetsky (1991) assumes that countries differ by their size; Peralta and van Ypersele (2005) consider different individual capital endowments. However, the choice of the nature of asymmetry would not affect our results, which are based on the property of strategic complementarity of tax rates. In Section 4, we establish a parallel between the less productive country and the smaller country on the ground of the arguments of capital elasticity or *ex ante* lowly endowed country.

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[5] The issue of equilibrium existence, *a fortiori* uniqueness, is seldom tackled in the tax competition literature. Bucovetsky (1991), Wildasin (1991) or Wilson (1991) specify their respective model so as to have simple (generally linear) best-reply curves. More recently, except Laussel and Le Breton (1998), we can mention the works of Bayindir-Upmann and Ziad (2005), Rothstein (2007) or Petchey and Shapiro (2009): Bayindir-Upmann and Ziad (2005) use the concept of a second-order locally consistent equilibrium, which is less general than the Nash equilibrium; Rothstein (2007) considers ad valorem taxes instead of unit taxes; Petchey and Shapiro (2009) develop a dual approach, where countries minimize their policies' costs.

[6] This framework is also used in the international trade literature (Syropoulos, 1994; Raimondos-Møller and Woodland, 2000) and in public economics (Kempf and Rota-Graziosi, 2010, where we propose a taxonomy of international interactions depending on the sign of the spillovers and the nature of interactions).

[7] Bulow et al. (1985) coined the terms "strategic substitutes" and "strategic complements" to define the cases of downward- and upward-sloping reaction functions, respectively.

[8] To apply the notion of risk-dominance, we consider quadratic production functions, because the use of the risk-dominance criterion requires the specification of the payoff functions.