Inter-jurisdictional Corporate Tax Game under Imperfect Competition and Different Preferences for Public Services

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Abstract

The purpose of this paper is to examine welfare gains from inter-jurisdictional profit tax game in the presence of international imperfect capital mobility and imperfect competition among firms. The world economy is composed of two countries linked by imperfect capital mobility. Both symmetric and asymmetric fiscal equilibria are investigated at the pure source principle by means of a two-stage game of complete and imperfect information using numerical simulations. The first stage of this game is formulated as a situation where each government has to determine the optimal profit tax rates levied on firms with a view to maximising the welfare of its residents. Firms have to compete with each other at the second stage according to the Cournot strategy in order to maximise their net profits taking as given the profit tax rates selected at the first stage by governments (co-operatively or non-cooperatively). The key question is to examine how welfare gains from tax co-operation may be affected as compared with tax competition by the asymmetric preferences of jurisdictions for public services, the size of capital mobility cost, and the degree of tax co-operation (tax co-ordination or tax harmonisation).

1. Introduction

Little attention is devoted in the public economics literature to the relationship between the inter-jurisdictional tax game on the one hand, and the international competition between non-competitive firms on the other. SORENSSEN (1991) and RAZIN and SADKA (1991) examine tax competition and tax co-ordination in a model where firms are purely competitive, and hence there are no

(*) We would like to thank Toumana BEN YAROU, Leon BETTENDORF, Remy HADHRI, Isabelle MEURET, and the anonymous referees for their helpful comments. Address of author: Catholic Faculty of Mons, Department of Economic Analysis, FUCAM, 151 Chaussée de Binche, B-7000 Mons, Belgium, and E-mail, hadhri@message.Fucam.ac.be.
pure profits. SORESEN focuses by means of an overlapping generations model on the question of whether governments in an interdependent world economy will tend to choose the “right” (efficient) level of taxation and public expenditure if they do not co-ordinate their policies. Results show in particular that if the marginal source of public finance is a capital income tax based on the source principle, countries can almost certainly make a long run gain by undertaking a co-ordinated increase in their level of taxation and public expenditure.

The issue of welfare gains from fiscal policy is analysed in these models in a ‘purely competitive’ case where the number of firms in each country is large. Firms are purely competitive in the sense that any single firm’s policy has no direct effect on prices nor on demand in any other countries. In the small-number setting matters are somewhat less clear. Unlike these works, a different set of papers examines the scope for international co-ordination of capital income and profit taxation in a model where there exist pure profits, in particular the works by KRELOVE (1992), APEL and DILLEN (1994), and HUIZINGA and NIELSEN (1995-1996). KRELOVE considers only source-based capital income taxation in a model where there exist pure profits that accrue fully to domestic residents. The source-based investment tax can be set either too low or too high without co-ordination.

APEL and DILLEN analyse the effects of tax competition and tax co-ordination in a modified version of the RAZIN and SADKA model with an endogenous interest rate. Their model consists of a number of small identical countries. Domestic output is produced by capital according to a neo-classical production function with decreasing returns to scale. Firms are assumed to generate pure profits and the purpose of their analysis is to study how the results are affected under different assumptions of the ability of taxing these profits. They compare the outcome of a non-co-operative tax game with the outcome obtained if countries co-ordinate their tax policies and hence take into account effects of taxes on the world market interest rate. Three different assumptions of how pure profit can be taxed are examined in their model. Specifically, they assume that pure profit can be fully taxed away by the government, that is cannot be taxed at all, and that it can be taxed at the same rate as returns to savings. Their analysis shows in particular that if pure profits can be fully taxed away by the government, the optimisation problem of the government under the application of the source principle is reduced to a tax revenue maximisation argument. This, in
turn, implies a zero tax rate on capital income. When profits cannot be fully taxed away, then in general neither the source nor the residence is optimal. Tax competition will, under the source principle, never lead to a higher capital tax rate than the co-ordinated solution.

In a recent work, HUIZINGA and NIELSEN (1996) attempt to extend the literature regarding the international co-ordination of capital income taxation by incorporating profit taxation and the degree of foreign ownership of firms. They investigate the scope for the co-ordination of capital income taxation in a model where there exist pure profits that generally are partly foreign-owned. Public goods are financed by taxes on capital income and profits. The tax instruments considered in their work are a source-based investment tax, a residence-based saving tax, and a profit tax. The scope for tax co-ordination is shown to depend on (i) the degree of foreign ownership, (ii) the feasibility of profit taxation, and (iii) whether savings and investment taxes are available jointly or only singly to each individual country. A main conclusion, in line with HUIZINGA and NIELSEN (1995), is that there is no scope for capital income tax co-ordination if profits are fully taxed. In the absence of full profit taxation, there is still no scope for co-ordinated capital income taxation if all domestic firms are domestically owned and if there exist both a savings and an investment tax in the open economy.

These contributions are relatively simplified in the sense that the analysis of international capital income tax co-ordination did not incorporate the role of the multinational character of the firms' investment, the asymmetric preferences of jurisdictions, or the several factors that account for the imperfect competition between imperfectly mobile firms. Most of these models assume the existence of pure profits but there is no competition among firms. This omission may be potentially serious.

Unlike that literature, the present research departs from the framework of pure competition among firms to examine the scope for inter-jurisdictional tax competition and tax co-operation in a small-number context in which there exist pure profits and where strategic interactions between firms cannot be ignored. A two-country model is considered to stress the important role of imperfect competition among firms in evaluating welfare effects of tax competition and tax co-operation between jurisdictions on the provision of public goods. The present
framework combines the standard literature on *tax competition*, which deals mostly with static models in which capital is perfectly mobile across countries, and the literature on *industrial organisation*, which is concerned in particular with the modelling of imperfect competition.\(^1\)

Suppose that the world economy is composed of two countries linked by imperfect capital mobility. In each country there is one representative firm endowed with one unit of capital. The problem of tax competition is modelled in this work as a game between the jurisdictions using the subgame perfection equilibrium concept of the game theory. The jurisdiction’s objective is to maximise social welfare by choosing under the source principle a tax rate on the profits of firms domestically earned. The concept of subgame perfect equilibria is often used in the literature on inter-jurisdictional fiscal competition.\(^2\) The purpose of this paper is to examine welfare gains from the inter-jurisdictional profit tax game in the presence of international imperfect capital mobility and imperfect competition among firms.

Both symmetric and asymmetric fiscal equilibria are investigated at the pure source principle by means of a two-stage game of complete and imperfect information using numerical simulations. The first stage of this game is formulated as a situation where each jurisdiction has to determine the optimal profit tax rates levied on firms with a view to maximising the welfare of its residents. Firms have to compete with each other at the second stage according to the Cournot strategy in order to maximise their net profits taking as given the profit tax rates selected at the first stage by jurisdictions (co-operatively or non-cooperatively). Public spending is financed in each country only by the profit tax rates. Each country’s jurisdiction maximises a social welfare function that has three arguments: the consumer surplus coming from the private good consumption, the net-of-tax profits of its firm, and the public good financed by the profit tax revenue. Each jurisdiction chooses optimally its profit tax rate, taking the

\(^1\) A good survey is provided in HADHRI (1997c) regarding the literature on the alternative approaches applied to the fiscal game modelling.

\(^2\) By way of example, competition between governments is modelled in MARKUSEN, MOREY, and OLEWILER (1995) as a two-stage non-cooperative game. In the first stage of the game, the two governments simultaneously set the values of *environmental policy variables*. In the second stage, the firm chooses one of four configurations of plants: a plant in both regions, a single plant in one region, or zero plants [see also JENSEN and TOMA (1991)].
other jurisdiction’s tax rate as given. So doing, it accounts for the effect of its tax rate on the Nash equilibrium in the capital allocations of firms. The subgame perfect equilibrium is computed after the analytical presentation of the model in the case of identical countries and in the case of heterogeneous countries which differ in their preferences for public services.

The problem is to describe the equilibrium tax rates that would hold under the Cournot approach and to identify the welfare implications of fiscal equilibria. This approach is relatively new with respect to other Nash equilibrium-based approaches used in WILDASIN’s (1988) model in which Cournot equilibrium is determined explicitly by a finite number of jurisdictions in a model where there are no pure profits for firms. In the present model, jurisdictions will therefore end up in a Nash equilibrium in profit tax rates, conditional on the imperfect competition among firms. The particularly interesting point of the present research is to integrate inter-jurisdictional tax competition and imperfect competitions among firms. Numerical simulations suggest that the main result of public finance literature dealing with inter-jurisdictional tax competition-under provision of local public goods, may not be valid if we incorporate the strategic interactions between non-competitive firms in each market.

The key question is to examine how welfare gains from tax co-operation may be affected compared with tax competition by asymmetric preferences of jurisdictions for public spending, by the size of capital mobility cost, and by the degree of tax co-operation (tax co-ordination or tax harmonisation). The issue of tax competition is analysed here in a framework where public service and tax rates are shown in the non-co-operative equilibrium to be “too high” in the sense that a central authority could raise the nation’s welfare by requiring each country to decrease its public service output. Results demonstrate that tax competition among identical countries is welfare decreasing by showing that a uniform decrease in the profit tax rates and public services in all jurisdictions increases social welfare in each country. Welfare gains for countries are negatively affected by the size of the capital mobility cost of investing abroad. Unlike the symmetric case, results show that asymmetric preferences of jurisdictions for public services are likely to be important and should be taken into account when designing the optimal level of tax co-operation. Welfare gains from tax co-ordination among asymmetric countries are confirmed as negatively affected by the preferences of jurisdictions for public spending. The size of welfare changes
from tax co-operation is basically affected by the degree to which countries intend to co-operate with each other.

The lay out of this research is organised as follows. The model is featured in section two. Data are presented in section three. Section four is concerned with the numerical analysis of welfare gains from the inter-jurisdictional tax games. Summary and concluding remarks are provided at the end of this work.

2. The Model

Little attention has been devoted so far in public economics literature to the modelling of the inter-jurisdiction tax game under international imperfect capital mobility. These include in particular the contributions of PERSSON and TABELLINI (1992), GERARD and HADHRI (1994), BACCHETTA and ESPINOSA (1995), and HADHRI and GERARD (1995-1996). The sensitivity of welfare gains from capital income tax co-ordination to the degree of capital mobility are tested in most of these models and confirmed. Capital mobility affects substantially the sign and magnitude of fiscal externalities and the welfare effect of capital income tax rates. This is in line with results suggested in GRUBERT and MUTTI (1985), and EICHENGREEN and GOULDER (1989). In all these works the admission of international capital mobility dramatically alters the manner in which capital taxes influence the economy in comparison with their effects in a closed economy.

A two-stage and two-country model is used with one private good produced by firms at the second stage. We consider two identical countries linked by imperfect capital mobility, referred to respectively as the home country and the foreign one. Firms have to decide about domestic and foreign investment with a view to maximising their profits net of all taxes. The demand facing these firms is linear in each country. Each market consists of two firms producing a differentiated product, and the representative consumer has to purchase on the home market from either the home firm or the foreign one. Each country has a jurisdiction that chooses under the pure source principle the optimal tax rate levied on profits of firms to maximise social welfare. According to the pure source principle, the profit of each firm is taxed only in the country where it is earned. Firms are not domestically taxed on their profits earned abroad, and no crediting
of taxes is paid abroad by firms. Furthermore, each jurisdiction is assumed not to discriminate between firms, which means that foreign firms are taxed by the home jurisdiction at the same rate as home firms on profits originating from the home country.

The welfare function of each country is specified as a function of the consumer surplus, the net profit of its representative firm, and the profit tax revenues used to finance the provision of public services. Welfare gains from the inter-jurisdictional profit tax game are modelled by means of a two-stage game where imperfect competition between home and foreign firms is assumed to take place at the second stage. Fiscal equilibria are to be solved by backward induction. We start first by calculating the second stage Nash equilibrium when firms behave non-cooperatively.

2-1. Imperfect Competition among Firms

A very simplistic structure is used in the model to analyse how the inter-jurisdictional profit tax game affects the behaviour of the non-competitive firm in each market. Each firm is assumed not to co-operate in order to maximise the net profit earned domestically and abroad, taking into account the behaviour of its competing firm, the structure of demand in each market, the total production cost and the net mobility cost of investing abroad. Moreover, each firm is assumed to exhibit a relatively high preference for its domestic market even if the tax rate levied abroad is higher compared with the domestic one.

Firms are assumed to have constant marginal cost, $c$ We refer henceforth to the home firm and the foreign one respectively as firm $i$ and $j$. Since the two economies are assumed to be identical, only a description of the domestic economy is necessary. The home market consists of the firm $i$ and the firm $j$ each producing a differentiated product, and the consumer has to purchase on the home market from either the home firm at price $p_i$ or the foreign firm at price $\bar{p}_j$. Firms behave as Cournot duopolists producing a differentiated product (in each market). Each country has one representative firm endowed with one unit of capital. Some part of this capital ($\alpha_i$) can be physically invested domestically, the rest ($1 - \alpha_i$) being invested abroad. The variable $\alpha_i$ is interpreted as in SPENCE (1977-1979), and DIXIT (1979-1980) as the level of capi-
tal to invest or as a quantity produced by firm i.

The demand function facing these firms is linear, namely:

\[ p_i = a - b\alpha_i - d(1 - \alpha_j), \quad \text{and} \quad \bar{p}_j = a - b(1 - \alpha_j) - d\alpha_i \quad a, b, d > 0; \quad b \geq d \]

Since \( d > 0 \) products are substitutes and since \( b \geq d \) "cross effects" are dominated by "own". The closer the coefficients \( b \) and \( d \) are to each other, the less differentiated the two are.

The profit to firm i from investing at home is defined as:

\[ \pi_i = \left[ a - b\alpha_i - d(1 - \alpha_j) - c \right] \alpha_i \]

There are additional costs born by a firm when it invests abroad. One way to model the imperfect capital mobility across countries is to use the net mobility costs function of investing abroad pioneered by PERSSON and TABELLINI (1992), and used in a more explicit way in HADHRI and GERARD (1996). We refer to the capital mobility costs of investing abroad as the extra complication that foreign direct investment requires compared with domestic investment (it can represent for example, the cost of gathering extra information about legal issues or about marketing, of overcoming country-specific regulations, of hiring foreign employees, and so on. But it can also represent the benefits of foreign investment closer to the market, or of foreign control).

The profit to firm i from investing in the foreign country is:

\[ \bar{\pi}_i = \left[ a - b(1 - \alpha_i) - d\alpha_j - c \right] (1 - \alpha_i) - \eta_i, \quad \eta_i = (\mu / 2) (\alpha^H_0 - \alpha_i)^2 \]

with\(^3\)

\[ c + d \leq a \leq 2b + c + \mu \min(\alpha^H_0, \alpha^F_0) \]

where \( \eta_i \) stands for the net mobility costs function. The parameter \( \mu \) measures the size of mobility costs and \( \alpha^H_0 \) is the preference of firms devoted to domestic investment \((\alpha^H_0 > 1/2)\). Let us define \( m^H \) and \( m^F \) as the profit tax rate levied

\(^3\) The results of the Nash equilibria derived in the model are consistent with that assumption.
respectively at home and abroad, the net-of-tax profit of firm $i$ is:

$$
\pi^H = (1-m^H)\pi_i(\alpha_i,1-\alpha_j) + (1-m^F)\pi_i(1-\alpha_i,\alpha_j)
$$

Firm $i$ has to determine how much to invest at home, $\alpha_i$ in order to maximise the net profit $\pi^H$, taking as given the amount of capital invested by firm $j$, $\alpha_j^*$ and the values of tax rates $(m^H,m^F)$ chosen by jurisdictions at the first stage. When deciding its allocation of capital endowment, each country’s firm takes into account those mobility costs, the profit rates at home and abroad, and also the capital allocation of the other country’s firm (there is a Nash equilibrium in the capital allocations of the two countries’ firms). When repatriated, profits are not taxed a second time.

The profit functions are specified in a similar way to the reduced-form profit functions specified in TIROLE (1990, p. 315) and that come from the short-term product-market competition with given capacities. The type of this game is well known in the literature on industrial organisation as a capacity constrained quantity game when firms compete with each other according to the Cournot approach. The profit functions have two properties: First, each firm dislikes capital investment by the other competing firm in the two markets. Second, each firm’s marginal value of capital decreases with the other firm’s capital level. The capital levels are therefore strategic substitutes.

The profit maximisation problem of firm $i$ is stated as:

$$
\text{Max } \pi^H(\alpha_i,\alpha_j^*,m^H,m^F) < \alpha_i >
$$

Solving that maximisation entails the home reaction function:

$$
\alpha_i^* = (e_j^*/e^H)\alpha_j^* + (e_0^H/e^H)
$$

where $e^H$, $e_0^H$ and $e_j$ are functions of $m^H$ and $m^F$ and calculated as:

$$
e^H = 2b(1-m^H) + (2b+\mu)(1-m^F) \geq 0,
$$

$$
e_j = d(1-m^H) + d(1-m^F) \geq 0,
$$

$$
e_0^H = (a-c-d)(1-m^H) + (2b+c-a+\mu\alpha_0^H)(1-m^F)
$$
The reaction function is linear and positively sloped. Similarly we get for the foreign firm:

\[ \alpha_{j}^{*} = \left( e_{1}/e^{F} \right) \alpha_{i}^{*} + \left( e_{0}^{F}/e^{F} \right) \]

where \( e^{F} \) and \( e_{0}^{F} \) are symmetrically defined as:

\[
e^{F} = 2b(1-m^{F}) + (2b+\mu)(1-m^{H}) \geq 0,
\]

\[
e_{0}^{F} = (a-c-d)(1-m^{F}) + (2b+c-a+\mu\alpha_{0}^{F})(1-m^{H})
\]

Solving the above system yields the second stage Nash equilibrium as:

\[
(8) \quad \alpha_{i}^{*}(m^{H}, m^{F}) = \frac{e_{1}e_{0}^{F} + e_{0}^{H}e^{F}}{e^{H}e^{F} - e_{1}^{2}} \quad \text{and} \quad \alpha_{j}^{*}(m^{H}, m^{F}) = \frac{e_{1}e_{0}^{H} + e_{0}^{F}e^{H}}{e^{H}e^{F} - e_{1}^{2}}
\]

We obtain therefore,

\[
(9) \quad \frac{\partial \alpha_{i}^{*}}{\partial m^{F}} = \left( e^{H}e^{F} - e_{1}^{2} \right)^{-1} l_{iH}^{*} \quad \text{and} \quad \frac{\partial \alpha_{j}^{*}}{\partial m^{H}} = \left( e^{H}e^{F} - e_{1}^{2} \right)^{-1} l_{jH}^{*}
\]

where

\[
l_{iH}^{*} = \left( 2be^{F} - 2de_{1} + (2b+\mu)e^{H} \right) \alpha_{i}^{*} - de_{0}^{F} + (c + d - a)e^{F} - (2b+\mu)e_{0}^{H} - e_{1}(2b+c+\mu\alpha_{0}^{F} - a)
\]

and

\[
l_{jH}^{*} = \left( 2be^{F} - 2de_{1} + (2b+\mu)e^{H} \right) \alpha_{j}^{*} - de_{0}^{H} + (c + d - a)e_{1} - 2be_{0}^{F} - e^{H}(2b+c+\mu\alpha_{0}^{H} - a)
\]

A key question is to investigate how raising the profit tax rate by the home jurisdiction will reduce the domestic profit of firm i, when the foreign tax rate is taken as given:
\[
\frac{\partial \pi^*_i}{\partial m^F} = \left( \frac{\partial \pi_i}{\partial \alpha_i} + \frac{\partial \pi_i}{\partial p_i} \frac{\partial p_i}{\partial \alpha_i} \right) \frac{\partial \alpha^*_i}{\partial m^H} + \left( \frac{\partial \pi_i}{\partial p_i} \frac{\partial p_i}{\partial \alpha_i} \right) \frac{\partial \alpha^*_i}{\partial m^H} \leq 0
\]

where
\[
\frac{\partial \pi_i}{\partial \alpha_i} = p_i - c \geq 0, \quad \frac{\partial \pi_i}{\partial p_i} \frac{\partial p_i}{\partial \alpha_i} = -b \alpha_i < 0, \quad \text{and} \quad \frac{\partial \pi_i}{\partial p_i} \frac{\partial p_i}{\partial \alpha_j} = d \alpha_i > 0
\]

Equation (10) shows that there are three effects to be analysed. The first term on the right hand side is positive and it represents the \textit{direct} effect of \(\alpha_i\) on \(\pi_i\) at the initial price, \(p_i\). The second term stands for the \textit{"own" price effect}. That effect is negative; an increase in the capital invested domestically by firm \(i\) will reduce the price charged by this firm in the home market and decreases therefore its profit earned domestically. The last term stands for the \textit{"cross" price effect} which is positive through the response of \(p_i\) to an increase in \(\alpha_j\).

The curve that relates \(\pi^*_i\) and \(\alpha^*_i\) is composed of two parts. The first one on the left hand side corresponds to the interval (case 1) in which \(\alpha_i\) and \(\pi_i\) move in the same direction. Thus, increasing the home tax will reduce both \(\alpha_i\) and \(\pi_i\). The second part of this curve corresponds to the \textit{negatively sloped section} where \(\alpha_i\) and \(\pi_i\) move in the opposite way. The main feature of this curve is to illustrate that when \(\alpha_i\) is very low (\(\alpha_i \leq \alpha_1\)) an increase in the profit tax rate, \(m^H\) will induce the firm \(i\) to invest less in its own country, \(\alpha_i\) which in turn reduces its domestic profit, \(\pi_i\). This means that the \textit{"own" price effect} (negative) is dominated by the direct effect (positive):

\[
\frac{d\pi_i}{d\alpha_i} \geq 0 \quad \text{for} \quad 0 \leq \alpha_i^* \leq \alpha_1
\]

where \(\alpha_1\) is the value from which an increase in \(\alpha_i\) will reduce \(\pi_i\):.

\[
\alpha_1 = \frac{d\alpha_j^* + a - (c + d)}{2b}
\]
The Domestic Profit Curve

In contrast, when $\alpha_i$ is high enough ($\alpha_i > \alpha_i^*$) an increase in $m^H_i$ will increase $\alpha_i$ and reduces therefore both $p_i$ and $\pi_i$. In fact, the reduction in $p_i$ could be so large that the profit generated from domestic investment decreases. This situation corresponds to the interval (case 2) in which $\alpha_i$ and $\pi_i$ move in the opposite way. This involves:

\[
\frac{d\pi_i}{d\alpha_i} < 0 \quad \text{for} \quad \alpha_i < \alpha_i^* \leq 2\alpha_i
\]

2-2. Inter-jurisdictional Corporate Tax Game

Each country has a jurisdiction that chooses under the pure source principle the optimal tax rate levied on firms on their profits domestically earned to maximise social welfare of its residents. Total welfare to one jurisdiction is defined in a similar way to GIBBONS (1992, p.75-79) as a function of the consumers’ surplus enjoyed by its own consumer, the world-wide net profit earned by its

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4 The model analysed in Gibbons is an application from international economics. Two identical countries are considered in his model. Each country has a government that chooses a tariff rate, a firm that produces output for both consumption and export, and consumers who buy on the home market from either the home firm or the foreign firm. The firms also incur tariff costs on exports. A two-stage game of complete and imperfect information is examined where total welfare for one country is specified as the sum of the consumers’ surplus, the profit earned by its own firms, and the tariff revenue collected by its government.
own firm, and the profit tax revenue collected by this jurisdiction from taxing profits of firms at source (see Appendix). Since debt policy is not considered, the provision of public services is assumed to be totally financed by the profit tax rate. That is,

\[ W^H = \left( \gamma_c^{1-\rho} CS^H + \gamma_\pi^{1-\rho} \pi^H + \gamma_g^{1-\rho} G^H \right)^{(1/\rho)}, \quad \rho = (\sigma - 1)/\sigma \]

where

\[ CS^H = (p_i + \bar{p}_j) \left[ 1 + (1/2)(\bar{b} + \bar{d})(\bar{p}_j - p_i) \right] \quad \text{and} \quad G^H = m^H (\pi_i + \bar{\pi}_j) \]

The social welfare function is allowed to vary from one country to another to reflect as well as possible the relative importance accorded by each government to its own consumer and firm as well as to the public sector activity. The parameters \( \gamma_c^I, \gamma_\pi^I \) and \( \gamma_g^I \) stand respectively for the preference of the jurisdiction for the consumers’ surplus, the net profit of its own firm, and the public consumption. The incorporation of «taste» parameters in the model is as important for the inter-jurisdictional tax game since it allows the analysis of welfare gains from tax competition and tax co-ordination when jurisdictions exhibit asymmetric preferences.

2-2-1. Corporate Tax Competition

The issue of tax competition and tax co-ordination among jurisdictions has always been important and is drawing attention. The inter-jurisdictional non-cooperative tax game is modelled here by means of a two-stage game in which jurisdictions and firms are assumed to choose their actions independently and simultaneously at each stage. At the first stage, each jurisdiction has to determine optimally the profit tax rate with a view to maximising the social welfare of its residents, taking as given the profit tax rate levied by the other competing jurisdiction. Competition among jurisdictions will lead to the Nash equilibrium in the profit tax rates. We assume that it is not feasible to change the value of tax rates at the beginning of the second stage. Imperfect competition among firms will lead to the Cournot equilibrium, which is a function of the profit tax rates. Payoffs of that game are the welfare of each jurisdiction, and the non-cooperative fiscal equilibrium has to be solved by backwards induction. (N-C) and (C-C) are referred to respectively as the Nash and co-operative equilibria when firms behave according to the Cournot Competition.
The problem of the home jurisdiction is,

\[
\text{Max } W^H[m^H, m^F, \alpha_i^*(m^H, m^F), \alpha_j^*(m^H, m^F)]
\]

\[< m^H >\]

(15)

The first order condition of that maximisation w.r.t. \(m^H\) can be stated as,

\[
\frac{\partial W^F}{\partial m^F} + \frac{\partial W^F}{\partial \alpha_j} \frac{d\alpha_j^*}{dm^H} + \frac{\partial W^F}{\partial \alpha_i} \frac{d\alpha_i^*}{dm^H} = 0
\]

(16)

By symmetry, the first order condition for the foreign country is,

\[
\frac{\partial W^F}{\partial m^F} + \frac{\partial W^F}{\partial \alpha_j} \frac{d\alpha_j^*}{dm^F} + \frac{\partial W^F}{\partial \alpha_i} \frac{d\alpha_i^*}{dm^F} = 0
\]

(17)

As shown above, Nash equilibrium in tax rates (N-C) is found by maximising the social welfare of residents with respect to the profit tax rate, setting the first derivative equal to zero. Each jurisdiction has to choose its own tax rate taking into consideration both direct and strategic effects. Solving the two optimal tax rules expressed in (16) and (17) involves the N-C equilibrium in tax rates \(m^H^*\) and \(m^F^*\).

Three effects are to be considered regarding the optimal tax rule in each country: the direct welfare effect, the “own” strategic welfare effect, and the “cross” strategic welfare effect. The first term of (16) stands for the direct welfare effect stemming from the impact of \(m^H\) on social welfare, at the initial value of capital invested by each firm (home and foreign). That effect is likely to be negative and it is equal to the direct corporate effect, (negative) and the direct public effect, (positive). No direct gain can be generated therefore for the home jurisdiction from taxing firms on their profits:

\[
\frac{\partial W^H}{\partial m^H} \equiv - \frac{\partial W^H}{\partial \pi} \pi_i + \frac{\partial W^H}{\partial G^H} (\pi_i + \pi_j) \leq 0
\]

(18)
The second term is referred to as the “own” strategic welfare effect originating from the indirect impact of the home profit tax rate on social welfare through the response of $\alpha_i^*$ to an increase in $m^H$. An increase in the home tax rate changes the amount of capital invested domestically by firm $i$, and affects therefore social welfare in the home country. That effect can be broken down as follows:

$$
\frac{\partial W^H}{\partial \alpha_i} \frac{d\alpha_i^*}{dm^H} = \left( \frac{\partial W^H}{\partial CS^H} \frac{\partial CS^H}{\partial \alpha_i} + \frac{\partial W^H}{\partial \pi^H} \frac{\partial \pi^H}{\partial \alpha_i} + \frac{\partial W^H}{\partial G^H} \frac{\partial G^H}{\partial \alpha_i} \right) \frac{d\alpha_i^*}{dm^H}
$$

(19)

The first term on the right hand side of (19) represents the "own" strategic private effect stemming from the indirect effect of $m^H$ on the private consumption of residents. That effect is non-negative, as private consumption depends positively on $\alpha_i$. The second term stands for the "own" strategic corporate effect induced from the impact of $m^H$ on the world-wide profit of firm $i$ net of all taxes. That effect is equal to zero from the second stage optimisation, i.e. by the envelope theorem, the effect of a change in $\alpha_i$ on $\pi^H$ is second order. The last term of (19) is the "own" strategic public (or revenue) effect generated from the indirect impact of $m^H$ on the home jurisdiction's tax revenue.

We turn now to the last term of (16) referred to as the "cross" strategic welfare effect stemming from the indirect impact of the home profit tax on social welfare via the response of the optimal choice of firm $j$, $\alpha_j^*$, to an increase in $m^H$. That effect can be broken down as the sum of the three following effects: a "cross" strategic private effect, a "cross" strategic corporate effect and a "cross" strategic public effect:

$$
\frac{\partial W^H}{\partial \alpha_j} \frac{d\alpha_j^*}{dm^H} = \left( \frac{\partial W^H}{\partial CS^H} \frac{\partial CS^H}{\partial \alpha_j} + \frac{\partial W^H}{\partial \pi^H} \frac{\partial \pi^H}{\partial \alpha_j} + \frac{\partial W^H}{\partial G^H} \frac{\partial G^H}{\partial \alpha_j} \right) \frac{d\alpha_j^*}{dm^H}
$$

(20)
2-2-2. Tax Co-ordination Versus Tax Harmonisation

Tax co-ordination has always been analysed using the game theory concept of the co-operative equilibrium. Welfare gains from tax co-ordination has became the subject of major theoretical and practical interest in recent times. A co-operative tax game is formulated by means of a two-stage game model where the second stage is modelled in the same way as in the non-cooperative equilibrium. In contrast, the first stage is specified as a situation where a central tax authority has to choose the profit tax rates in the two countries to maximise social welfare of the collectivity specified in (21).

The timing of the co-operative fiscal game is as follows. First, profit tax rates are to be selected optimally by the central government to maximise welfare of the collectivity taking into account the spill-over effects of tax rates. Second, the firms observe the tax rates and determine simultaneously and independently their optimal choices to maximise their profits. Third, payoffs are welfare of each jurisdiction. The co-operative fiscal equilibrium has to be solved by backward induction.

The co-operative equilibrium tax rates are to be found by solving (21) where $g_h$ stands for the central tax authority's preference for the welfare of the home country.

\[
Max \quad W = \left( g_h^{(1-p)} \ W^H + (1 - g_h)^{(1-p)} \ W^F \right)^{(1/p)}
\]

\[< m^H, m^F > \]

(21)

Tax harmonisation is a particular case of tax co-ordination. It is formulated in this model, as often used in the literature, as a situation where the co-operative tax game will result in a uniform profit tax rate, ($m^H = m^F$). Firms are taxed therefore at the same rate regardless of the country where profit is earned. If the two countries are totally identical, then, tax harmonisation and tax co-ordination yield the same outcome. Fiscal equilibrium when jurisdictions harmonise their profit tax rates has to be solved as:

\[
m^* = Argmax_W \left( m, \alpha_i^*(m), \alpha_j^*(m) \right)
\]

(22)
The issue of tax harmonisation versus tax co-ordination is widely discussed in the literature. Notably the papers of WILDASIN (1992), CNOSSEN (1990), and TANZI and BOVENBERG (1989). Several factors make the harmonisation process too difficult to realise. Some of them are strictly administrative. Others are due to political and cultural barriers. Two key questions are examined in the literature. Is there a need for harmonisation of tax policies within the European Union? If so, in what respects would harmonisation be most advantageous?

Some economists suggest that explicit co-ordination of policy is unnecessary and that governments themselves will make the proper adjustments to policy when confronted with open borders. Whatever degree of the convergence of the European tax systems can be achieved through the free play of market forces.\(^5\) Other economists including WILDASIN (1992) show that tax rates are not necessarily too high or too low overall; they are simply too different. Fiscal externalities associated with mobility factors suggest that some types of co-ordination could be beneficial.\(^6\)

3. Data

Since the co-operative and non co-operative fiscal equilibria are too difficult to be solved analytically, only numerical solutions are provided and compared to each other by means of the GAMS programme [see, e.g. BROOKE and MEESAUS (1988)]. The parameters of the model must be assigned numerical values. Some of them are chosen by reference to economic studies. Notably, the

---

\(^5\) Tax diversity between countries represents the different consumers’ preferences which reflect the economic and social structures, different perceptions on the role of taxation, and perhaps differences in preferences for the public sector among countries. In fact, the crucial question is not how the various taxes can be equated (harmonised) but on the contrary, how much tax diversity can be permitted without interfering with the establishment of the European Common Market and, further down the road, a Monetary Union. Tax harmonisation is thus not necessary. In fact, taxes which are assumed to be equated on paper can be widely diverging in practice.

\(^6\) This kind of argument often leads to suggestions for tax harmonisation, i.e. a move toward greater uniformity in capital taxation. The social cost of an inadequate or non-co-ordination of tax policies is limited as tax diversity is reduced. Too little co-ordination might lead to unrestrained tax competition. On the other hand, the overestimated tax co-ordination will lead to an undesirable degree of tax harmonisation [see CNOSSEN (1990)].
preference of each firm for domestic investment which is set to 60% by analogy to the value used by THALMANN, DELORME and GOULDER (1996). The evidence on this parameter is scarce. As mentioned in BETTENDORF (1996), FRENCH and POTERBA (1991) estimate that the percentage of equity portfolio invested in domestic firms is 98% for Japan, 94% for the U.S., and 82% for the U.K. in December 1989. This parameter is set to 70% in BETTENDORF.

Tax rate is set here to 50% by analogy to the cross-country estimates of tax rate provided in MENDOZA, RAZIN and TESAR (1994, table 5)'s work where the average tax rate is reported from 24% to 56% in the U.K.

**TABLE 1**

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Notation</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>$a$</td>
<td>2.00</td>
</tr>
<tr>
<td>Direct preference</td>
<td>$b$</td>
<td>2.00</td>
</tr>
<tr>
<td>Indirect preference</td>
<td>$d$</td>
<td>1.00</td>
</tr>
<tr>
<td>Constant Marginal cost</td>
<td>$c$</td>
<td>0.10</td>
</tr>
<tr>
<td>Preference for domestic investment</td>
<td>$\alpha \theta$</td>
<td>0.60</td>
</tr>
<tr>
<td>International Mobility Cost</td>
<td>$\mu$</td>
<td>0.25</td>
</tr>
<tr>
<td>Profit tax rate</td>
<td>$m$</td>
<td>0.50</td>
</tr>
<tr>
<td>Preference for the consumer</td>
<td>$\gamma c$</td>
<td>1/3</td>
</tr>
<tr>
<td>Preference for the firm</td>
<td>$\gamma \pi$</td>
<td>1/3</td>
</tr>
<tr>
<td>Preference for public consumption</td>
<td>$\gamma g$</td>
<td>1/3</td>
</tr>
<tr>
<td>Elasticity of substitution</td>
<td>$\sigma$</td>
<td>1.20</td>
</tr>
<tr>
<td>Preference for the home country</td>
<td>$gh$</td>
<td>0.50</td>
</tr>
</tbody>
</table>

The parameter stands for the size of the capital mobility costs derived from BACCHETTA and ESPINOSA (1995), and the elasticity of substitution, set numerically on the basis of the excellent survey provided in AUERBACH and KOLITKOFF (1987). The other parameters are selected using reasonable values.
4. Optimal Policies

We analyse first whether fiscal externalities are likely to be important and which parameters have the largest impact on the results. Second we focus on the numerical analysis of fiscal equilibria when countries move away from the non-cooperative equilibrium to the co-operative equilibrium.

4-1. Fiscal Externalities

The interest of this subsection is to examine the following questions. Does the taxation of profits of firms in one country harm welfare in the other country? Are the results of fiscal externalities sensitive to the strategic behaviour of firms, to the preference of the home firm for the domestic market, and to the size of the capital mobility costs of investing abroad? To this end, we consider the case where the home jurisdiction chooses optimally the home tax rate to maximise social welfare, taking as given the foreign tax rate. The optimal decision of the home jurisdiction is referred to as the best response (or reply) with a given tax rate in the foreign country. We see therefore what happens in the two economies.

The so-called «initial situation» is numerically computed as a case where tax rates in the two countries are set to their initial values of 50%; each firm is assumed to choose optimally its investment. Nash equilibrium in the second stage is computed according to (8). The Column «Changes %» in table 2 reveals what happens in each country when the home jurisdiction takes the best solution compared with the «Initial» situation. The column «Best Reply» shows for example that the best response of the home jurisdiction induces an increase of 37.4% of the profit tax rate (a change from 0.50 to 0.687). Social welfare in that country is improved by 2.7%. Finally, the last two columns in table 2 stand for fiscal externalities in the foreign country. As mentioned in table 2, an increase in the home tax rate is likely to reduce social welfare in the foreign country by 5.5%.
### Table 2

**Cournot Case**

<table>
<thead>
<tr>
<th>Key Variables</th>
<th>Home Country</th>
<th>Foreign Country</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Best Reply</td>
<td>Changes (%)</td>
</tr>
<tr>
<td>Profit tax rate</td>
<td>0.687</td>
<td>37.4</td>
</tr>
<tr>
<td>Domestic investment</td>
<td>0.531</td>
<td>5.35</td>
</tr>
<tr>
<td>Domestic price</td>
<td>0.414</td>
<td>-16.53</td>
</tr>
<tr>
<td>Domestic profit</td>
<td>0.167</td>
<td>-16.8</td>
</tr>
<tr>
<td>Foreign price</td>
<td>0.586</td>
<td>16.26</td>
</tr>
<tr>
<td>Foreign profit</td>
<td>0.227</td>
<td>14.1</td>
</tr>
<tr>
<td>Total profit</td>
<td>0.166</td>
<td>-16.8</td>
</tr>
<tr>
<td>Consumer surplus</td>
<td>0.556</td>
<td>11.3</td>
</tr>
<tr>
<td>Public consumption</td>
<td>0.229</td>
<td>14.8</td>
</tr>
<tr>
<td>Social welfare</td>
<td>0.853</td>
<td>2.70</td>
</tr>
</tbody>
</table>

A higher tax rate in one country will have a negative long-term welfare effect on the other country. The main reason is that increasing the tax rate by the home jurisdiction is likely to reduce the profit of firms (home and foreign) via the reduction in domestic prices. Normally, it would seem likely that an increase in the tax rate in the home country would cause both firms to invest more in the foreign country. Such an increase might decrease both the consumer surplus in the home country, and the home firm’s profits. But the present case corresponds to the «negatively sloped» situation explained in (13), in which this latter effect is offset by some strategic effects. Investment and profit move therefore in the opposite direction. As revealed in table 2, an increase in the home tax increases domestic investment and therefore causes a reduction in domestic prices. The reduction in prices could be so large that the firms’ domestically-earned profit might decrease. Consumer surplus in the home country is improved via the increase in domestic investment to the detriment of foreign consumers.

Raising the home tax is likely to increase private consumption and the provision of public spending but reduces the net profit of firms. Such a policy induces firms to earn more profit in the foreign market than in the home one. Although public spending is raised in the two countries, welfare in the foreign country is reduced due basically to the “strategic” private and corporate effects of the higher tax in the home country. Results show that the corporate and public activities are likely to have the largest impact on the sign of fiscal externalities and
welfare changes in the two countries. Furthermore, the strategic corporate effects are largely dominated by the negative direct effect. First higher taxes involve a higher tax burden. Second, the public effect is principally affected by the direct effect, which is positive: the higher tax rate generates more tax revenue for the government and improves welfare through the increased public consumption.

Fiscal externalities are likely to decrease when the size of the capital mobility cost from investing abroad increases. As specified above, a higher value of capital mobility cost induces firms to invest more at home than abroad. Moreover, fiscal externalities are less important when the preference of the home firm for its country is higher. Due to the negative fiscal externality, both countries can make a long-term welfare gain by engaging in a co-ordinated reduction of their public budgets, if they move away from a non-cooperative policy equilibrium.

4-2. Fiscal Equilibria

We show first how social welfare of each country can be improved from tax co-operation when countries move away from the non-cooperative equilibrium. Fiscal equilibria are numerically computed and compared with each other. Second we examine how welfare effects of tax co-operation can be affected compared with tax competition by asymmetric preferences of jurisdictions, capital mobility costs, and by the degree of tax co-operation (tax co-ordination or tax harmonisation).

4-2-1. Symmetric Jurisdictions

The fiscal externalities illustrated above and associated with imperfect competition and capital mobility suggest that tax co-ordination between symmetric jurisdictions may be beneficial. A tentative investigation is carried out to see whether it is welfare improving for each jurisdiction to co-ordinate its profit tax policy with the other jurisdiction compared with tax competition. Second, is the co-operative equilibrium tax rate (C-C) higher or lower than the non-cooperative one (N-C)? And to what degree can capital mobility cost affect the tax rate and social welfare in the non-cooperative and co-operative fiscal equilibria?
TABLE 3
Symmetric Fiscal Equilibria

<table>
<thead>
<tr>
<th></th>
<th>Low Mobility Cost, $\mu = 0.25$</th>
<th>High Mobility Cost, $\mu = 4$</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Profit tax rate</strong></td>
<td>0.663</td>
<td>0.500</td>
</tr>
<tr>
<td><strong>Total profit</strong></td>
<td>0.134</td>
<td>0.199</td>
</tr>
<tr>
<td><strong>Public consump</strong></td>
<td>0.264</td>
<td>0.199</td>
</tr>
<tr>
<td><strong>Social welfare</strong></td>
<td>0.806</td>
<td>0.830</td>
</tr>
</tbody>
</table>

The results show that, in the case of identical countries (a perfectly symmetric environment) the profit tax rates and public spending are lower under co-operation than under non-co-operation. In the non co-operative case, tax rates and public spending are higher as each jurisdiction ignores the negative externalities of their tax policies upon changes in consumers' surplus abroad. Under the co-operative case, such externalities are internalised, which means that each jurisdiction takes into account the negative «welfare effect» of the higher tax rate on the other jurisdiction. The policy makers reduce the profit tax rates to improve the social welfare of both countries. A lower tax rate will lead to smaller tax bases and higher world-wide profits of the firms in the two countries compared with the non co-operative case. Each country will be better-off by undertaking a co-ordinated symmetric decrease in public services financed by a lower profit tax rate with the other country.

The size of the capital mobility cost is likely to generate a small effect on the magnitude of welfare gains in the two countries. Welfare gains from tax co-operation are negatively affected by the size of the capital mobility cost of investing abroad for firms. A higher degree of mobility cost is likely to reduce the incentives of firms for investing abroad due to a change in the home tax rates. Fiscal externalities induced by tax competition tend to be reduced when the capital mobility cost is increased.

---

$^7$ Co-op/Nash stands for the relative changes of the co-ordinated solution to the Nash one (%) (for instance, -24.6 % means a decrease from 0.663 to 0.5).
4-2-2. Asymmetric Jurisdictions

The traditional literature on tax competition shows that non co-operative behaviour of jurisdictions will lead to inefficient low tax rates and levels of public spending [see WILSON (1986) and ZODROW and MIESKOWSKI (1986)]. Many of these works analyse the issue of tax competition in the ‘purely competitive’ case where the number of symmetric jurisdictions is large. A number of recent studies departed from the framework of pure and symmetric competition to examine the inter-jurisdictional tax game in a small-number and asymmetric context where strategic interactions between jurisdictions cannot be ignored and when countries are not identical. These include contributions by BUCOVETSKY (1991), CREMER and PESTIEAU (1995), and recently by LOPEZ, MARCHAND and PESTIEAU (1996), HAUFLER (1996), EGGERT and HAUFLER (1996), and HADHRI (1997b).

BUCOVETSKY (1991) analyses the inter-jurisdictional capital income tax competition in a two-country model in which capital is internationally perfectly mobile (but fixed in supply nationally), and jurisdictions are identical in every respect except for their populations. CREMER and PESTIEAU (1995) extend the literature on tax competition by means of a two-country model as a situation where each jurisdiction competes for the value of subsidy taking into account the foreign subsidy level which influences the migration equilibrium. Asymmetry is incorporated into their framework through the difference between countries in terms of the government’s aversion to income inequality (reflected by the concavity of the utility function). Asymmetry is recently modelled in LOPEZ, MARCHAND and PESTIEAU (1996) by means of a simplified model of two-class economies where countries are assumed to be heterogeneous in terms of preferences for equity, population size, and social composition. Three experiments are simulated by means of numerical illustrations to analyse how the two countries interact at the Nash equilibrium.

In addition, HAUFLER (1996) analyses the effects of commodity tax competition and tax co-ordination in a simple trade model which captures the essential elements of cross-border shopping. Her analysis is focused on tax co-ordination when optimal tax rates differ across countries due to different preferences for public goods. Finally, EGGERT and HAUFLER (1996) consider a static model of two countries which are identical in all respects except for population size. They study the conditions under which the smaller of two otherwise identical
countries prefers the non-cooperative Nash equilibrium to a situation of fully harmonised tax rates. A standard two-country model of capital tax competition is used allowing for the following extensions, (i) transaction costs, (ii) additional countries, and (iii) additional tax instruments.

Unlike these works, the present model attempts to extend the inter-jurisdictional tax game literature in different directions. The present experiment is concerned with analysis of the inter-jurisdictional tax game when countries are identical in every respect except for their choices of public policy. Both co-operative and non co-operative equilibria are expected to result in the different levels of tax rates due to asymmetric preferences of jurisdictions for public spending. The welfare gains from tax co-operation are mainly affected by the sign and magnitude of the asymmetric preferences.

**TABLE 4A**

**The Home Country: Cournot Case**

<table>
<thead>
<tr>
<th>Key Variables</th>
<th>Nash Sol.</th>
<th>Co-op. Sol.</th>
<th>Co-op / Nash</th>
<th>Harm / Nash</th>
</tr>
</thead>
<tbody>
<tr>
<td>Profit tax rate</td>
<td>0.387</td>
<td>0.234</td>
<td>-39.5</td>
<td>0.40</td>
</tr>
<tr>
<td>Domestic invest</td>
<td>0.464</td>
<td>0.480</td>
<td>3.40</td>
<td>8.60</td>
</tr>
<tr>
<td>Domestic profit</td>
<td>0.239</td>
<td>0.225</td>
<td>-5.90</td>
<td>-16.5</td>
</tr>
<tr>
<td>Foreign profit</td>
<td>0.150</td>
<td>0.170</td>
<td>13.4</td>
<td>32.5</td>
</tr>
<tr>
<td>Total profit</td>
<td>0.193</td>
<td>0.259</td>
<td>34.2</td>
<td>26.5</td>
</tr>
<tr>
<td>Consum. surplus</td>
<td>0.424</td>
<td>0.453</td>
<td>6.80</td>
<td>17.9</td>
</tr>
<tr>
<td>Public Consump</td>
<td>0.185</td>
<td>0.105</td>
<td>-43.1</td>
<td>-16.1</td>
</tr>
<tr>
<td>Social Welfare</td>
<td>0.201</td>
<td>0.216</td>
<td>7.30</td>
<td>15.6</td>
</tr>
</tbody>
</table>

---

Harm/Nash stands for the relative changes of the tax harmonisation solution to the Nash one (%).
Asymmetry is incorporated in the model by considering that the home jurisdiction exhibits a lower preference for the public consumption compared with the foreign country. The interest of this experiment is to analyse whether asymmetric preferences of jurisdictions for public spending are important for the sign and magnitude of welfare changes stemming from the co-operative tax game. Fiscal equilibria are numerically computed by setting, \( \gamma_c^* = (1/3) \gamma_c^f \) \(^9\).

The present experiment shows that asymmetric preferences for public spending are likely to imply differences in the magnitude of the following effects: (i) the “direct” public effect stemming from the impact of the profit tax rate on public spending and hence on welfare at the initial value of capital determined by firms in each country (see 18); (ii) the “own” strategic public effect generated from the impact of the tax rate on public expenditure and welfare via the level of capital determined domestically by home firms (see 19); (iii) and the «cross» strategic public effect induced by the impact of the tax rate on public

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9 A similar experiment is carried out in HADHRI and GERARD’s (1995) model in which welfare effects of capital income tax rates are examined when jurisdictions co-operate with each other and capital is imperfectly mobile. Using a two-period general equilibrium model, results suggest that asymmetric preferences for public services have a large impact on social welfare when the degree of international capital mobility is high. However, under a low degree of capital mobility, tax co-ordination generates the reverse outcome.
spending and welfare through the level of capital decided by foreign firms in the home market (see 20). Technically speaking, differences in preferences for public spending reflect the difference between the two countries in terms of the magnitude of concavity of the social welfare function. This asymmetry implies different choices of public policy in fiscal equilibria and involves therefore tax differences.

A higher tax rate in one country is likely to increase the provision of public spending. This means that the «direct» public effect (positive) of tax rate dominates largely the “own” and “strategic” public effects. A country with a lower preference for public spending will have less incentive for increasing the tax rate than the other country. Results show that tax competition will lead to a lower tax rate and public spending in the (home) country exhibiting a weak public preference compared with the other country. The optimal tax rates differ across countries due to different preferences of jurisdictions for public spending. These different preferences involve different levels of consumer surplus, public spending, and social welfare. The world-wide profit net of all taxes is likely to be the same in the two countries.

Fiscal externalities associated with the profit taxation are reduced when countries move away from the non-cooperative equilibrium to the co-operative one. Tax co-ordination results in a lower level of tax rates and public spending and a higher level of profit of firms compared with the non-co-operative equilibrium. Both countries may be the winners of tax co-ordination, and welfare gains are stemming basically from the corporate effects: tax co-ordination introduces a cut in the provision of public consumption which is largely dominated by the higher profits of firms generated through the lower tax rates. Unlike the symmetric case, welfare cost of public consumption is lower in the country with a weak preference for public spending, and welfare gains are higher compared with the other country. A lower tax rate in the co-operative equilibrium will induce firms (home and foreign) to invest more in the home market, which in turn improves the consumers’ surplus in that country to the detriment of foreign consumers. Results of the numerical simulation correspond to the «negatively sloped situation» of the profit curve. Tax co-ordination is likely to induce firms to earn more profits in the foreign market to the detriment of the home one.

A high sensitivity of welfare effects of the profit tax rate to the degree of inter-jurisdiction tax co-operation is tested and confirmed when jurisdictions
exhibit asymmetric public preferences. The analysis shows that the inter-jurisdictional co-operative tax game allows the home country to gain much more in the case of tax harmonisation where tax uniformity is imposed compared with tax co-ordination. Welfare gains in that country increase when tax diversity in the co-operative equilibrium is reduced. By contrast, welfare cost of public spending in the foreign country is likely to increase with the degree of convergence of the international tax policies. That country will gain relatively little in terms of welfare from tax harmonisation which lead to a lower tax rate in comparison to tax co-ordination.

5. Summary and Concluding Comments

A question frequently addressed in the literature on inter-regional tax competition is whether non-cooperative tax policies necessarily imply the under-provision of public goods. According to the general conclusion of the public finance literature, if public goods are financed by equity taxes, and under non-cooperative behaviour governments fear capital out-flows, then unilaterally set tax rates may be too low to finance the optimal provision of public goods. Such works include contributions by MINTZ and TULKENS (1986), WILDASIN (1988) and WILSON (1986), who examine the implications of capital mobility for competition among fiscal authorities, usually in a framework where there are no issues of direct competition among firms in each market. Fiscal games are analysed in most of these models in a 'purely competitive' case in the sense that there is a large number of firms and, as a consequence, any single firm's policy has no direct effect on prices and demand in any other countries. In the small-number setting matters are somewhat less clear.

A different set of papers examines the scope for international co-ordination of capital income and profit taxation in a model where there exist pure profits. In particular, the works by KRELOVE (1992), APEL and DILLEN (1994), and HUIZINGA and NIJELSEN (1995-1996). These contributions are relatively simplified in the sense that the analysis of international capital income tax co-ordination did not incorporate the role of the multinational character of the firms' investment, the asymmetric preferences of jurisdictions, and the several factors that account for imperfect competition between imperfectly mobile firms. Most
of these models assume the existence of pure profits but there is no competition among firms. This omission may be potentially serious.

Unlike that literature, the present work departs from the framework of pure competition among firms to examine the scope for inter-jurisdictional tax competition and tax co-operation in a small-number context in which there exist pure profits and where strategic interactions between firms cannot be ignored. A numerical analysis is provided regarding the welfare gains from the inter-jurisdictional profit tax game under international imperfect capital mobility and imperfect competition among firms. Fiscal equilibria are computed at source by means of a two-stage game of complete and imperfect information. The key question is to examine how welfare effects of tax co-operation can be affected compared with tax competition by the asymmetric preferences of jurisdictions for public spending, the size of capital mobility cost, and the degree of tax co-operation (tax co-ordination or tax harmonisation).

Numerical simulations suggest that the main result of public finance literature dealing with inter-jurisdictional tax competition-under provision of local public goods may not be valid if we incorporate strategic interactions between non-competitive firms in each market. The question whether under-or over-provision emerges crucially depends on the intensity of imperfect competition among firms, the size of capital mobility cost, and the firm's preference devoted to domestic investment. The level of public spending stemming from tax competition is likely to be affected by the main factors influencing the sensitivity of mobility of firms to tax rates. Tax competition is analysed here in a framework where public service and tax rates are shown to be "too high" in the non-cooperative equilibrium in the sense that a central authority could raise the nation's welfare by requiring each country to decrease its public service. Results demonstrate that tax competition among identical countries is welfare decreasing by showing that a uniform decrease in the profit tax rates and public services in all jurisdictions increases social welfare in each country. Welfare gains for countries are negatively affected by the size of the capital mobility cost of investing abroad.

Unlike the symmetric case, results show that asymmetric preferences of jurisdictions are likely to be important and should be taken into account when designing the optimal level of tax co-operation. Welfare gains from tax co-ordi-
nation among asymmetric countries are confirmed as negatively affected by the preferences of jurisdictions for public services. The size of welfare changes from tax co-operation is basically affected by the degree to which countries intend to co-operate with each other. The present framework is relatively simple in the sense that it reduces the inter-jurisdictional tax game to a game between only two countries, and assumes that a source tax on profit of firms is the only instrument to finance the provision of public goods. The co-operative and non co-operative fiscal strategies are analysed by means of a two-stage game which does not explicitly take into account the utility maximisation of the representative agent. The incorporation of this factor is very important for the effects of inter-jurisdictional tax game on the international allocation of savings on the one hand and the multinational character of the firms’ investment on the other.

It would be of interest to examine in future research the issue of sustainability analysed in JENSEN (1994). The conventional method is to support co-operative outcomes as Nash equilibria through “trigger” strategies of the FRIEDMAN (1971) type: [In the macro-economic literature contributions that apply this technique include CHARI and KEHOE (1990)]. The sustainable co-operation can be formulated by analogy to JENSEN’s (1994) work as a situation where each jurisdiction maximises its own country’s welfare, taking the other country’s profit tax rate as being co-operative. The jurisdiction’s best reply is provided therefore when the other jurisdiction acts in accordance with the co-operative solution. The interest of that experiment is to analyse to what degree it is sustained for policy co-operation when countries are asymmetric. The finding of JENSEN’s (1994) model is that national heterogeneity unambiguously reduces trigger strategies’ support for policy co-operation. When countries are asymmetric, and when the bargaining power differs, the more countries differ, the harder it is to sustain for policy co-operation. This suggests that sustainable policy co-operation (in terms of public spending) is most likely to be successful among comparable countries.

A two-period and two-country framework is considered by HADHRI (1997d) to examine the scope for the co-ordination of capital income and profit taxation in a model where there exist pure profits that generally are partly foreign-owned. The interest of this research is to attempt to extend the literature on the international co-ordination of capital income taxation examined in APEL and DILLEN (1994), and HUIZINGA and NIELSEN (1996) by incorporating imperfect com-
petition among firms. Each firm (home and foreign) is assumed to be owned to some extent by the representative household of each country.

A share, of domestic firms is assumed as in HUIZINGA and NIELSEN (1996) to be owned by foreigners. This is also the share of the after-tax profits of domestic firms accruing to foreign individuals. HADHRI (1997d) studies how welfare gains generated for jurisdictions can be affected by the degree to which domestic firms are owned by foreigners when countries move away from the non co-operative fiscal equilibrium to the co-operative one. Two different assumptions of how pure profit can be taxed are examined in that model. First, pure profit is taxed away by the government. Second, it can be taxed at the same rate as returns to savings.

6. Appendix

6-1. Cournot Equilibrium

The demand functions facing firms in the home market are:

\[ p_i = a - b\alpha_i - d\alpha_j, \quad \text{and} \quad \bar{p}_j = a - b\bar{\alpha}_j - d\alpha_i \]

which may be rewritten as follows:

\[ \alpha_i = \bar{a} - \bar{b}p_i + \bar{d}\bar{p}_j, \quad \text{and} \quad \bar{\alpha}_j = \bar{a} - \bar{b}\bar{p}_j + \bar{d}p_i \quad \bar{a}, \bar{b}, \bar{d} > 0, \quad \bar{b} > \bar{a} \]

where

\[ \bar{a} = \frac{a}{b + d}, \quad \bar{b} = \frac{b}{(b - d)(b + d)}, \quad \bar{d} = \frac{d}{(b - d)(b + d)} \]

The demand functions may be rewritten as:

\[ \alpha_i = \bar{a}_i - \bar{b}p_i - \bar{d}p_j \quad \text{and} \quad \alpha_j = \bar{a}_j - \bar{b}\bar{p}_j - \bar{d}p_i \quad \bar{a}_i = \bar{a} + \bar{d}a_0 \]
6-2. Consumer's surplus

Consumer's surplus is written as follows:

\[ CS^H = \int_0^{\bar{p}_i} q^H (t_i, \bar{r}_j) dt_i + \int_0^{\bar{p}_j} q^H (t_i, \bar{r}_j) d\bar{r}_j \]

where

\[ q^H (t_i, \bar{r}_j) = \alpha_i (t_i, \bar{r}_j) + \overline{\alpha}_j (t_i, \bar{r}_j), \alpha_i (t_i, \bar{r}_j) = \bar{a} - \bar{b} t_i + \bar{d} \bar{r}_j, \]

\[ \overline{\alpha}_j (t_i, \bar{r}_j) = 1 - (\bar{a} - \bar{b} \bar{r}_j + \bar{d} t_i) \]

One can show that:

\[ \int_0^{\bar{p}_i} q^H (t_i, \bar{r}_j) dt_i = -\frac{\bar{b} + \bar{d}}{2} \bar{p}_i^2 + \left(1 + (\bar{b} + \bar{d}) \bar{p}_j\right) p_i \]

and

\[ \int_0^{\bar{p}_j} q^H (t_i, \bar{r}_j) d\bar{r}_j = \frac{\bar{b} + \bar{d}}{2} \bar{p}_j^2 + \left(1 - (\bar{b} + \bar{d}) p_i\right) \bar{p}_j \]

This involves that:

\[ CS^H = (p_i + \bar{p}_j) \left[1 + (1/2)(\bar{b} + \bar{d})(\bar{p}_j - p_i)\right] \]
6-3. Numerical Analysis of Fiscal Externalities

**TABLE 2B**

Cournot Case, \((\mu = 4, b=2, d=1)\)

<table>
<thead>
<tr>
<th>Key Variables</th>
<th>Home Country</th>
<th>Foreign Country</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Best Reply</td>
<td>Changes (%)</td>
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<tr>
<td>Profit tax rate</td>
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<td>Domestic investment</td>
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<tr>
<td>Domestic profit</td>
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<td>Foreign profit</td>
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<tr>
<td>Total profit</td>
<td>0.165</td>
<td>- 15.5</td>
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<tr>
<td>Consumer surplus</td>
<td>0.542</td>
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<td>Public consumption</td>
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<td>Social welfare</td>
<td>0.836</td>
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</table>

**TABLE 2C**

Cournot Case, \((\mu = 0, b=2, d=1)\)

<table>
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<tr>
<th>Key Variables</th>
<th>Home Country</th>
<th>Foreign Country</th>
</tr>
</thead>
<tbody>
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<td>Best Reply</td>
<td>Changes (%)</td>
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<tr>
<td>Total profit</td>
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<tr>
<td>Consumer surplus</td>
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<tr>
<td>Public consumption</td>
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<tr>
<td>Social welfare</td>
<td>0.855</td>
<td>2.80</td>
</tr>
</tbody>
</table>
References


EGGERT, W., and A. HAUFLE, (1996), When do Small Countries Win Tax Wars, University of Konstanz, Germany.


GIBBONS, R., (1992), A Primer in Game Theory, Harvester Wheatsheaf.


HADHRI M., (1997b), Inter-jurisdictional Fiscal Competition and Fiscal Co-operation Under Imperfect Capital Mobility and Asymmetric Preferences, Ph.D. dissertations, Free University of Brussels.


