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No.502

WARWICK ECONOMIC RESEARCH PAPERS

THE UNIVERSITY OF WARWICK

DEPARTMENT OF ECONOMICS

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No.502

November 1997

This paper is circulated for discussion purposes only and its contents should be considered preliminary.

November 11, 1997

The Optimal Design of Transfer Pricing Rules: A Non-cooperative Analysis*

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Abstract

The literature on the regulation of multinationals' transfer prices has not considered the possibility that governments choose their transfer pricing rules in a non-cooperative fashion. The present paper fills this gap and shows that a non-cooperative equilibrium is characterised by above-optimal levels of effective taxation in comparison with a cooperative solution. We also derive conditions under which harmonisation of transfer pricing rules lead to a Pareto improvement, and show that harmonisation according to the 'arm's length' principle — the form of harmonisation advocated by international organisations such as the OECD — is not Pareto improving relative to the non-cooperative outcome.

JEL Classification: F23, H25.
Keywords: Transfer Pricing Rules, Taxation of MNEs, Harmonisation.

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*Raimondos-Møller's research was funded by a grant from the Danish National Research Foundation. Earlier versions of this paper were presented in two workshops at EPRU, in April and July 1997. The authors would like to thank all participants and in particular Nicholas Schmitt for comments and suggestions.

1 Introduction

The issue of how best to tax the profits of a multinational enterprise (MNE) has taken centre stage in policy circles due to increasing concerns that differential taxation across borders can induce MNEs to shift profits through transfer pricing. This has led to the adoption of presumptive transfer pricing rules (henceforth, TPRs) within the separate accounting method of calculating corporate tax liabilities. Two methods of transfer pricing regulation have mainly been practised: the arm's length pricing rule, and the comparable profits rule. Both of them are based on the idea of relating prices or profits to the levels that the MNE would experience if it was subject to 'ordinary' competition.[1,2]

Different countries, however, adopt different rules, and there has been some discussion, and some pressure from international organisations such as the OECD, towards harmonisation of TPRs. In this paper we argue that in order to assess the viability of a certain harmonisation concept, it is necessary to relate it to the outcome of a non-cooperative transfer pricing rule game between governments.

The literature on transfer pricing is quite extensive; a general idea of the theoretical issues involved can be obtained by referring to Rugman and Eden (1985). The usual story echoed in the debate on taxation and transfer pricing is that the ability of MNEs to transfer profits to the country with the lower taxes induces tax competition among countries 'towards the bottom'—a conclusion which parallels the findings of the literature on capital tax competition;[3] lower tax revenues will then lead to under-provision of public goods. Little, however, has been written with respect to

[1]See Schjeldrup and Weichenrieder (1996) for a discussion of the two systems and the efficiency repercussions of moving from the one to the other.

[2]Some countries have considered a more radical response to the transfer price problem by adopting a Formula Apportionment method of calculating corporate tax liabilities. In this case, taxes are based on global profits, and knowledge of the transfer prices is not necessary: revenues are distributed among states according to some 'objective' measure (such as, e.g., sales, employment, capital requirements within a state). Only the USA, Canada and Switzerland have adopted the formula apportionment method for companies that operate in different regions of the country, while the EU has been discussing the idea of switching to this method. For a lucid discussion of the issues involved in the choice between the separate accounting and formula apportionment methods, see McLure and Weiner (1997), and Nelson (1997). For a more theoretical analysis of the formula apportionment method see Gordon and Wilson (1986).

[3]For some early contributions see Zodrow and Mieszkowski (1986) and Wilson (1986).

the question of the design and optimality of transfer pricing rules. Papers by Prusa (1990), Gresik and Nelson (1994), and Stoughton and Talmor (1994) have examined the optimal design of transfer pricing rules from the point of view of a single government when MNEs have private information about technologies; but the design of a harmonised TPR across governments is not examined.

Bond and Gresik (1996) analyse a common agency game of two governments that try to regulate a MNE by the use of trade taxes (and not TPRs). Elitzur and Mintz (1996) consider the tax externalities that one government imposes to the other when a particular transfer pricing rule is used and when the transfer price is used to motivate the manager of the subsidiary firm.[4] Again, however, the issue of the optimality of a coordinated TPR is not addressed.

Continuing this line of research, this paper examines a non-cooperative transfer pricing rule game between a home and a host government. In Section 2 we describe our framework, which has important differences from other work in this area. First, we depart from existing literature by assuming that governments are constrained in their use of profit taxation; we thus take tax levels as given and examine the welfare maximizing choice of TPR by each government, an issue that has been neglected in the literature.[5] Second, we explicitly incorporate firm ownership into the government's objective and examine the implications of cross-ownership for the design of TPRs.

Section 3 derives conditions under which above-optimal levels of effective taxation will occur in a non-cooperative outcome. This finding is in line with a more general principle that Elitzur and Mintz's analysis points to and that is independent of agency considerations, namely that regulation of transfer prices leads to too high effective taxation of multinational income. This conjecture fits well with the experience in international tax disputes where attempts to control transfer pricing by the

[4]Elitzur and Mintz's study is the first to underline the fact that transfer prices are not used only for minimizing tax liabilities, but also for agency considerations (see also Chu and Chen (1997)). Schjeldrup and Sørgard (1997) show that a transfer price can also be used as a strategic instrument in a oligopolistic final good market. Our analysis abstracts from this type of considerations.

[5]An exception is Mansori and Weichenrieder (1997) who have simultaneously developed a framework similar to ours.

use of rules have led to conflicts between governments about the possibility of double taxation (see Shoup (1985) for some early evidence). It turns out that the inefficiency created by the non-cooperative behaviour of governments is analogous to the so-called double marginalisation problem affecting non-integrated upstream and downstream firms. Here, however, it is the intervention by governments that creates the distortion and not the structure of the MNE, which is already a vertically integrated firm.[6]

Section 4 investigates whether there exist harmonisation reforms that lead to Pareto improvements. We show conditions under which this will occur, and then examine whether a form of harmonisation based on the most prevalent TPR, i.e. the arm's length pricing rule, is Pareto improving. Interestingly, this turns out *not* to be the case. This finding clearly undermines the viability of the arm's length pricing rule, and questions the practice of international organizations such as the OECD of promoting it as a harmonisation method.

2 The Basic Model

Consider a vertically integrated multinational enterprise (MNE) with a parent firm operating in a domestic market and a single subsidiary operating in a foreign market. The parent produces an intermediate input x which is sold to the subsidiary for use in the production of a final output Q to be sold in the foreign market.

We assume that Q is produced according to decreasing-returns-to-scale technologies. In particular, we adopt the quadratic form specified by Elitzur and Mintz (1996):

$$\hat{Q} \equiv Q(x) = z + bx - d\frac{x^2}{2}, \tag{1}$$

where $\hat{Q}$ is the production function for the final output, and z is a fixed factor which is employed by the subsidiary. We also require the marginal product of x to be positive, i.e., $\hat{Q}' = b - dx > 0$. The good is assumed to be sold in competitive markets in the

[6] An informal presentation of this argument can be found in Aliber (1985).

foreign country and thus its price is fixed for the firm.[7] Without loss of generality, the price is assumed to be unity.

In the domestic country, the parent firm produces x at a constant marginal cost c. Sales of x to the subsidiary are internally priced, with r denoting the transfer price used by the parent firm. In the absence of taxes, the transfer price is simply an arbitrary accounting device for the MNE; for a given transfer price r, the domestic and foreign profits are given by

$$\pi^d = x(r - c); \tag{2}$$

$$\pi^f = \hat{Q} - rx. \tag{3}$$

Clearly, the MNE's global before-tax profits are equal to $\hat{Q} - cx$, from which we can see that the transfer price r has no effect on the global profits of the MNE.

Now suppose that governments in both countries levy taxes on the profits of firms operating within their jurisdiction. This is consistent with both countries applying the so-called separable accounting method of taxing MNEs' profits, which is the method used, e.g., in the EU. Let t^d and t^f denote the profit tax rate set by the domestic and foreign governments respectively. If this were the only policy instrument available to the governments, then the multinational enterprise would simply over- or underinvoice the internal price of x so as to avoid the tax. Governments are aware of this and use an imputed transfer price (i.e. a transfer pricing rule) for the firm operating within their jurisdiction for the purpose of calculating taxable profits. Let r^d and r^f denote the imputed transfer prices chosen by the domestic and foreign governments respectively. Then imputed profits in the domestic country and the foreign country are respectively given by

$$\overline{\pi}^d = x(r^d - c); \tag{4}$$

$$\overline{\pi}^f = \hat{Q} - r^f x; \tag{5}$$

[7] We discuss the implications of this assumption just before the concluding section of this paper.

and the after-tax profits of the MNE are respectively

$$\Pi^d = \pi^d - t^d \overline{\pi}^d; \tag{6}$$

$$\Pi^f = \pi^f - t^f \overline{\pi}^f. \tag{7}$$

Given (6) and (7), the MNE's global after-tax profits can be written as

$$\Pi = \Pi^d + \Pi^f = \hat{Q}(1-t^f) - cx(1-t^d) + x\left(t^f r^f - t^d r^d\right). \tag{8}$$

National welfare in the domestic country is the sum of domestic producer surplus and tax revenues. If $\alpha \in [0,1]$ is the fraction of the MNE's profits that accrue to domestic residents, then domestic producer surplus is simply $\alpha\Pi$. We assume that alternative sources of revenue are costly from a social point of view. The social value of the domestic tax revenue collected from the parent firm is then $R^d = t^d \overline{\pi}^d (1+\rho^d)$, where $\rho^d > 0$ is the marginal social cost of public funds for the domestic government. We can thus write domestic welfare as

$$W^d = \alpha\Pi + R^d. \tag{9}$$

Likewise, national welfare in the foreign country W^f is the sum of foreign producer surplus and foreign tax revenues. The social value of foreign tax revenues R^f is equal to revenues collected from the subsidiary, weighted by one plus the foreign marginal social cost of public funds ρ^f, i.e., $R^f = t^f \overline{\pi}^f (1+\rho^f)$. Thus, foreign national welfare can be written as

$$W^f = \beta\Pi + R^f, \tag{10}$$

where $\beta \in [0,1]$ is the share of the MNE owned by foreign citizens.

The ownership parameters, α and β, allow us to model a range of different scenarios with respect to the ownership structure: (i) if $\alpha = 1$ and $\beta = 0$, the firm is fully owned by domestic citizens; (ii) if $\alpha = 0$ and $\beta = 1$, the firm is fully owned by foreign citizens; and (iii) if $\alpha, \beta \in (0,1)$ and $\alpha + \beta = 1$, the firm's ownership is shared between domestic and foreign citizens. Notice that if the firm is owned partially, or totally, by agents in a third country, then we have $\alpha + \beta < 1$, and $\alpha = 0$, $\beta = 0$ respectively.[8]

3 Non-cooperative Transfer Pricing Rules

In this section we describe a two-stage non-cooperative game between the foreign and domestic governments. Governments and the MNE are assumed to make their decisions in the following order: at Stage 1 governments non-cooperatively choose their optimal TPR taking the tax rates as given; at Stage 2 the MNE chooses production and import levels.[9] In what follows we shall solve for the subgame perfect equilibrium of this game.

3.1 Stage 1: The MNE's Maximization Problem

The multinational's objective is to maximize global profits (equation (8)) by choosing the level of its intermediate input x taking the TPRs and tax rates as given, i.e. $\max_x \Pi = \Pi^d + \Pi^f$. The first-order condition is characterized by the following condition:[10]

$$\partial\Pi^d/\partial x + \partial\Pi^f/\partial x = 0, \tag{11}$$

which yields the following first-order condition for the optimal level of intermediate input:

$$(1 - t^f)(b - dx) - c(1 - t^d) + (t^f r^f - t^d r^d) = 0. \tag{12}$$

The first term on the left hand side of (12) is the MNE's net-of-tax marginal revenue from sales of the final product in the foreign market; the second term is its

[8]For a discussion of the implications of cross-ownership in optimal tax issues see Huizinga and Nielsen (1997).

[9]Location decisions are not considered in this paper. Clearly, the MNE has a choice of where to locate and that choice may affect the governments' power to tax its profits (see Hines (1996) for empirical support of the hypothesis that tax rates do have an impact on the location decision of a MNE). In this paper we assume that the location decision has been made at a previous stage; once in the country, the MNE faces large fixed costs for changing location, which means that governments re-capture their power in taxing MNE's profits. The analysis in this paper concentrates in this latter stage of the game.

[10]Second-order conditions are trivially satisfied in this model and thus will not be reported.

net-of-tax marginal cost of production; and the third term represents the marginal cost or benefit to the firm of the foreign and domestic TPRs respectively.[11] Expression (12) defines the optimal level of intermediate input produced by the parent company $\hat{x}$ as an implicit function of the domestic and foreign TPRs, i.e., $\hat{x} = x(r^d, r^f)$. We can now state the following proposition:

Proposition 1: *The MNE's production is (i) decreasing in the domestic TPR and (ii) increasing in the foreign TPR, i.e.*

$$(i) \quad \frac{\partial \hat{x}}{\partial r^d} = -\frac{t^d}{(1-t^f)d} < 0, \quad and \quad (ii) \quad \frac{\partial \hat{x}}{\partial r^f} = \frac{t^f}{(1-t^f)d} > 0.$$

These effects of the TPRs on the MNE's production of the intermediate input, and thus on the production of the final good, can be explained as follows: a higher domestic TPR implies that higher imputed profits in the domestic country and thus higher taxation of the MNE's profits. The latter discourages the production of x. Likewise, a higher foreign TPR reduces imputed profits for the subsidiary and thus increases global profits of the MNE which encourages the production of x. All in all, the higher the imputed profits, the lower the MNE's incentive to produce.

Proposition 1 reflects the presence of the well-known 'double marginalisation' problem in industrial organization theory. A non-integrated, vertically linked firm experiences efficiency losses due to the fact that each plant of the firm will behave as a monopolist and will set a price above the plant's marginal cost. The final price will end up being too high, and the quantity sold will be too low, compared to the vertical integrated optimal price and quantity. In this sense, integration of the individual plants avoids the double mark-up problem and creates efficiency gains both for consumers and producers.[12] The MNE in our problem is a vertically integrated firm and thus it does not face this problem. However, intervention by the respective governments

[11] Condition (12) together with our assumption of a positive marginal product of the intermediate input x, i.e. $Q' = b - dx > 0$, implies that a necessary condition for an interior solution is that $c > (t^f r^f - t^d r^d)/(1-t^d)$.

[12] Hence the motto 'one monopoly is better than two monopolies' (see Tirole (1988)).

in the form of taxes and inconsistent TPRs re-introduces the double marginalisation distortion.

3.2 Stage 2: The Governments' Maximisation Problem

As mentioned above, both domestic and foreign governments are assumed to choose TPRs for given tax rates so as to maximize national welfare subject to the reaction the reaction of the MNE. Tax rates are assumed to be less than 100 percent, reflecting the idea that governments are unable or unwilling to tax the MNE with a 100 percent profit tax; the reason for this might be that there exist dynamic allocative distortions associated with taxation, or simply the presence of institutional or political constraints, such as lobbying by domestic producers in conjunction with nondiscriminatory taxation commitments. In our analysis, we abstract from the choice of tax rate by the government — implicitly assuming that the welfare effect associated with taxation of the MNE are 'small' relative to the concerns driving the structure of the rest of the tax system — and focus on the choice of TPR for given taxes.

For the domestic government this amounts to the following problem:

$$\max_{r^d} \quad \alpha\Pi + R^d \quad \text{s.t.} \quad (12). \tag{13}$$

The first-order condition is

$$(1+\rho^d-\alpha)\hat{x} - (1+\rho^d)(r^d-c)\frac{t^d}{(1-t^f)\,d} = 0. \tag{14}$$

Notice that the optimal choice of the domestic government will depend upon the ownership structure of the MNE and the marginal social cost of domestic public funds. The following Proposition 2 stems directly from the above equation and highlights the nature of this relationship:

Proposition 2: *(i) If $\rho^d = 0$ and $\alpha = 1$, then a necessary condition for an optimal TPR choice by the domestic government is that $r^d = c$, i.e. the TPR is set so as to exactly equal the marginal cost of production. (ii) If $\rho^d > 0$ and $\alpha \leq 1$, then a* *necessary condition for an optimal TPR choice by the domestic government is that $r^d > c$, i.e. the TPR is set so as to be larger than the marginal cost of production.*

We can provide some intuition for Proposition 2 by re-writing condition (14) as

$$-\alpha\hat{x} + (1+\rho^d)\left[\hat{x} + (r^d - c)\frac{\partial\,\hat{x}}{\partial r^d}\right] = 0. \tag{15}$$

The term $-\alpha\hat{x}$ reflects the loss in producer surplus that results from having a higher imputed base upon which to levy the profit tax, while the second term is the change in tax revenues that results from a larger imputed tax base: on the one hand there is a direct increase in revenues stemming from the larger base (represented by $(1+\rho^d)\hat{x}$), but there will also be a disincentive to production which reduces the base at the margin (reflected in the term $(1+\rho^d)(r^d-c)\partial\hat{x}/\partial r^d$). When the MNE is fully owned by domestic citizens ($\alpha = 1$), and when the marginal cost of public funds is zero ($\rho^d = 0$), the negative effect on the producer surplus is neutralized by the positive direct effect on tax revenues; what remains is the negative indirect tax revenue effect which is minimized when the government sets a TPR equal to the marginal costs ($r^d = c$), i.e. when the government does not raise any revenue from the TPR, but uses it solely to curb profit shifting opportunities available to the MNE.[13]

The first-order condition for the domestic government's maximisation problem also defines the domestic government's reaction function, $\hat{r}^d = r^d(r^f)$. Substituting (12) into (14) and solving for r^d gives the following expression:

$$r^d = c + \frac{\left(1+\rho^d-\alpha\right)\left[\left(1-t^f\right)b + t^f r^f - c\right]}{\left[2\left(1+\rho^d\right)-\alpha\right]t^d}. \tag{16}$$

Our next proposition concerns the properties of this reaction function:

Proposition 3: *For the general case of $\rho^d > 0$ and $\alpha < 1$, the optimal domestic TPR (i) increases as the foreign TPR increases, and (ii) decreases as the domestic*

[13]Mansori and Weichenrieder (1997) show that a revenue maximising domestic government will always choose a $r^d > c$, when $\rho^d = 0$ and $\alpha = 1$. However, as it is shown here, this will not hold when the government maximises welfare. In other words, welfare maximisation in the model that Mansori and Weichenrieder examine will make the domestic government to have a vertical reaction function.

ownership ratio increases, i.e.

$$\text{(i)} \quad \frac{\partial r^d}{\partial r^f} = \frac{\left(1+\rho^d-\alpha\right)t^f}{\left[2\left(1+\rho^d\right)-\alpha\right]t^d} > 0; \tag{17}$$

$$\text{(ii)} \quad \frac{\partial r^d}{\partial \alpha} = -\frac{x\left(1-t^f\right)d}{\left[2(1+\rho^d)-\alpha\right]t^d} < 0. \tag{18}$$

First, note that for $\rho^d = 0$ and $\alpha = 1$ the domestic government sets $r^d = c$ and thus its choice of TPR does not depend on what the foreign government does. However, in the more general case of Proposition 3, the reaction function is positively sloped. The intuition for that is the following: a higher r^f results into lower foreign taxation which, as shown in Proposition 1, creates an incentive for the MNE to expand its activities in the domestic country. The optimal reaction of the domestic government is to exploit this opportunity by increasing r^d in order to capture more of the MNE's profits. Thus, in a sense, the domestic country exploits the waiving of the foreign country's right to tax the MNE.

Condition (18) states that as the domestic ownership of the MNE increases, the optimal TPR decreases. This result is quite intuitive, since the higher the domestic ownership is, the more the government values producer surplus in its objective function and, thus, the lower the regulation should be, i.e. the lower r^d.[14]

Moving to the foreign government' maximization problem, we know that it maximizes welfare by choosing its TPR, i.e. $\max_{r^f} \beta\Pi + T^f$. Using similar arguments as above, we derive the first-order condition for welfare maximization:

$$-\left(1+\rho^f-\beta\right)t^f\hat{x} + \left(1+\rho^f\right)\left(Q'-r^f\right)\frac{\partial \hat{x}}{\partial r^f} = 0. \tag{19}$$

We can see from the above the general principles that affect the design of the optimal r^f. The first term of the left hand side represents the net direct effect that r^f has on the MNE's profits and on the tax revenues. The second term is the indirect

[14]This effect suggests a way for MNE to reduce its effective taxation, namely changing its ownership structure.

effect (through the change of x) that a change in r^f has on tax revenues. When the MNE is owned totally by foreign citizens ($\beta = 1$) and the marginal cost of foreign public funds is zero ($\rho^f = 0$) the direct effect disappears: the interest for the producer surplus neutralizes the interest for taxes. In that case, the optimal foreign regulation price is always positive and equal to the marginal revenue, i.e. $r^f = Q' > 0$. However, considering the general case of $\beta < 1$ and $\rho^f > 0$ will, on the one hand, reduce the optimal value of r^f, since the welfare net direct effect of a higher r^f is now negative, i.e. the reduction of tax revenues is bigger than the benefits of higher producer surplus and, on the other hand, will increase the value of the indirect effect — the second term is multiplied by $1 + \rho^f$. The overall effect turns out to be ambiguous, indicating that for particular parameter values of the model the optimal value of r^f may be negative, i.e. the foreign government may use its transfer pricing rule as an instrument to attract the MNE to report high profits in its foreign plant, increasing thus the tax base in that country.

By substituting $Q' = b - dx$ and using (12) we derive the foreign government's reaction function $\hat{r}^f = r^f(r^d)$:

$$\hat{r}^f = \frac{\left(1+\rho^f\right)\left(1-t^f\right)bt^f - \left[1+\rho^f - \beta\left(1-t^f\right)\right]\left[\left(1-t^f\right)b - c(1-t^d) - t^d r^d\right]}{\left[(1+\rho^f-\beta)\left(1-t^f\right)+1+\rho^f\right]t^f}. \tag{20}$$

Proposition 4 concerns the properties of the foreign reaction function:

Proposition 4: *For the general case with $\rho^f > 0$ and $\beta < 1$, the optimal foreign TPR increases (i) as the domestic TPR increases, and (ii) as the foreign ownership ratio increases, i.e.*

$$(i) \qquad \frac{\partial r^f}{\partial r^d} = \frac{\left[1+\rho^f-\beta\left(1-t^f\right)\right]t^d}{\left[(1+\rho^f)-\beta\left(1-t^f\right)+(1+\rho^f)\left(1-t^f\right)\right]t^f} > 0; \tag{21}$$

$$(ii) \qquad \frac{\partial r^f}{\partial \beta} = \frac{x\left(1-t^f\right)d}{\left[(1+\rho^f)-\beta\left(1-t^f\right)+(1+\rho^f)\left(1-t^f\right)\right]t^f} > 0. \tag{22}$$

The intuition for these results is similar to the one presented for the properties of the domestic reaction function and are therefore left out.[15]

We can now depict the two reactions functions in the following figure:

[Figure 1 about here]

As shown in Figure 1, both reaction functions are positively sloped; point N depicts the Nash equilibrium.[16] It can be easily shown (see equations (24) and (25) later on) that the welfare of the domestic country increases as we move up the domestic reaction function, i.e. $\partial W^d/\partial r^f > 0$, while the welfare of the foreign country increases as we move down the foreign reaction function, i.e. $\partial W^f/\partial r^d < 0$. This indirectly establishes that the iso-welfare contour loci for the domestic country are convex while the iso-welfare contour loci for the foreign country are concave.[17] Thus, there must exist a cooperative equilibrium point that lies to the North-West of the Nash equilibrium N, such as point P, which is characterized by lower regulation in both countries, i.e. lower r^d and higher r^f.[18] In this sense, the market of the MNE's intermediate input ends up being over-regulated and the combined effective tax rate is too high.[19]

An alternative route for establishing the relation between the cooperative and non-cooperative values of the TPRs would be to maximize joint welfare with respect to r^d and r^f, i.e. $\max_{r^d,r^f}(\alpha+\beta)\Pi + R^d + R^f$. By comparing the first-order conditions from this maximization problem with the ones from the non-cooperative maximization problem (equations (16) and (20)), it can be easily established that $r^{dP} < r^{dN}$ and

[15]Note, however, that a high r^f operates as a low r^d, i.e. a high r^f leads to low transfer price regulation and thus to higher profits for the MNE.

[16]Note that, at this stage, we still do not know whether the Nash equilibrium is point N or N'.

[17]To see this, we can look at the iso-welfare loci $W^d(t^d, t^f) = \overline{W}^d$. It is then true that the slope of the iso-welfare curves equals $dr^f/dr^d = -(\partial W^d/\partial r^d)/(\partial W^d/\partial r^f)$. We know that the sign of the numerator is zero on the reaction function, positive to the left of the reaction function, and negative to the right of the reaction function. We can therefore say that on the left of the reaction function the slope of the iso-welfare curve is the opposite of the $\partial W^d/\partial r^f$ sign, while at the right of the reaction function is the same with the $\partial W^d/\partial r^f$ sign. However, the $\partial W^d/\partial r^f$ sign tell us also in which direction on the domestic reaction function the welfare of the domestic country increases. Thus, the slope of the iso-welfare curves and the direction of welfare increase are two indirectly linked notions.

[18]The condition for stability of a Nash equilibrium, viz. that the domestic reaction function needs to be steeper than the foreign reaction function $\left(dr^f/dr^d\right)_{r^d} > \left(dr^f/dr^d\right)_{r^f}$, is always satisfied in this game.

[19]Note, that the Stackelberg equilibrium for the case where the domestic (foreign) government is the leader is S^d (S^f). Clearly, the follower in this game is always worse off in comparison with a simultaneous move game.

$r^{fP} > r^{fN}$. Clearly, when $\alpha + \beta = 1$, the cooperative problem is identical to the MNE's maximization problem only when $\rho^d = \rho^f = 0$. Thus, we can conclude that the cooperative solution does not impose any double marginalisation distortion if, and only if, the MNE is owned entirely by citizens of the two countries and the marginal cost of public funds in both countries is zero. In this case the optimal values of r^d, r^f will be set so that MNE's before-tax global profit is maximised, i.e. $Q' = c$.

A few remarks concerning the relationship between this result and the findings of capital tax competition literature are in order here. The main result obtained in the capital tax competition literature is that, as countries try to attract internationally mobile capital, they compete in capital taxes, driving the rates downwards and resulting in rates that are insufficient to provide the optimal level of public goods, i.e., underprovision. This result opens the door to the possibility that (i) tax coordination, or (ii) regulation of international income flows, might remedy the problem. In our analysis we have shown that the latter gives rise to the opposite type of distortion: any attempt to affect capital flows by regulating the MNE's transfer pricing behaviour will lead to too high regulation (read, too high effective taxes) and thus *over-provision* of public goods.

4 Is Harmonisation of TPRs Pareto Improving?

We have established that non-cooperative behaviour by governments will lead to too high regulation of intra-MNE's trade and that a strict Pareto improvement could be achieved if cooperative action reduced the domestic country's TPR and increased the foreign country's TPR. Such form of cooperative agreement has proved to be very popular in the international policy arena, perhaps because of its simplicity. With this in mind, it seems natural to ask the following question: *Can a harmonisation of TPRs lead to a Pareto improvement?* This section attempts to provide an answer to this question.

Looking at Figure 2, we can see what is the necessary and sufficient condition for a harmonisation to be Pareto improving starting from the Nash equilibrium: the 45° line (the harmonisation line) must pass through the Pareto improving region. For this to happen, the domestic TPR's Nash value must be higher than the foreign TPR Nash value, i.e. $r_N^d - r_N^f > 0$. If this condition holds, then any harmonisation that brings the TPRs on the EF part of the 45° line in Figure 2 will lead to a Pareto improvement.

[Figure 2 about here]

To illustrate, suppose that the two countries adopt the same tax rate, $t^d = t^f = t$, and face the same marginal costs of public funds, $\rho^d = \rho^f = \rho$, and that the MNE is totally owned by citizens of the two countries, i.e. $\beta = 1 - \alpha$. We refer to this case as the 'symmetrical' case.

Calculating the Nash values from the two reaction functions (16) and (20), assuming symmetry, and taking the difference $r_N^d - r_N^f$ as required above, leads to the following:

$$r_N^d - r_N^f = -\frac{(b-c)(1-t)^2(1+2\rho)}{t\,[\rho(2t-3)+(t-2)]}. \tag{23}$$

Two points should be noted. First, the above relationship is independent of the ownership structure. So, while the ownership structure affects the Nash equilibrium values as such, it does not affect their difference and thus the location of N relative to the 45° line. Second, given that the denominator is always negative, we have that $sign(r_N^d - r_N^f) = sign(b-c)$. With the MNE having a marginal revenue that is at least equal to its marginal cost, i.e. $Q' = b - dx \geq c$, we can conclude that $b - c > 0$, and hence $r_N^d - r_N^f > 0$. Thus, the Nash equilibrium is located at the right of the harmonisation line; therefore, there exist harmonised TPRs that will lead to a Pareto improvement.[20,21]

[20]If 'symmetry' is not assumed, an unambiguous solution can not be achieved. Thus, in principle, the Nash equilibrium can be either to the left of the 45° line (in which case no harmonisation can lead to Pareto improvement), or to the right (the case that we examine here in detail), or even on the 45° line (where TPRs are already harmonised). Mansori and Weichenrieder (1997) derive also the same location of the Nash equilibrium in their model with revenue maximising governments.

[21]The result that the Nash equilibrium is always located to the right of the harmonisation line as the ownership structure changes can be understood with the help of Figure 2. As the domestic MNE

To characterize the nature of Pareto improving harmonisations in the more general case, we turn to the methodology used in the literature on tax harmonisation (e.g. Keen (1987, 1989)), i.e. we investigate a partial *move towards* the harmonised value and not a *jump to* the harmonised value.[22] For this purpose, we can totally differentiate (9) and (10); taking into account (11), we get

$$dW^d = Adr^d + Bdr^f; \tag{24}$$

$$dW^f = Cdr^f + Ddr^d; \tag{25}$$

where $A = 0$ and $C = 0$ represent the Nash equilibrium values for the domestic and foreign TPRs, defined respectively in (14) and (19); and

$$B = t^d(r^d - c)(1+\rho^d)\frac{\partial x}{\partial r^f} + \alpha x t^f > 0;$$

$$D = t^f(Q' - r^f)(1+\rho^f)\frac{\partial x}{\partial r^d} + \beta x t^d < 0.$$

Equations (24) and (25) implicitly yield the partial derivatives of the reduced-form utility functions $W^i = W^i(r^i, r^j), i, j = \alpha, \beta, i \neq j$. It is now easy to see that, as a consequence of the envelope theorem, any reform of the TPRs starting from the Nash equilibrium will affect countries' welfare only through the externality effect, $\partial W^i/\partial r^j$. As mentioned earlier in our discussion of Figure 1, and as can be seen directly from the definitions of B and D, we have that $\partial W^d/\partial r^f > 0$ and $\partial W^f/\partial r^d < 0$. Thus, a reform of TPRs will benefit both countries only if it raises the foreign TPR and lowers the domestic TPR.

Specifying the actual harmonisation rule turns out to be straightforward in the present case. First of all, define harmonisation as a move towards a weighted average of the initial values:

$$\begin{bmatrix} dr^d \\ dr^f \end{bmatrix} = \varepsilon \begin{bmatrix} H - r_N^d \\ H - r_N^f \end{bmatrix}, \tag{26}$$

ownership increases we know that the domestic reaction curve shifts to the left and that the foreign reaction curve shifts to the right (Propositions 3(ii) and 4(ii)). The new reaction curves are depicted as $r^{d'}$ and $r^{f'}$; the Nash equilibrium is still to the right of the harmonisation line.

[22] In other words, we examine differential changes away from the initial equilibrium towards a harmonised value.

where ε is a small positive number, and H is the targeted weighted average of the initial TPRs, i.e. $H = Kr_N^d + (1-K)r_N^f$, with $K \in (0,1)$ being the weight chosen. We can thus re-write (26) as $dr^d = -\varepsilon(1-K)(r_N^d + r_N^f)$ and $dr^f = \varepsilon K(r_N^d + r_N^f)$. The welfare equations (24) and (25) are then written as follows:

$$dW^d = B\varepsilon K(r_N^d + r_N^f); \tag{27}$$

$$dW^f = -D\varepsilon(1-K)(r_N^d + r_N^f). \tag{28}$$

Clearly, any harmonisation towards the average of the Nash values, i.e. any choice of $K \in (0,1)$, will result in a strict Pareto improvement. Proposition 5 states this result:

Proposition 5: *A necessary and sufficient condition for a harmonisation of TPRs to lead to a strict Pareto improvement is that it be towards a strict convex combination of their Nash values.*

It is now interesting to see whether the most commonly adopted transfer pricing convention, i.e. the arm's length principle, leads to a Pareto improvement. On the basis of our previous findings, we formulate the following question: *Does a harmonised choice $c = r^d = r^f$ lie in the average of the Nash equilibrium values?* This amounts to asking whether there exists a $K \in (0,1)$ which satisfies

$$c = Kr_N^d + (1-K)r_N^f \qquad \Rightarrow \qquad K = \frac{c - r_N^f}{r_N^d - r_N^f}. \tag{29}$$

Substituting the Nash equilibrium values yields, after manipulation,

$$K = \frac{(1+2\rho)(t-1) - (\rho+\alpha)(t+1)}{(1-t)^2(1+2\rho)}.$$

It is easy to see that the above K is always negative and not positive as required. Thus, a harmonisation according to the arm's length principle involves a reduction of both the domestic TPR and the foreign TPR, which in turn will deteriorate domestic welfare and improve foreign welfare (see (27) and (28)). We can thus conclude that a harmonisation towards the arm's length TPR can not lead to Pareto improvement. This result is stated in the following proposition.

Proposition 6: *Harmonisation of TPRs according to the arm's length principle will not be Pareto improving relative to a non-cooperative equilibrium.*

Diagrammatically, Proposition 6 says that the Nash equilibrium value of the foreign TPR lies above c. To see this, note that the denominator of (29) is positive due to the location of the Nash equilibrium. A necessary and sufficient condition for $K > 0$ is then that the nominator of (29) be also positive, which is precisely the difference between c and r_N^f.[23,24]

This result has important policy implications. The OECD has routinely advised its members countries to adopt the arm's length principle whenever the transfer price of a MNE's intermediate good needs to be established. We have shown that, in comparison with a non-cooperative equilibrium, this policy may be beneficial for some countries, but detrimental for others, implying that it could not be sustainable though cooperation unless side payments are used.

Before concluding, we should comment on the implications of two of the assumptions we have made in our analysis. First, we have assumed that the final good's market is perfectly competitive. If a monopolistic market were assumed instead (which may better fit the character of MNEs), and if the good were sold in both markets, the double marginalisation problem that governments create would compound the pre-existing distortion associated with the monopolistic markup. The consumer surplus would fall and this whould reduce the governments' incentive to regulate. However, an opposite effect will also exist as higher (monopolistic) profits will enter the governments' objective. Which effect will dominate is ambiguous under the specifications used in this paper. Secondly, if the revenue obtained from taxing the MNE's profits

[23] The location of C in Figure 2 stems from the fact that, according to Proposition 2(i), c is the minimum value that the domestic TPR can take.

[24] Proposition 6 also establishes that the Nash equilibrium value of r^f is always positive (see the discussion in Footnote 16 where the possibility of a negative r_N^f was left open).

were sufficiently large relative to the revenues from other taxes, one could envision a situation where the choice of corporate tax rates could also be affected; to analyse this scenario, one would have to look at a game sequence where governments first set their taxes and then their TPRs.[25]

5 Concluding Remarks

It is well known that capital mobility reduces the ability of countries to tax capital income and leads to a 'race to the bottom,' i.e. tax revenues that are too low, leading to under-provision of public goods. The implicit story behind this argument is the idea that countries behave non-cooperatively with respect to their choice of tax rates. For the case of income generated within a MNE, however, countries can directly affect the tax base on which they levy taxes by choosing presumptive TPRs; such transfer pricing regulation can effectively preclude this race to the bottom from occurring. Indeed, we have shown that if it takes place in a non-cooperative fashion, transfer pricing regulation does more than just that: it leads to a 'race to the top,' i.e. excessive tax revenues and over-provision of public goods.

Any coordinated solution to this problem should be assessed in relation to such a non-cooperative equilibrium, in order to establish whether it is beneficial to all parties involved. This criterion, which is based on economic incentives and individual rationality, seems to be a more natural criterion for evaluating transfer pricing principles than methods based on comparisons of prices and profits with hypothetical, 'competitive' equivalents. From this perspective, we have shown that there exist forms of harmonisation that can lead to a Pareto improvements, but arm's length pricing — a frequently proposed form of harmonisation — is not one of them.

[25] A related question is what happens if governments choose their tax rates cooperatively and their TPRs non-cooperatively. This is similar to the trade theoretic issue analysed by Copeland (1990), where governments first agree in the reduction of the tariff protection and then behave non-cooperatively with respect to their quota protection. In this sense, similar conclusions should be expected, namely that the existence of non-negotiable instruments undermine the effectiveness of the negotiable instruments.

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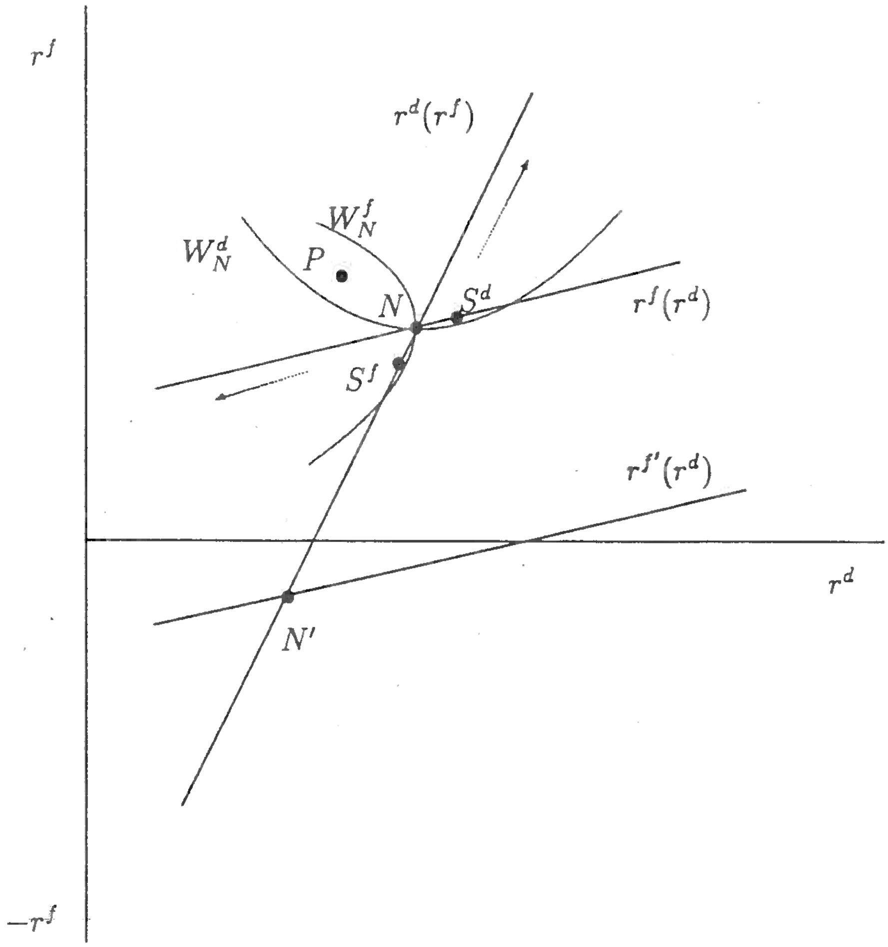

Figure 1: Non-cooperative Equilibrium of a Transfer Pricing Rule Game

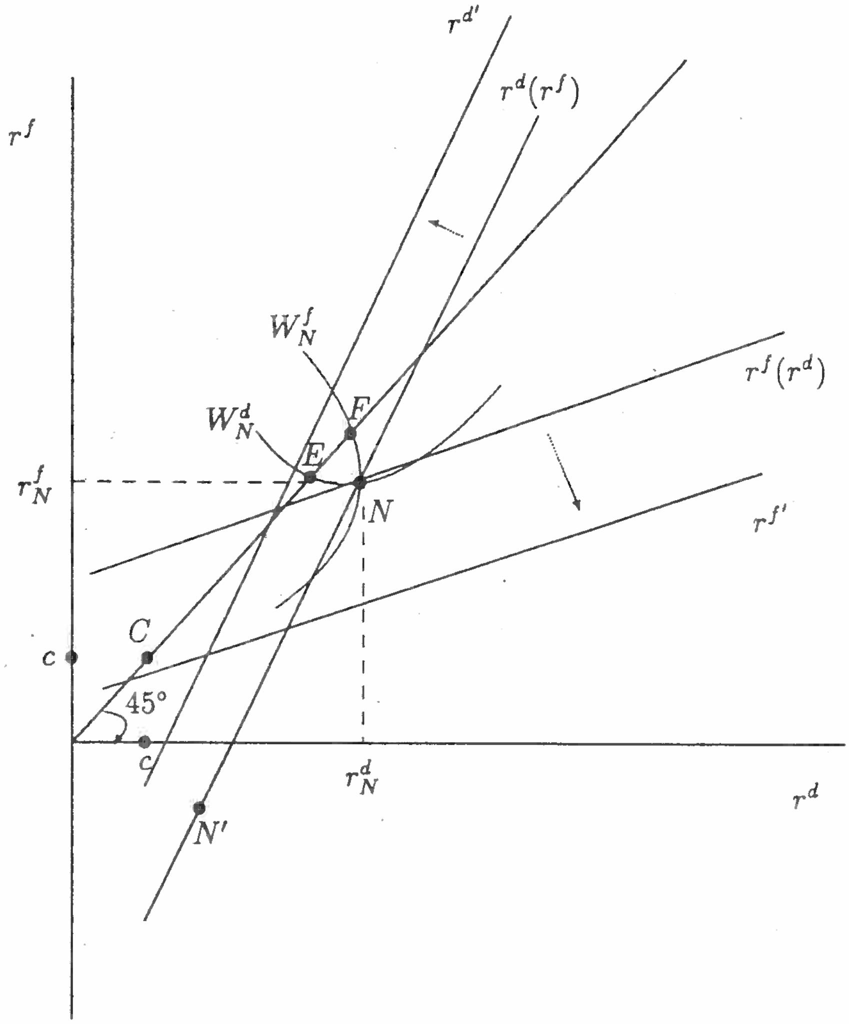

Figure 2: Harmonisation of TPRs Starting from a Non-cooperative Equilibrium