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Competing for Foreign Direct Investments: A Real Options Approach

by

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Abstract

This paper uses the Bad News Principle to study how the ability of multinationals to shift profits by transfer pricing affects both the timing of foreign direct investment decisions and government tax policy. A main finding of the paper is that if countries compete to attract foreign direct investments, only weak conditions are needed to establish that welfare is higher when firms can postpone irreversible investments as opposed to when they cannot.

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1 Introduction

The tax competition literature studies how capital taxes are set by independent governments that do not cooperate. At the heart of this literature are underlying assumptions concerning the role of capital. Most studies are either undertaken by assuming that capital investment is fully reversible or that capital is irreversible, but characterised by exogenous investment timing.[1] As argued by Dixit and Pindyck (1994, p.3), however; "*Most investment decisions share three important characteristics; investment irreversibility, uncertainty, and the ability to choose the optimal timing of investment*". Foreign direct investments (FDIs) are not an exception to this description. FDIs usually entail the payment of sunk costs making them at least partially irreversible. Moreover, imperfect information concerning market conditions and national rules and regulations means that there is uncertainty related to the true costs of FDIs and their payoff. Finally managers are aware of that investments are an opportunity and not an obligation, and that irreversible choices reduce the flexibility of their strategy. Thus, managers behave as if they owned option-rights thereby computing the optimal investment (exercise) timing.

Using a real-option approach, we focus on how the ability to postpone FDI decisions affects firm behavior under taxation, and how taxes in the Nash equilibrium are set when governments compete to attract foreign direct investments. In the standard tax competition literature the issue of timing is ignored, and a main question is therefore if adding timing of investments to the standard model leads to higher or lower taxes in the equilibrium.[2] Our model embeddes two empirical facts pertaining to multinationals.[3] First, multinational firms can shift profits to low-tax countries by transfer pricing and, second, the amount of profits shifted is a function of statutory tax rates.

The findings in this paper can be divided into two categories: those that pertain to firm behavior, and those that affect tax policy by governments. On the firm level we apply Bernanke's (1983) Bad News Principle (BNP) to show that (i) taxation

[1] Surveys of this literature are given in Wilson (1999) and Wildasin and Wilson (2001).

[2] See e.g., Zodrow and Mieszkowski (1986) and Wilson (1986) for benchmark results in the standard tax competition literature.

[3] It is well known in the tax competition literature that multinationals shift profits by way of transfer prices, and the role of statutory tax rates is documented in Hines (1999). For surveys on transfer pricing and multinationals see Hines (1999) and Gresik (2001).

affects investment timing and (ii) that the ability of multinationals to shift profits to save tax payments has an asymmetric effect on threshold investment values. In particular, we find that profit shifting reduces the threshold value in the now-or-later case more than in the now-or-never case. The second set of results derives from our tax competition setting. *We find that tax competition among countries to attract FDI leads to higher tax rates. Moreover, tax revenue and welfare rise when firms can delay their investments, on condition that the average profitability of firms in the economy is sufficiently high.*

The structure of the article is as follows. Section 2 outlines the basic principles used in the analysis pertaining to the timing of investments. Section 3 models the investment strategy of a firms considering whether or not to undertake FDIs. Section 4 uses a two-country model to investigate how taxes are affected by competition between countries over FDI. Finally, section 5 concludes.

2 Some Preliminaries

In this section we introduce a two-period model describing investment choices by a multinational. For simplicity we employ a model with two symmetric countries called A and B. Let $PDV_{0,A}$ be the net present value of additional profits (i.e., profits above those derived from home investments) produced by a firm with its headquarters (HQ) in country A at time 0. Without any opportunity to delay irreversible investment, the firm decides whether to undertake an investment according to the standard net-present-value rule

$$\max\{PDV_{0,A}, 0\}. \tag{1}$$

As commonly argued in the literature on investment decisions (see e.g. Trigeorgis, 1996), managers are well aware of that any decision to undertake irreversible investment reduces the flexibility of their strategy. Investment opportunities, therefore, are not obligations, but option-rights. If firms can postpone irreversible investments, their will choose the optimal exercise timing, and the rule given in (1) changes. One must now take into account the option to delay. To see the implication, suppose the firm can delay investment until time 1. If the firm invests immediately, it will enjoy the profit stream between time 0 and time 1. If it waits until time 1, it has the possibility of acquiring new information, which may emerge in the form of good news (profits) or bad news (losses). Therefore, investing at time 0 implies the exercise of the option to delay and entails paying an opportunity cost for the flexibility lost in the firm's strategy.[4] To decide when to invest, the firm compares $PDV_{0,A}$ with the expected net present value of the investment opportunity at time 1, $PDV_{1,A}$. The optimal decision entails choosing the maximum value:

$$\max \{PDV_{0,A}, PDV_{1,A}\}. \tag{2}$$

Subtracting (1) from (2) yields the option to delay as $\max \{PDV_{1,A}, 0\}$. Equation (2) shows that the firm chooses the optimal investment timing by comparing the two alternative policies. If the inequality $PDV_{0,A} > PDV_{1,A}$ holds, immediate investment is undertaken. If instead, $PDV_{1,A} > PDV_{0,A}$, then waiting until time 1 is better. This rule can be interpreted as follows: if the firm receives good news (positive profits), it invests. If, instead, it faces losses, it does not invest.

As shown by Bernanke (1983) if the firm can postpone its investments, the investment decision depends on bad news, but is independent of the good news. This result is often referred to as the *Bad News Principle* (*BNP*), and states that uncertainty acts asymmetrically, since only unfavorable events affect the current propensity to invest. The implication of the BNP is that the worse the news, the higher is the return required to compensate for irreversibility. Consequently, the higher is the trigger point for when investment is profitable.

The rules outlined above differ slightly if we introduce taxation. Define $T_{0,A}$ as the present discounted value of tax payments when investment is undertaken at time 0 by a firm located in country A. In the absence of any option to delay, the firm's problem is

$$\max \{NPV_{0,A}, 0\}, \tag{3}$$

where $NPV_{0,A} \equiv PDV_{0,A} - T_{0,A}$. If $NPV_{0,A} > 0$, investing abroad is profitable and vice versa. Equation (3) describes an investment rule that is used by the empirical tax competition literature to study the effects of average taxation on investment (e.g., Devereux and Griffith, 1998). It shows that when the firm can postpone investment, average taxation matters for investment (and location) decisions.

[4] McDonald and Siegel (1986) show that the opportunity to invest is analogous to a call option.

If the firm can delay investments and $T_{1,A}$ is the present value of tax payments when investment is undertaken at time 1, the firm's maximization problem becomes

$$\max\{NPV_{0,A}, NPV_{1,A}\}, \tag{4}$$

where $NPV_{1,A} \equiv PDV_{1,A} - T_{1,A}$. It is worth noting that delaying investment entails a postponement in the tax payment. In particular, an increase in $(T_{0,A} - T_{1,A})$ raises the tax savings due to the delay of investment. This discourages immediate investment.[5] In the following sections we will use rules (3) and (4) to study FDI decisions as well as the outcome of tax competition over FDI.

3 The model

We consider a representative firm that initially is located only in country A. The firm earns a certain net profit flow after tax equal to $(1-\tau_A)\pi_A$, where τ_A is the statutory tax rate and π_A are gross profits. The firm has an opportunity to expand production by investing in country B. For simplicity we assume that expanding production in the home country is less profitable than producing abroad.[6]

Define I as the sunk investment cost which must be paid by the firm to enter the foreign market. Let $(1+j)\pi_B$ be gross profits in country B. At time 0, j is zero. At time 1, however, it will change: with probability q, it will be $j = u$ and with probability $(1-q)$ it will be negative $j = -d$. Parameters u and d are positive and measure the downward and upward profit moves, respectively. At time 1, uncertainty vanishes due to the release of new information and gross profits will remain at the new level forever. Risk is fully diversifiable and both countries are assumed to be small so that the interest rate r used to discount profits is fixed. Furthermore, we assume that:

Assumption 1. *The shock is mean-preserving*

$$q(1+u) + (1-q)(1-d) = 1.$$

[5] For further details on the effects of taxation on investment timing, see Panteghini (2002).

[6] There may be several reasons for not expanding abroad. Lack of OLI advantages in the sense of Dunning (1977) may be one. Others may pertain to home anti-trust legislation, or simply that there are technological reasons (diseconomies of scale) in the home country, which may make FDI more profitable.

According to the above assumption, any change in one of the relevant parameters is offset by changes in the other parameters. The implication is that the expected current payoff is equal to the payoff faced by the firm at time 0. As will be shown later in this section, despite Assumption 1, the BNP will make bad news relevant for investment decisions when the firm has an option to delay.

Foreign profits are taxed at the rate τ_B. After investing abroad, the firm can save tax payments in the high tax country by shifting profits to the low tax country. We denote the amount of profits shifted by $\beta \lesseqgtr 0$. In line with most of the literature on transfer pricing we make the realistic assumption that it is costly to conceal deviations in the transfer price from the true cost of production. Hence, profit shifting entails convex costs, $\nu(\beta)$, with $\nu(0) = \nu'(0) = 0$ and $\nu''(\beta) > 0$. The cost element may be interpreted as the hiring of lawyers or consultants to conceal the illegality of the transaction.[7]

The overall net operating profits of the firm (if it invests in B) are

$$\Pi_A^N(j) = (1-\tau_A)\pi_A + (1-\tau_B)(1+j)\pi_B + \phi(\beta)\pi_A, \tag{5}$$

where $\phi(\beta) \equiv [(\tau_A - \tau_B)\beta - \nu(\beta)]$ measures the net of cost per-unit tax savings arising from profit shifting. With no consequence for our results, we normalize overall tax savings with respect to π_A.[8] In what follows we make the reasonable assumption that it is costly to shift all profits in the sense that the multinational firm cannot eliminate positive profits in high-tax country. The implication of this assumption is that

$$[(1-\tau_A) - \beta]\pi_A > 0, \quad (1-\tau_B)(1+j)\pi_B + \beta\pi_A > 0, \quad \Pi_A^N(j) > 0,$$

which holds for a sufficiently convex cost function $v(\beta)$.

Differentiating (5) with respect to the transfer pricing variable β, one obtains the optimal level of profit shifting

$$\beta_A^* = \beta \mid \nu'(\beta) = \tau_A - \tau_B \tag{6}$$

[7]These costs may be tax deductible or they may not. Neither assumption has an impact on the qualitative results, but tax deductibility lowers the cost of profit shifting. See Haufler and Schjelderup (2000) for a more detailed discussion.

[8]The normalization does not affect our results.

Equation (6) states that the firm shifts profits to the low tax country so that if $\tau_A < \tau_B$ $(\tau_A > \tau_B)$, then $\beta > 0$ $(\beta < 0)$. This result is in line with empirical findings suggesting that statutory tax rates matter for the transfer pricing decision.[9]

Substituting the result of (6) yields

$$\Pi_A^N(j, \beta_A^*) \equiv \max_\beta \Pi_A^N(j).$$

In what follows we start out by asking what level of profit is needed for foreign investments to occur when the firm cannot delay its investments? We will then compare this benchmark level to the profit level necessary to trigger investment when the firm can postpone its investment.

FDI without the option to delay investments. If the multinational firm cannot postpone its investment abroad, its problem is defined by (3). For the firm to invest abroad, the profits derived from doing so must exceed those obtained if it only invests at home. In order to establish the level of investments (trigger point) that makes FDI profitable, we solve $NPV_{0,A} = 0$ for π_B,

$$\pi_B^* = \frac{r}{1+r}\frac{\tilde{I}}{1-\tau_B}, \tag{7}$$

where $\tilde{I} \equiv \left[(1-\tau_B)I - \frac{1+r}{r}\phi(\beta_A^*)\pi_A\right]$ is the effective net sunk cost.

It is seen from (7) that a requirement for FDI to be undertaken is that $\pi_B > \pi_B^*$, since otherwise the firm is better off refraining from investing abroad. It is worth noting that π_B^* is affected by *both* good and bad news. Given Assumption 1, however, the net effect of news (bad or good) is zero.

The effect of profits shifting on FDI is also evident from (7); the more profitable it is to shift profits (a high $\phi(\beta_A^*)$), the lower is $\tilde{I}$ and the trigger point that induces FDI. Put differently, profit shifting allows the firm to save tax payments and makes investments even in high-tax countries more attractive.

FDI with the option to delay investments. Suppose now that the firm can postpone its foreign investment. In order to undertake this analysis we need to specify how one should interpret bad news. We make the following assumption:

[9] See Hines (1999) for empirical results concerning transfer pricing. Note that β_A^* is not state-contingent due to our assumptions about the convexity of the cost function $v(\beta)$. If we relaxed this assumption so that one of the profit expressions could be zero, a corner solution would be obtained, and β_A^* would be state contingent.

Assumption 2: *If at time 1 the firm faces bad news, the present discounted value of future profits is less than the net discounted cost of investment, that is:*

$$\sum_{t=1}^{\infty} \frac{\Pi^N\left(-d, \beta_A^*\right)}{(1+r)^t} - \frac{1-\tau_B}{1+r} I < 0. \tag{8}$$

Assumption 2 states that bad news inflicts a loss on the firm. If this were not the case, all news would be good in the sense that any news would generate positive profits and the BNP would not apply. It follows from (8) that a rational firm does not invest at time 1 under the bad state. In order to find the trigger value above which immediate FDI is profitable when the firm can delay its investments, we set $NPV_{0,A} - NPV_{1,A} = 0$, and solve for π_B. This yields (the full derivation is given in the Appendix)

$$\pi_B^{**} = \eta \pi_B^*, \tag{9}$$

where $\eta \equiv \frac{r+(1-q)}{r+(1-q)(1-d)}$ is the wedge between the two threshold values. Since the trigger point for investment abroad π_B^{**} must account not only for the explicit investment costs (net of the tax benefit of profit shifting), but also for the opportunity cost, which is represented by the exercise of the call option, it must be the case that $\eta > 1$. Thus, equation (9) shows that the firm requires higher expected profits to undertake FDI in the now-or-later case than in the now-or-never case (i.e., $\pi_B^{**} > \pi_B^*$) due to the option of postponing its investment. Put differently, uncertainty has an asymmetric effect on firm profits in the now-or-later case. In particular, the investment decision depends on the seriousness of the downward move, d, and its probability $(1-q)$, but is independent of the parameter that leads to the upward move. This can be explained by Bernanke's (1983) BNP. If the firm that owns an option to delay invests either at time 0 or at time 1 and receives good news, the investment is profitable irrespective of the firm's timing. In contrast, timing is crucial if bad news is reported. To see this, say the firm waits until time 1 with its investment and then receives bad news. In this case it will not invest and the choice of waiting turns out to be a good choice. If, instead, it had invested at time 0, it would have regretted its choice. Thus, bad news matters for the timing of investments, but good news does not.[10]

[10] As stated by Bernanke (1983) "the impact of downside uncertainty on investment has nothing to do with preferences ... The negative effect of uncertainty is instead closely related to the search theory result that a greater dispersion of outcomes, by increasing the value of information, lengthens the optimal search time" [p. 93].

In order to obtain more information about the firm's investment decisions under the two alternative scenarios, we use (7) and (9), to derive

$$\Delta \equiv \pi_B^{**} - \pi_B^{*} = \frac{d(1-q)}{r+(1-q)(1-d)}\pi_B^{*} = (\eta - 1)\tilde{I} > 0, \tag{10}$$

The impact of profit shifting on the relative thresholds values for investments is evident from (10) through $\tilde{I}$. The greater are the net tax savings from profit shifiting and transfer pricing (i.e., a high $\phi(\beta_A^*)$), the lower is $\tilde{I}$, and the smaller is the difference between the two trigger points. Thus, profit shifting affects threshold values asymetrically and reduces the trigger point more in the now-or-later case than in the now-or-never case. It can be shown that this asymmetry also extends to how the BNP works, in the sense that bad news have a greater impact on the threshold value for investments in the now-or-later case than in the now-or-never case. In particular:

Proposition 1 *As bad news gets worse, the greater is the difference* $\Delta = \pi_B^{**} - \pi_B^{*} > 0$.

Proof. It is straightforward to show that $\partial\Delta/\partial x > 0$ and $\partial\pi_B^{*}/\partial x = 0$ with $x = 1-q,\ d$.

$$\frac{\partial\Delta}{\partial(1-q)} = \frac{\partial\pi_B^{**}}{\partial(1-q)} = \frac{rd}{\left[r+(1-q)(1-d)\right]^2} > 0$$

$$\frac{\partial\Delta}{\partial d} = \frac{\partial\pi_B^{**}}{\partial d} = \frac{(1-q)\left[r+(1-q)\right]}{\left[r+(1-q)(1-d)\right]^2} > 0$$

where the positive sign follows immediately from the definition of the variables r, d and q.■

Proposition 1 is a result of how the BNP works; bad news increases the effective sunk cost ($\tilde{I}$) and widens the difference Δ. In both the now-or-never case and the now-or-later case, the higher is $\tilde{I}$, the higher is the profit threshold for acceptance of the investment project. *In the now-or-later case, however, this effect is greater in magnitude. When firms own an option to delay, in fact, an increase in $\tilde{I}$ raises the opportunity cost (i.e. the option value).*

Our discussion so far has aimed at contrasting investment decisions when the firm cannot delay investments to the case when investments can be postponed in a tax environment with profit shifting. The set up captures the main features of how multinationals act as well as the tax implications. In the next section we analyze the impact on tax rates if countries compete to attract investments from firms.

4 FDI in a tax competitive setting

In this section we investigate how the option to delay investments affects tax rates in a setting with two identical countries, A and B. The governments' objective functions are given by the expected present value of tax revenues. Both countries set their tax rate at the beginning of the first period, so as to maximize their own revenues, taking the other country's tax rate as given. We will assume that each government can precommit to these tax rates.[11] We define π_i^* and π_i^{**} as the trigger points (now-or-never and now-or-later cases) of a firm located in country j that considers to invest in country i, where $i \neq j$. Let $\phi(\beta_i^*) \equiv [(\tau_i - \tau_j)\beta_i^* - \nu(\beta_i^*)]$ be the optimal percentage of tax savings from profit shifting where tax savings are normalized with respect to π.

We assume that the economy consists of a continuum of firms, each with its own starting profit (π) arising from investing abroad. The firm-specific profits are distributed according to a linear density function $f(\pi)$ with $\pi \in [\underline{\pi}, \overline{\pi}]$. This implies that $F(\pi) = \frac{\pi - \underline{\pi}}{\overline{\pi} - \underline{\pi}}$. We also assume that $\underline{\pi} < \pi_i^*$ $i = A, B$ and that $\underline{\pi} < \frac{r}{1+r} I < (1+u)\underline{\pi}$ hold. These inequalities imply that without taxation, investing abroad is profitable in the good state. The assumption serves to rule out firms that have a zero probability of investing abroad. Finally, we make the assumption that $\overline{\pi} > \pi_i^{**}$. This means that some firms invest at time 0 irrespective of the option to delay. It is worth pointing out that the trigger points π_i^{**} and π_i^* for $i = A, B$ are the same for all firms so there exist high-income firms that invest abroad at time 0 irrespective of the existence of an option to delay. To simplify further, we will assume that there are no tax effects on the sunk cost of an investment.

Tax competition in the absence of investment timing. In the absence of any option to delay, the home government maximizes the present value of tax

[11] Since the tax on capital interacts with the taxation of personal income as well as other parts of the tax system, one can argue that there are serious costs related to reoptimizing the capital tax. Hence, the assumption of commitment is reasonable.

revenues, net of profit shifting

$$\max_{\tau_A} \left\{ \frac{1+r}{r} H(\tau_A, \tau_B) \right\},$$

where

$$\begin{aligned} H(\tau_A, \tau_B) \equiv & \left[\int_{\underline{\pi}}^{\overline{\pi}} \tau_A f(x)dx - \int_{\pi_B^*}^{\overline{\pi}} \beta_A^* f(x)dx \right] + \\ + & \int_{\pi_A^*}^{\overline{\pi}} \tau_A \left[q(1+u) + (1-q)(1-d)\right] f(x)dx + \int_{\pi_A^*}^{\overline{\pi}} \beta_B^* f(x)dx \end{aligned} \tag{11}$$

The first line is taxes paid by incumbent firms, while the second line is the additional revenue arising from investment in the home country by the foreign firm. Both terms are net of profit shifting. By invoking symmetry on the first order conditions of each country we obtain[12]

$$f(\tau) = a, \tag{12}$$

where $f(\tau) \equiv \frac{1-2\tau}{(1-\tau)^2}$ and $a \equiv \frac{(1+r)\underline{\pi}}{rI} < 1$. Solving (12) we state:

Proposition 2 *There exists an equilibrium tax rate* $\tau^* = \frac{\sqrt{1-a}}{1+\sqrt{1-a}} < 1$.

Given Assumption 1, it is also easy to ascertain that τ^* is unaffected by uncertainty. In fact, any type of news is insulated from having an effect on firms or the government, since the firm cannot postpone its investment. Thus,

Corollary 1 *The equilibrium tax rate* τ^* *is affected by* $\underline{\pi}$ *but independent of* $\overline{\pi}$.

This means that the tax rate in equilibrium is set so as to take into account that taxation may make it unprofitable for low-income firms to invest abroad, while FDI decisions made by high-income firms have no effect on the equilibrium tax rate, since these firms would invest irrespective of taxation.

Tax competition when firms can delay their investments Proposition 2 serves as a benchmark case in order to understand how the option to delay investments affect tax policy. When firms can delay their investment decisions the government's objective function must take into account investment timing. In particular, high-income firms (i.e. with $\pi \geq \pi_i^{**}$) will invest immediately. Low-income firms (i.e. with $\pi \leq \pi_i^{**}$) will instead wait. With respect to the 'now-or-never case', the government's tax revenues are also affected by profit shifting undertaken at time 1. For example, if low-income firms receive good news at time 1, they undertake the investment and start shifting profits to the low-tax country.

[12] The full derivation is given in the Appendix.

When firms can delay their investment, the home government's problem (country A) is

$$\max_{\tau_A} \left\{ \frac{1+r}{r} G(\tau_A, \tau_B) \right\}$$

where

$$\begin{aligned} G(\tau_A, \tau_B) \equiv \tau_A & \left[\int_{\underline{\pi}}^{\overline{\pi}} f(x)dx - \int_{\pi_B^{**}}^{\overline{\pi}} \beta_A^* f(x)dx - \frac{q}{1+r} \int_{\tilde{\pi}_B}^{\pi_B^{**}} \beta_A^* f(x)dx \right] + \\ + \int_{\pi_A^{**}}^{\overline{\pi}} & \tau_A \left[q(1+u) + (1-q)(1-d) \right] f(x)dx + \int_{\pi_A^{**}}^{\overline{\pi}} \beta_B^* f(x)dx + \\ & + \frac{q}{1+r} \int_{\tilde{\pi}_A}^{\pi_A^{**}} \left[(1+u)\tau_A + \beta_B^* \right] f(x)dx, \end{aligned} \tag{13}$$

and $\tilde{\pi}_i \equiv \frac{1}{1+u}\frac{r}{1+r}\frac{I}{1-\tau_i}$ for $i = A, B$, measures the threshold level of profit above which investing at time 1 (in the good state) is profitable.

The first line in (13) is tax revenues collected from domestic firms, net of profit shifting. The second and third line of $G(\tau_A, \tau_B)$ are tax revenues, net of profit shifting, due to the decision of foreign firms (resident in country B) to invest in the home country (A). Recall from (9) that bad news affects the trigger point π_B^{**}. From the definition of $G(\tau_A, \tau_B)$ we see that this has an affect on the amount of profits shifted by foreign high-income firms (second row in $G(\tau_A, \tau_B)$). The third row in $G(\tau_A, \tau_B)$ measures the expected profit-shifting opportunities exploited by foreign low-income firms (who may enter at time 1). Therefore, the probability of receiving good news by foreign low-income firms affects the expected present value of profits shifted, and, consequently the equilibrium tax rates.

Using symmetry assumptions on the full set of first order conditions we have that

$$g(\tau) \equiv \frac{b - 2c\tau}{(1-\tau)^2} = a, \tag{14}$$

where

$$b \equiv \frac{r + 1 - \frac{(1-u)^2}{1+u} q}{r + (1-q)(1-d)} > c \equiv \frac{r + 1 - \frac{1+u^2}{1+u} q}{r + (1-q)(1-d)}, \quad \text{and } \frac{b}{2} < c.$$

Hence, from (14) it follows that,

Proposition 3 *There exists a unique equilibrium tax rate τ^{**} such that*

$$\tau^{**} > \tau^*.$$

Proof See the Appendix.

Proposition 3 states that the Nash equilibrium tax rate is higher when firms can delay their investments as opposed to when they cannot delay. Put differently, the ability to postpone investments allows countries to set a higher tax rate in equilibrium. Proposition 3 can be understood by realizing that, coeteris paribus, an option to delay increases the threshold level for profits above which investments are profitable. As a consequence, the number of firms investing immediately falls as does the amount of tax revenues raised at time 0. On the other hand, low-income firms (which delayed their decision) have the opportunity to undertake investment after the realization of uncertainty. At time 1, therefore, the number of firms operating abroad rises. Moreover, late comers face relatively high profits (i.e.$(1+u)\pi$). For these reasons, tax revenues grow in the second period. It is worth noting that late comers decide whether to invest or not in a deterministic context making them less sensitive to taxation. Thus, since firms that invest at time 1 no longer face bad news, they can efford a higher tax rate. This explains the higher equilibrium tax rate.

An immediate consequence of Proposition 3 is that *only* low-income firms have an effect on tax policy:

Corollary 2 *The equilibrium tax rate τ^{**} is affected by $\underline{\pi}$, but independent of $\overline{\pi}$.*

As in the case when the firm could not delay its investment (Corollary 1), the tax rate is set so as to take into account that low-income firms are very tax sensitive while high-income firms are not (and thus not relevant when setting τ^{**}).[13]

It is instructive to compare the level of tax revenue when the firm can time its investment to the case when it cannot postpone its investment. Using Propositions 2 and 3, we may state:

Proposition 4 *Welfare in the tax competition equilibrium is higher when firms can delay their investments provided $\overline{\pi}$ is high enough.*

Proof See the Appendix.

Proposition 4 claims that $G(\tau^{**},\tau^{**}) > H(\tau^{*},\tau^{*})$ for a sufficiently high value of $\overline{\pi}$. An increase in $\overline{\pi}$ reduces the percentage of firms with initial profits ranging in the interval (π^{*},π^{**}) thereby increasing the average profitability of firms. When the average profitability rises, more firms will invest abroad at time 1 in the now-or-later

[13] Note that equation (14) shows that the equilibrium tax rate τ^{**} is affected by the probability and the seriousness of both the news. *However, the effects are different.*

case than in the now-or never case, and this increases the tax base and tax revenue in all countries relative to the now-or-never case.

5 Conclusion

This paper has applied the Bad News Principle to derive how the ability to postpone foreign direct investments affects firms' behavior and tax policy. According to the BNP, the intertemporal investment decision depends on the seriousness of the bad news and its probability, and is independent of the good news. Following the BNP, we have shown that taxation affects the timing of investments and this result is in line with empircal findings (e.g. Devereux and Griffith 1998). In particular, we have shown that the effect of profit shifting on inevstment decisions depends on the firm's opportunity to delay investment. If profit shifting is easy to undertake, the firm requires a relative higher expected pay-off before it invests abroad in the now-or-later case than in the now-or-never case.

A second set of results derives from tax competition. We have shown that the Nash equilibrium tax rates depend on the MNEs' ability to postpone investment. In particular, we have shown that taxes, tax revenue and welfare rise if the average profitability of firms in the economy is sufficiently high.

A final comment on our results pertains to Proposition 4. One of the main insights from the tax competition literature is that taxes are set too low in the tax equilibrium due to the positive fiscal externality that arises when one country increases its tax rate. With identical countries (as here) a tax increase by country i increases the tax base in all countries $j \neq i$. Since country i does not take this effect into account, taxes are set too low in the Nash equilibrium. Our model is by construction driven by the same positive externality and thus *entails too low taxes in equilibrium relative to a closed economy setting. The conjecture is that the severity of tax competition is lessened relative to the closed economy setting if firms can delay their investment choices. Although we do not model this explicitly, we leave it for future research.*

6 Appendix

Derivation of eq (7)

If the firm does not invest abroad, the present value of its payoff is

$$\sum_{t=0} \frac{(1-\tau_A)\,\pi_A}{(1+r)^t} = \frac{1+r}{r}\,(1-\tau_A)\,\pi_A. \tag{15}$$

If it invests abroad its overall net present value is

$$\begin{aligned} &\left[\Pi^N\left(0,\beta_A^*\right)\right] + q\left[\sum_{t=1} \frac{\Pi^N\left(u,\beta_A^*\right)}{(1+r)^t}\right] + \\ &+(1-q)\left[\sum_{t=1} \frac{\Pi^N\left(-d,\beta_A^*\right)}{(1+r)^t}\right] - I, \end{aligned} \tag{16}$$

Using (15) and (16), the net present value of firm's additional payoff is

$$\begin{aligned} NPV_{0,A} &= \Pi^N\left(0,\beta_A^*\right) + q\left[\sum_{t=1} \frac{\Pi^N\left(u,\beta_A^*\right)}{(1+r)^t}\right] + \\ +(1-q) &\left[\sum_{t=1} \frac{\Pi^N\left(-d,\beta_A^*\right)}{(1+r)^t}\right] - \frac{1+r}{r}\,(1-\tau_A)\,\pi_A. \end{aligned} \tag{17}$$

Substituting (17) into equation (3), setting $NPV_{0,A} = 0$, and solving for π_B we obtain (7)

Derivation of equation (9)

The firm's overall net present value when investing at time 1 is

$$(1-\tau_A)\,\pi_A + q\sum_{t=1} \frac{\Pi^N\left(u,\beta_A^*\right)}{(1+r)^t} + (1-q)\,.\sum_{t=1} \frac{(1-\tau_A)\,\pi_A}{(1+r)^t} - \frac{1}{1+r}I \tag{18}$$

From (18), the net present value of the firm's additional payoff investing at time 1 is

$$\begin{aligned} NPV_{1,A} = &\left\{ (1-\tau_A)\,\pi_A + q\sum_{t=1} \frac{\Pi^N\left(u,\beta_A^*\right)}{(1+r)^t} + \right. \\ &\left. +\,(1-q)\,.\sum_{t=1} \frac{(1-\tau_A)\pi_A}{(1+r)^t} - \frac{1}{1+r}I \right\} - \frac{1+r}{r}\,(1-\tau_A)\,\pi_A. \end{aligned} \tag{19}$$

Substituting (17) and (19) into problem (4), setting $NPV_{0,A} - NPV_{1,A} = 0$, and solving for π_B one obtains the trigger value above which immediate FDI is profitable

Derivation of equation (12)

By Assumption 1; $q(1+u) + (1-q)(1-d) = 1$, and using this in (11) yields:

$$H(\tau_A,\tau_B) = \left[\tau_A - \frac{\overline{\pi} - \pi_B^*}{\overline{\pi} - \underline{\pi}}\,(\tau_A - \tau_B)\right] + \frac{\overline{\pi} - \pi_A^*}{\overline{\pi} - \underline{\pi}}\tau_B. \tag{20}$$

The first order condition of (20) is

$$\left(1-\frac{\overline{\pi}-\pi_B^*}{\overline{\pi}-\underline{\pi}}\right)+\frac{\tau_A-\tau_B}{\overline{\pi}-\underline{\pi}}\frac{\partial\pi_B^*}{\partial\tau_A}-\frac{\tau_B}{\overline{\pi}-\underline{\pi}}\frac{\partial\pi_A^*}{\partial\tau_A}=0. \tag{21}$$

Let us next focus on a symmetric equilibrium. Namely, we have $\tau_A=\tau_B=\tau$, $\gamma_A=\gamma_B=\gamma$, $\pi_A^*=\pi_B^*=\pi^*(\tau)=\frac{r}{1+r}\frac{I}{1-\tau}$, $\pi_A=\pi_B=\pi$, and $\frac{\partial\pi_A^*}{\partial\tau_A}=\frac{\partial\pi_B^*}{\partial\tau_B}=\frac{\partial\pi^*(\tau)}{\partial\tau}=\frac{r}{1+r}\frac{I}{(1-\tau)^2}=\frac{\pi^*(\tau)}{1-\tau}$. Note that $\frac{\partial^2H(\tau_A,\tau_B)}{\partial\tau_A^2}<0$. This entails that there exists a maximum. It is now easy to see that eq. (21) reduces to (12)

Derivation of (14)

Using Assumption 1, the welfare function (13) can be rewritten as

$$\begin{aligned}G(\tau_A,\tau_B)=&\left[\tau_A-\tfrac{\overline{\pi}-\pi_B^{**}}{\overline{\pi}-\underline{\pi}}(\tau_A-\tau_B)-\tfrac{q}{1+r}\tfrac{\pi_B^{**}-\gamma_B}{\overline{\pi}-\underline{\pi}}(\tau_A-\tau_B)\right]+\\&+\tfrac{\overline{\pi}-\pi_A^{**}}{\overline{\pi}-\underline{\pi}}\tau_B+\tfrac{q}{1+r}\tfrac{\pi_A^{**}-\gamma_A}{\overline{\pi}-\underline{\pi}}(u\tau_A+\tau_B).\end{aligned} \tag{22}$$

The f.o.c. is

$$\begin{aligned}\frac{\partial G(\tau_A,\tau_B)}{\partial\tau_A}=&\,1-\left(\frac{\overline{\pi}-\left[\frac{r+(1-q)}{1+r}+\frac{q}{1+r}\frac{1}{1+u}\frac{1}{\eta}\right]\pi_B^{**}}{\overline{\pi}-\underline{\pi}}\right)+\left[\frac{r+(1-q)}{1+r}+\frac{q}{1+r}\frac{1}{1+u}\frac{1}{\eta}\right]\frac{\tau_A-\tau_B}{\overline{\pi}-\underline{\pi}}\frac{\partial\pi_B^{**}}{\partial\tau_A}+\\&-\frac{\tau_B}{\overline{\pi}-\underline{\pi}}\frac{\partial\pi_A^{**}}{\partial\tau_A}+\frac{q}{1+r}\left(1-\frac{1}{1+u}\frac{1}{\eta}\right)\frac{u\pi_A^{**}+(u\tau_A+\tau_B)\frac{\partial\pi_A^{**}}{\partial\tau_A}}{\overline{\pi}-\underline{\pi}}=0.\end{aligned} \tag{23}$$

Under symmetry ($\pi_A^{**}=\pi_B^{**}=\pi^{**}(\tau)=\eta\pi^*(\tau)$), eq. (23) reduces to (14).

Proof Proposition 3

Recall (12) and (14). It is straightforward to show that:

1. $g(\tau)$ and $f(\tau)$ are continuous functions in the $[0,1)$ region;
2. $g(0)>f(0)=1$;
3. $f'(\tau)=\frac{-2\tau}{(1-\tau)^3}\leq 0$ for $\tau\in[0,1)$, and $f''(\tau)=\frac{-2(1+2\tau)}{(1-\tau)^4}<0$;
4. $g(\tau)\propto(\tau_1-\tau)$ with $\tau_1\equiv\frac{b}{2c}>\frac{1}{2}$, $g'(\tau)\propto(\tau_2-\tau)$ with $\tau_2\equiv\frac{b-c}{c}$, $g''(\tau)\propto(\tau_3-\tau)$, with $\tau_3\equiv\frac{3b-4c}{c}$; it is easy to ascertain that $1>\tau_1>\tau_2>\tau_3$;
5. $\lim_{\tau\to1}g(\tau)=lim_{\tau\to1}f(\tau)=-\infty$;
6. $g(\tau)>f(\tau)$ for $\tau\in[0,1)$.

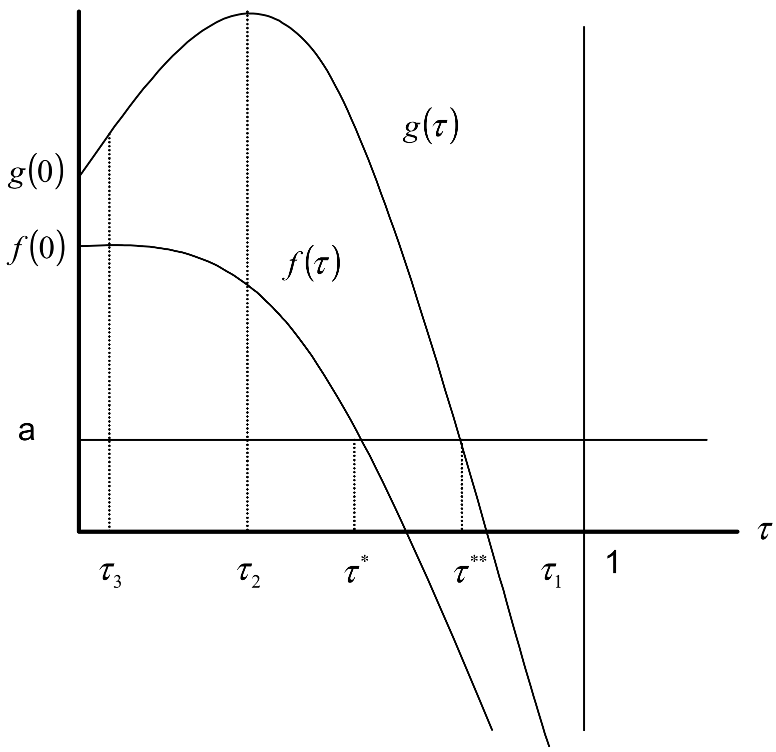

Figure 1: Proof of Proposition 3

The above conditions are illustrated in Figure 1. Given $f(\tau)$ there exists one point τ^{**} such that $g(\tau^{**}) = a$. The inequality $g(\tau) > f(\tau)$ for all $\tau \in [0, 1)$ is then sufficient to ensure that $\tau^{**} > \tau^{*}$. The Proposition is thus proven.■

Proof Proposition 4

We substitute τ^{*} and τ^{**} into (11) and (22) and derive

$$H(\tau^{*}, \tau^{*}) = \frac{\tau^{*}}{\overline{\pi} - \underline{\pi}} \left(2\overline{\pi} - \underline{\pi} - \pi^{*}\right) \tag{24}$$

$$G(\tau^{**}, \tau^{**}) = \frac{\tau^{**}}{\overline{\pi} - \underline{\pi}} \left(2\overline{\pi} - \underline{\pi} - \pi^{**}\right) \tag{25}$$

Substituting (7) and (9) into (24) and (25), respectively, it follows that $G(\tau^{**}, \tau^{**}) > H(\tau^{*}, \tau^{*})$ holds iff

$$h(\overline{\pi}) > \frac{1}{(1 - \tau^{*})(1 - \tau^{**})}, \tag{26}$$

where $h(\overline{\pi}) \equiv 2\frac{(1+r)\overline{\pi}}{rI} - a > 1$ is an increasing function of $\overline{\pi}$. As shown by Corollaries 1 and 2, the equilibrium tax rates are independent of $\overline{\pi}$. If, therefore, $\overline{\pi}$ is high enough then inequality (26) holds. This proves the Proposition.■

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