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Dynamic Tax Competition, Home Bias and the gain from Non-preferential Agreements*
(First Draft: comments welcome)

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Abstract

In a dynamic two-period model of tax competition, where an investor has home bias for the country where he/she invests in the initial period, we show that tax revenue under a non-preferential taxation scheme is strictly higher compared to a preferential taxation scheme. A non-preferential taxation scheme not only increases tax revenue in the later period, it also reduces competition in the initial period. The gain from having a non-preferential regime is strictly increasing in home bias as long as home bias is not large enough. When home bias is above a critical level, the gain from having a non-preferential agreement is independent of home bias. While the literature on tax competition has identified that "home bias" can make non-preferential taxation preferable to a preferential regime when investors are small with heterogeneous home bias, we show that even when investors are large with a discrete home bias, a non-preferential regime generates higher tax revenue compared to a preferential regime. We show that even when only one of the capital bases has home bias, a non-preferential regime generates higher tax revenue compared to a preferential regime. This paper also quantify the gain from a non-preferential regime with a parameter which captures home bias and provide clear comparative statics. Moreover, we also show that a country has an incentive to unilaterally commit to a non-preferential agreement.

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1 Introduction

This paper is a contribution to the significant theoretical literature that has focused on the comparison of tax revenues generated under capital tax competition between two countries under a preferential regime (where the two countries set discriminatory taxes on the two bases) and a non-preferential regime (when the countries are required to set the same tax rate on the two bases). In recent years, concerned by the perceived "harmful effects" of such preferential measures adopted competitively by large number of countries, several international agreements and non-binding resolutions have been adopted by the European Union[1] (EU)[2] and Organization for Economic Co-operation and Development (OECD)[3] in order to impose restrictions on preferential taxation among member countries and to take joint action against continuation of preferential tax regimes by non-member countries. The primary "harmful effect" motivating such agreements appears to be the erosion of tax revenues and the loss of economic efficiency due to movement of capital between jurisdictions solely to evade tax payments.

There is a vast literature on tax competition[4] and the effects of non-preferential agreements on tax revenue of competing countries[5]. But the literature is not conclusive whether a preferential or a non-preferential regime generates higher tax revenues. Keen (2001) analyzes a symmetric game of tax competition between two countries that compete over two exogenous capital bases and shows

[1] Main emphasis in the meeting of Council of Economics and Finance Ministers (1997) was to formalize "a design to detect such tax measures which unduly affect the location of business activity in the Community by being targeted merely at non-residents and by providing them with a more favorable tax treatment than that which is generally available in the Member State concerned. In 1998 EU Group established to identify harmful tax measures. By Nov 1999, Group identified 66 harmful tax measures".

[2] The European Commission's (1997) "code of conduct on Business Taxation"is a non-binding resolution among member states to avoid preferential taxation of certain activities including foreign investment.

[3] In 1998, the OECD adopted its "Guideline on Harmful Preferential Tax Regimes" (see, OECD, 1998). OECD(2000) Committee on Harmful Tax Practices identified 47 preferential tax regimes. In its progress report, OECD (2004) mentions that, 18 of these abolished, 14 amended and 13 were not found to be harmful on further analysis. OECD (2006) report states "The Committee considers that this part of the project has fully achieved its initial aims. Future work in this area will focus on monitoring any continuing and newly introduced preferential tax regimes identified by member countries".

[4] See for example Janeba (1998), Zodrow and Mieszkowski (1986), Janeba and Keen (1996), Zodrow (2010), Bucovetsky (1991), Bakdwin and Krugman (2004), Bucovetsky and Haufler (2007), Burbidge and Leach (2006), Davies and Cuff (2010), Oshima (2010), Hong and Smart (2010), Konrad and Kovenock (2009), Bucovetsky and Haufler (2008), Zodrow and Mieszkowski (1986), Janeba (1998).

[5] See Wilson (1999) and more recently Keen and Konard (2013) for a review of the tax competition literature.

that if the elasticity of investment flow with respect to tax differential is not too high, then tax revenues generated in Nash equilibrium are higher under preferential taxation relative to non-preferential taxation. Non-preferential regimes distort tax rates (as optimal tax rates are different for capital bases with different elasticity) and spread competition for more elastic investment to less elastic investment as well, resulting in lower total tax revenues. While in Keen (2001), both capital bases are imperfectly mobile, Wilson (2005) looks at a scenario where one of the capital cases is perfectly mobile, and other is imperfectly mobile. He finds that a preferential regime generates higher tax revenues compared a non-preferential regime[6].

The literature has identified rationales for having non-preferential agreements. Haupt and Peters (2005) introduced "home bias" in a model similar to Keen (2001) and find that a non-preferential taxation scheme generates higher tax revenue compared to non-preferential taxation scheme. Janeba and peters (1999) show that if competing countries differ in size (capital base) a non-preferential regime generates a higher tax revenue compared to a preferential tax regime. Janeba and Smart (2003) show that a non-preferential taxation is desirable when tax bases are on average highly responsive to a coordinated increase in tax rates by all governments, and when tax bases with large domestic elasticities are also more mobile internationally. Mongrain and Wilson (2015) provide a microfoundations for "home bias" in terms of different cost of relocation and find that a non-preferential regime generates higher tax revenue compared to a preferential regime.

While papers discussed above are static in nature, I consider a dynamic two-period model of tax competition. Two identical countries compete for foreign investments from over two periods, where, in each period, an investor is willing to invest in one of the competing countries. An investor who invests in a particular country during an initial period has a discrete cost of relocation ("home bias effect") to the competing country in a later period. In Haupt and Peters (2005) and Mongrain and Wilson (2015) investors are small with different cost of relocation, while in our paper, investors are large and have an equal and discrete cost of relocation ("home bias"). Haupt and Peters (2005) and Mongrain and Wilson (2015) consider competition over two capital bases where both capital bases are imperfectly mobile between two countries. Wilson (2005) looks at a scenario where one of the capital bases is perfectly mobile, and the other capital base is imperfectly mobile. While in Wilson (2005) imperfectly mobile investors are small, we consider a scenario with large investors.

The literature on tax competition is silent on whether a country has an incentive to commit to a non-preferential taxation strategy unilaterally. Kishore and Roy (2004) show that when a single country wish to attract heterogeneous investors, it has an incentive to commit to a non-preferential regime to circumvent a dynamic inconsistency problem when it cannot commit to future tax rates. In this paper, we show that a country may have an incentive to commit to a non-preferential tax strategy even if it faces competition from other country.

[6] See proposition 2 in Wilson (2005).

Major contributions of this paper are following. First, we extend the result of Haupt and Peters (2005) and Mongrain and Wilson (2015) in a dynamic setting when investors are large. It also captures a scenario where only of the capital bases has home bias. This paper also captures a scenario when the capital bases are infinitely elastic. While Wilson (2005) shows that in a scenario where one of the capital bases is perfectly mobile, and another capital base is imperfectly mobile, a preferential regime generates higher tax revenue compared to a non-preferential regime, we show that the result is opposite when investors are large, a non-preferential regime generates higher tax revenue compared to a preferential regime. We show that the gain from having a non-preferential taxation is larger in a dynamic setting. Non-preferential taxation scheme not only generate higher tax revenue in the later period, it also reduces tax incentives provided to investors during the initial period.

2 Model

There are two identical countries/jurisdictions indexed by $i \in \{A,\ B\}$, who compete to attract capital from the outside their jurisdictions. The economy lasts for two periods, 1 and 2. In the beginning of period 1 competing countries have no domestic capital. In each period, there is a single investor (who owns a unit of capital), who wish to invest either in country A or country B. For simplicity we assume that outside the two competing countries the return on capital is equal to 0. Once capital is invested in country A (country B) the return on capital is equal to 1. If the investor invests in country A (country B) in period 1, it has "home bias" for country A (country B). Home bias is captured by the term $F \geq 0$. If the investor invests in country A (country B) in period 1, then if country B (country A) wish to attract the investor in period 2, it has to undercut the tax rate set by country A (country B) by a margin of F. We assume that competing countries cannot commit to future tax rates. In the beginning of each period, competing countries announce tax rates applicable for that period. In the beginning of period 1, competing countries announce tax rates applicable for period 1. The investor observes tax rates and decide whether to make an investment in country A (country B), or stay outside. In the beginning of period 2, both governments announce tax rates applicable in period 2. The investor residing outside two competing countries decides whether to invest in country A or country B. The investor who is already invested either in country A (country B) decides whether to relocate to country B (country A) or remain invested in the initial location. We analyze this two-period dynamic tax competition game under a "preferential taxation" scheme and a "non-preferential taxation" scheme. Under a preferential taxation scheme, a government is free to set different tax rates for domestic and foreign capital. Under a non-preferential taxation scheme, a government is restricted to set an equal tax rate for domestic and foreign capital. In the present scenario competing countries has no domestic capital in the beginning of period 1. Hence, a non-preferential and a non-preferential taxation scheme has a role in the beginning of period 2. If a country receives an investment in period 1, then in period 2, it cannot set different tax rates for domestic (investment in period 1) and foreign capital under a non-preferential taxation scheme. We assume that governments wish to maximize tax revenue and investors maximize their net return on capital after tax payments. For simplicity, we assume that governments and investors do not discount future income. We compare equilibrium tax revenue of competing countries when both commit to a non-preferential agreement and when both adopts a preferential taxation strategy. The equilibrium concept is subgame-perfect Nash equilibrium. In section 6, we analyze if a country has an incentive to unilaterally commit to a non-preferential taxation strategy.

3 Non-preferential Taxation

In this section we analyze the game under a non-preferential taxation scheme. Under a non-preferential regime, competing countries are restricted to set an equal tax rate on domestic and foreign capital. First, we look at the outcome in period 2.

3.1 Tax Competition in Period 2 under Non-preferential Taxation

A country which receives an investment in period 1, has to offer tax discounts to its domestic capital as well if it wishes to attract foreign capital in period 2. This makes the country which receive an investment in period 1, less competitive in period 2. A higher value for F (home bias) make both competing countries less competitive in period 2. A country which receives an investment in period 1 finds it beneficial to set a high tax rate and receive taxes from domestic capital only while the country which does not receive an investment in period 1 is more willing to compete for new investment and not undercut the competing country to attract its domestic capital as well. As F decreases, competition is more intense in period 2. Here, one of the capital bases (investment from period 1) is imperfectly mobile, while the other tax base (investor in period 2) is perfectly mobile between two countries. Wilson (2005) also considered tax competition over two tax bases where one of the capital bases is perfectly mobile and the other imperfectly mobile. Haupt and Peters (2005) and Mongrain and Wilson (2015) consider competition over two tax bases where both capital bases are imperfectly mobile between two competing countries. Wilson (2005), Haupt and Peters (2005) and Mongrain and Wilson (2015) consider a scenario with continuum of investors with heterogeneous cost of mobility (home bias). In this paper, we have large investors with an equal and discrete cost of mobility. This scenario is important because a majority of foreign direct investments (FDI) is done my large multinationals. Below, we analyze this game of tax competition in period 2.

Without loss of generality, suppose in period 1 the investor invests in country A. Under a non-preferential taxation scheme, country A is restricted to set an equal tax rate on both domestic and foreign capital. Suppose in the beginning of period 2, country A and country B set the tax rates t_{A2} and t_{B2}, respectively. The tax revenue of country A in period 2 (TR_{A2}) is

$$TR_{A2} = \begin{cases} 0 & if\ t_{A2} > t_{B2} + F \\ t_{A2} & if\ t_{B2} < t_{A2} \le t_{B2} + F \\ 2t_{A2} & if\ t_{A2} \le t_{B2} \end{cases} . \tag{1}$$

If country A sets the tax rate $t_{A2} > t_{B2} + F$ then country B is able to attract the new investor as well as the investor from country A. If country A sets t_{A2} such that $t_{B2} < t_{A2} \le t_{B2} + F$, country B receives new investment in period 2 but country A is able to keep its domestic investor because of home bias. When $t_{A2} \le t_{B2}$, country A is also able to attract new investment as well. Similarly, the tax revenue of country B in period 2 (TR_{B2}) is

$$TR_{B2} = \begin{cases} 0 & if\ t_{A2} \le t_{B2} \\ t_{B2} & if\ t_{B2} - F \le t_{A2} < t_{B2} \\ 2t_{B2} & if\ t_{B2} < t_{A2} - F \end{cases} . \tag{2}$$

Note that country B is more aggressive competitor in period 2. Country B has to undercut the tax rate of country A by a small margin to attract the new investor. Country B can also undercut country A by a margin of F to attract the domestic investor of country A. Proposition 1 states that there is no pure strategy Nash equilibrium of this tax game.

Proposition 1 *There is no pure strategy Nash equilibrium of this game for $F > 0$. When $F = 0$, there is a unique symmetric pure strategy Nash equilibrium where both countries set the tax rate equal to* 0*.*

Proof. Suppose there is a symmetric pure strategy Nash equilibrium where both competing countries set an equal tax rate t. Note that t should be greater than 0 because, country A can receive a positive tax revenue by setting a higher tax rate and receive taxes only from its domestic investor. When $t > 0$, country B would like to lower its tax rate and receive foreign investment. Hence, there is no possibility of a symmetric Nash equilibrium. Suppose there is an asymmetric pure strategy Nash equilibrium where country A sets t_A and country B sets t_B such that $t_A > t_B$. In this case country B will receive foreign investment but it has incentive to increase the tax rate. Similarly, there is no possibility of a Nash equilibrium where $t_A < t_B$. The proof is complete. ■

Given a pure strategy Nash equilibrium does not exist for $F > 0$, we analyze a mixed strategy Nash equilibrium. Wilson (2005) also didn't find a pure strategy Nash equilibrium when one of the capital bases is imperfectly mobile and the other capital base is perfectly mobile. Given we don't have a pure strategy Nash equilibrium, we analyze a mixed strategy Nash equilibrium. Proposition 2 describes a mixed strategy Nash equilibrium when home bias is relatively large, *i.e.*, $F \ge \frac{2}{3}$.

Proposition 2 *If $\frac{2}{3} \leq F$, in a mixed strategy Nash equilibrium country A and country B receives 1 and $\frac{1}{2}$ respectively, as tax revenue. The support of the mixed strategy Nash equilibrium is $\left(\frac{1}{2},\ 1\right)$ with country A having a probability mass of $\frac{1}{2}$ at 1. Distribution of taxes of country A $(\mathcal{F}_A(t_{A2}))$ and country B $(\mathcal{F}_B(t_{B2}))$ over the support are*

$$\mathcal{F}_A(t_{A2}) = \begin{cases} 1 - \frac{1}{2t_{A2}} & for\ t_{A2} \in \left[\frac{1}{2},\ 1\right] \\ 0 & for\ t_{A2} \notin \left[\frac{1}{2},\ 1\right] \end{cases} \tag{3}$$

$$\mathcal{F}_B(t_{B2}) = \begin{cases} 2 - \frac{1}{t_{A2}} & for\ t_{B2} \in \left[\frac{1}{2},\ 1\right] \\ 0 & for\ t_{B2} \notin \left[\frac{1}{2},\ 1\right] \end{cases}. \tag{4}$$

Proof. From (3) and (4) state that country A has probability mass of $\frac{1}{2}$ at the supremum of the support. Country B has no probability mass anywhere on the support. In step 1 we will show that competing country's expected tax revenue is same everywhere on the support. In step 2 we will show that no country can do strictly better by unilateral deviation.

Step 1 : If country A (country B) sets a tax rate $t \in \left[\frac{1}{2},\ 1\right]$, their expected tax revenue can be represented as

$$TR_{A2} = t + t\left[1 - \mathcal{F}_{B2}(t)\right] = t + t\left[1 - \left(2 - \frac{1}{t}\right)\right] = 1 \tag{5}$$

$$TR_{B2} = t\left[1 - \mathcal{F}_{A2}(t)\right] = t\left[1 - \left(1 - \frac{1}{2t}\right)\right] = \frac{1}{2}. \tag{6}$$

Equality in (5) and (6) follow from (3) and (4).

Step 2 : Note that no country can set a tax rate higher than 1, because in that case the investor will not make an investment. It is easy to observe that country A cannot gain from setting a tax rate lower than $\frac{1}{2}$, as tax revenue is strictly less than 1. If country B sets a tax rate sets a tax rate such that $t \leq 1 - F$ its tax revenue will be strictly less than $\frac{1}{2}$. Only thing remains to be checked is that if country B can do strictly better by setting a tax rate less than or equal to $1 - F$. When country B sets a tax rate lower than $\frac{1}{2}$, its tax revenue jump discontinuously at $1 - F$.

$$(1 - F) + \frac{1}{2}(1 - F) > \frac{1}{2} \Rightarrow F < \frac{2}{3}. \tag{7}$$

From (7) it is clear that country B cannot do better by setting the tax rate equal to $1 - F$. If country B sets the tax rate lower than $1 - F$ then we have $\frac{\partial TR_{B2}}{\partial t} = \frac{F}{2(t+F)^2} > 0$. Hence, its tax revenue decreases if the tax rate is reduced. Hence, the proof is complete. ■

Proposition 2 states that when home bias is large enough, in period 2, competing countries receive strictly positive tax revenues. Equilibrium tax revenues of competing countries do not depend on home bias. When F is large, the mixed strategy Nash equilibrium is similar to Varian (1980) and Narasimhan (1988). When $F = 1$, the mixed strategy Nash equilibrium is exactly similar to

Narasimhan (1988). Country A can receive tax revenue equal to 1 by setting the tax rate equal to 1 on domestic investor and forgo new investor. Hence, the minimum tax rate country A sets is equal to $\frac{1}{2}$ because even if country A is able to attract the new investor with probability 1 at a tax rate lower than $\frac{1}{2}$ its tax revenue is lower than 1. It is interesting to note that the scenario when $\frac{2}{3} \leq F < 1$, is not considered in Narsimhan (1988). When $\frac{2}{3} \leq F < 1$, the mixed strategy Nash equilibrium remains the same because if country B has to set a tax rate lower than $1 - F$ to attract investor from country A which is too low to be beneficial for country B. The interesting feature of this equilibrium is that both countries receive new investor with a positive probability and country A is able to retain its domestic investor.

Proposition 3 *When $\frac{1}{(1.83929)} < F < \frac{2}{3}$, in a mixed strategy Nash equilibrium, country A and country B receive $\frac{\phi}{1-\phi}$ and ϕ respectively as tax revenue. Country A randomizes between $(\phi,\ 1)$ and country 2 randomizes between $\left[(\phi - F,\ 1 - F),\ \left(\phi,\ \frac{\phi}{1-\phi}\right)\right]$. Country A has a positive probability mass of m at the supremum of its support. Distribution of taxes of country A $(\mathcal{F}_A(t_{A2}))$ and country B $(\mathcal{F}_B(t_{B2}))$ are*

$$\mathcal{F}_A(t_{A2}) = \begin{cases} \frac{2(t_{A2}-F)-\phi}{t_{A2}-F} & for\ t_{A2} \in \left[\frac{\phi}{1-\phi},\ 1\right] \\ 1 - \frac{\phi}{t_{A2}} & for\ t_{A2} \in \left[\phi,\ \frac{\phi}{1-\phi}\right] \end{cases} \tag{8}$$

$$\mathcal{F}_B(t_{B2}) = \begin{cases} 2 - \frac{\phi}{(1-\phi)t_{B2}} & for\ t_{B2} \in \left[\phi,\ \frac{\phi}{1-\phi}\right] \\ \frac{(t_{B2}+F)(1-\phi)-\phi}{(t_{B2}+F)(1-\phi)} & for\ t_{B2} \in [\phi - F,\ 1 - F] \end{cases} \tag{9}$$

$$\phi = \frac{1}{2F}\left(1 + 3F - \sqrt{6F + F^2 + 1}\right)$$

$$m = \frac{\phi + F - 1}{1 - F}$$

Proof. We need to show that strategy profile given by (8) and (9) constitute a mixed strategy Nash equilibrium. First, We will show that the distribution of taxes over the support are continuous. From (9), we must have $\mathcal{F}_B(\phi) = \mathcal{F}_B(1 - F)$.

$$\lim_{\in \to 0} \mathcal{F}_B(\phi + \in) = 2 - \frac{\phi}{(1-\phi)\phi} = \frac{1-2\phi}{1-\phi}. \tag{10}$$

$$\lim_{\in \to 0} \mathcal{F}_B(1 - F - \in) = \frac{(1 - F + F)(1-\phi) - \phi}{(1 - F + F)(1-\phi)} = \frac{1-2\phi}{1-\phi}. \tag{11}$$

From (10) and (11) it is clear that the distribution of taxes over the support of country B is continuous. Similarly, we must have $\lim_{\in \to 0} \mathcal{F}_A\left(\frac{\phi}{1-\phi} - \in\right) =$

$\lim_{\in\to 0}\mathcal{F}_B\left(\frac{\phi}{1-\phi}+\in\right)$. From (8), we have

$$\begin{aligned}\lim_{\in\to 0}\mathcal{F}_A\left(\frac{\phi}{1-\phi}+\in\right) &= 2-\frac{\phi}{\frac{\phi}{1-\phi}-F} && (12)\\ \lim_{\in\to 0}\mathcal{F}_A\left(\frac{\phi}{1-\phi}-\in\right) &= 1-\frac{\phi}{\frac{\phi}{1-\phi}} && (13)\end{aligned}$$

From (12) and (13) we have

$$2-\frac{\phi}{1-\frac{1-2\phi}{1-\phi}-F}=1-\frac{\phi}{1-\frac{1-2\phi}{1-\phi}}. \qquad (14)$$

Solving (14) for ϕ we get

$$\phi=\frac{1}{2F}\left(1+3F-\sqrt{6F+F^2+1}\right). \qquad (15)$$

From (15) it is clear that the distribution of taxes over the support of country A is also continuous. The remaining part of the proof we will show in two steps. In step 1, We will show that competing countries earn an equal tax revenues everywhere on the support. In step 2, we will show that a country cannot do better from unilateral deviation.

Step 1 : First, we prove that country A gets an equal tax revenue everywhere on the support. If country A sets a tax rate $t\in\left(\phi,\ \frac{\phi}{1-\phi}\right)$. Using (9), the expected tax revenue of country A is

$$\begin{aligned}t+t\left[1-\mathcal{F}_B(t)\right] &= t+t\left[1-\left(2-\frac{\phi}{(1-\phi)\,t}\right)\right]\\ &= t+t\left[\frac{\phi}{(1-\phi)\,t}-1\right]=\frac{\phi}{1-\phi}. && (16)\end{aligned}$$

Similarly, if country A sets $t\in\left(\frac{\phi}{1-\phi},\ 1\right)$ then its tax revenue is

$$\begin{aligned}t\left[1-\mathcal{F}_B(t)\right] &= t\left[1-\left(2-\frac{\phi}{(1-\phi)\,t}\right)\right]\\ &= t\left[\frac{\phi}{(1-\phi)\,t}\right]=\frac{\phi}{1-\phi}. && (17)\end{aligned}$$

Using (16) and (17), and noting the fact that distribution of taxes of country B is continuous with no probability mass anywhere over the support, it is clear that country A earns an equal tax revenue everywhere on the support. Similarly, we prove that country B earns an equal tax revenue everywhere on the support. Note that if country B sets $t\in\left(\phi,\ \frac{\phi}{1-\phi}\right)$, the distribution of taxes of country A is given by (8). Hence, tax revenues of country B over $\left(\phi,\ \frac{\phi}{1-\phi}\right)$ is

$$t\left[1-\mathcal{F}_B(t)\right]=\phi. \qquad (18)$$

Similarly, the tax revenue of country B over the interval $\left(\frac{\phi}{1-\phi} - F,\ 1 - F\right)$ is

$$t + t\left[1 - \mathcal{F}_A\left(t + F\right)\right] = \phi. \tag{19}$$

From (18) and (19) it is clear that country B earns an equal tax revenue everywhere on the interior of the support.

Step 2 : Now we prove that no country can do strictly better from unilateral deviation. Note that country B does not set a tax rate such that $1 - F < t < \phi$. Hence, if country A deviates and sets a tax rate such that $1 - F < t < \phi$ then it is not undercutting the tax rate of country B with a higher probability but still setting a lower tax rate. Suppose country A deviates and sets a tax rate such that $\frac{\phi}{1-\phi} - F < t < 1 - F$. In this scenario country A is undercutting the tax rate of country B with a higher probability. Distribution of taxes of country B over the range $\left(\frac{\phi}{1-\phi} - F,\ 1 - F\right)$ is relevant. Hence, the tax revenue of country A is equal to

$$t + t\left[1 - \mathcal{F}_B\left(t\right)\right] = t + \frac{t}{t + F}\left(\frac{\phi}{1 - \phi}\right). \tag{20}$$

Differentiating (20) with respect to t we obtain

$$1 + \left(\frac{\phi}{1 - \phi}\right)\frac{F}{\left(t + F\right)^2} > 0. \tag{21}$$

From (21) it is clear that the tax revenue of country A reduces as it lowers the tax rate in the range $(1 - F - q,\ 1 - F)$. If country A sets $t = \frac{\phi}{1-\phi} - F$, it will attract receive investments from both investors with probability one and earn tax revenue equal to $2\left(\frac{\phi}{1-\phi} - F\right)$. But note that

$$2\left(1 - F - q\right) \geq \frac{\phi}{1 - \phi} \Rightarrow \frac{\phi}{1 - \phi} \geq 2F. \tag{22}$$

From (21) and (22) it is clear that country A cannot do strictly better from a unilateral deviation. Now, we need to show that country B has no incentive to deviate from the proposed strategy unilaterally. Following arguments similar to above, it is easy to see that country B cannot do better by setting a tax rate t such that $1 - F < t < \phi$. We have to check for $t \in \left(\frac{\phi}{1-\phi},\ 1\right)$ and $t < \frac{\phi}{1-\phi} - F$. Using (8) for $t \in \left(\frac{\phi}{1-\phi},\ 1\right)$, the tax revenue of country B is

$$t\left(\frac{\phi - t - F}{t - F}\right). \tag{23}$$

Differentiating (23) with respect to t we obtain

$$-1 - \frac{F\phi}{\left(t - F\right)^2} < 0. \tag{24}$$

If country B deviates and sets t such that $\phi - F < t < \frac{\phi}{1-\phi} - F$ its tax revenue is

$$t + t\left[1 - \mathcal{F}_A\left(t + F\right)\right].$$

From (8), the tax revenue of country B in this case is equal to

$$t + t\left(\frac{\phi}{t + F}\right). \tag{25}$$

From (24) and (25) it is clear that the tax revenue of country B is decreasing in its tax rate if the tax rate is higher than $\frac{\phi}{1-\phi}$, and the tax revenue is increasing in its taxes when it is lower than $\frac{\phi}{1-\phi} - F$. This proves that country B cannot do better by a unilateral deviation. The proof is complete. ■

Proposition 3 describes the outcome when $\frac{1}{(1.83929)} < F < \frac{2}{3}$. The support of the mixed strategy Nash equilibrium is a union of two disjoint sets. Because, F is relatively lower, country B has incentive to undercut country A and attract the new investor as well as the investor from country A if the tax rate of country A is large. If country A sets a tax rate low enough such that country B has no incentive to undercut country A by a margin large enough to attract the investor from country A. Table 1 depicts equilibrium tax revenues of competing countries when $\frac{1}{(1.83929)} < F < \frac{2}{3}$. The blue line is the tax revenue of country A and the red line is the tax revenue of country B. We can see that tax revenue of competing countries decreases monotonically as F decreases and at $F = \frac{2}{3}$, the tax revenues of country A and country B are 1 and $\frac{1}{2}$, respectively.

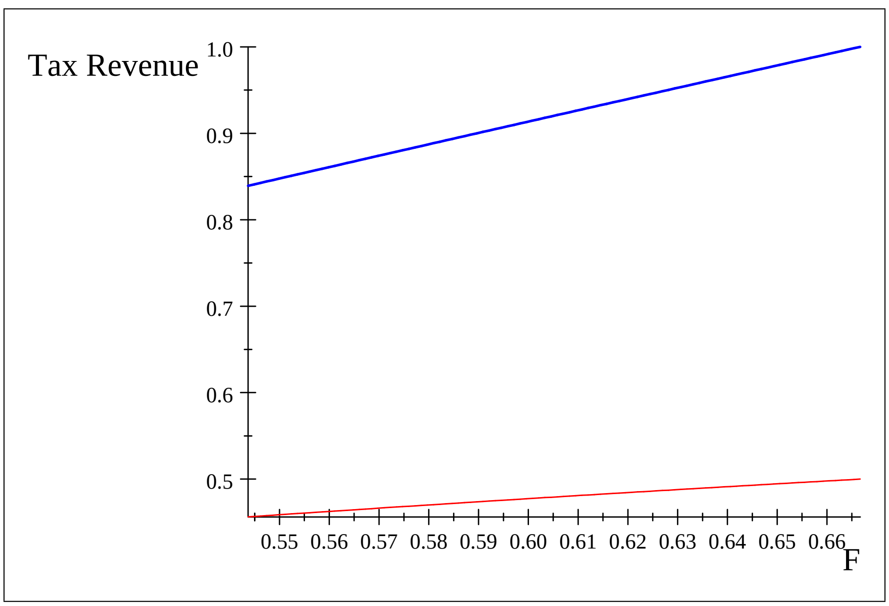

Table 1

Proposition 4 *When $F \leq \frac{1}{(1.83929)}$, in a mixed strategy Nash equilibrium country A and country B earn $(1.54370)\,F$ and $(0.83929)\,F$ respectively as tax rev-*

enue.

$$\mathcal{F}_{A2}\left(t_{A2}\right)=\begin{cases} 2-\frac{(0.83929)F}{t_{2A}-F} & for\ t_{2A}\in\left[(1.54370)\,F,\ (1.83929)\,F\right] \\ 1-\frac{(0.83929)F}{t_{2A}} & for\ t_{2A}\in\left[(0.83929)\,F,\ (1.54370)\,F\right] \end{cases} \tag{26}$$

$$\mathcal{F}_{B2}\left(t_{B2}\right)=\begin{cases} 1-\frac{(1.54370)F}{t_{B2}+F} & for\ t_{B2}\in\left[(0.54370)\,F,\ (0.83929)\,F\right] \\ 2-\frac{(1.54370)F}{t_{B2}} & for\ t_{B2}\in\left[(0.83929)\,F,\ (1.54370)\,F\right] \end{cases} \tag{27}$$

Proof. First, I will show that distribution of taxes of competing countries are continuous over the support. Distribution of taxes over the support of country A for taxes over the range $[(0.83929)\,F,\ (1.54370)\,F]$ and $[(1.54370)\,F,\ (1.83929)\,F]$ is given by (26).

$$\lim_{\in\to 0}\mathcal{F}_A\left[(1.54370)\,F+\in\right]=2-\frac{(0.83929)\,F}{(1.54370)\,F-F}=0.4563 \tag{28}$$

$$\lim_{\in\to 0}\mathcal{F}_A\left[(1.54370)\,F-\in\right]=1-\frac{(0.83929)\,F}{(1.54370)\,F}=0.4563 \tag{29}$$

From (28) and (29) we have

$$\lim_{\in\to 0}\mathcal{F}_A\left[(1.54370)\,F+\in\right]=\lim_{\in\to 0}\mathcal{F}_A\left[(1.54370)\,F-\in\right]. \tag{30}$$

Similarly, it can be shown that

$$\lim_{\in\to 0}\mathcal{F}_B\left[(0.83929)\,F+\in\right]=\lim_{\in\to 0}\mathcal{F}_B\left[(0.83929)\,F-\in\right]. \tag{31}$$

From (30) and (31) it is clear that the distributions of taxes over the support are continuous. The remaining part of the proof we show in two steps. In step 1, we show that competing countries receive equal tax revenues everywhere on the support. In step 2, we show that competing countries cannot do strictly better by unilateral deviation from the proposed strategies.

Step 1 : Suppose country A sets the tax rate $t\in[(1.54370)\,F,\ (1.83929)\,F]$. The expected tax revenue is $t\left[1-\mathcal{F}_B\left(t-F\right)\right]$. If $t\in[(1.54370)\,F,\ (1.83929)\,F]$ then $t-F\in[(0.54370)\,F,\ (0.83929)\,F]$. Using (27), the expected tax revenue of country A is

$$t\left[\frac{(1.54370)\,F}{t}\right]=(1.54370)\,F. \tag{32}$$

Similarly, if country A sets $t\in[(0.83929)\,F,\ (1.54370)\,F]$ then its tax revenue is

$$t+t\left[1-\left(2-\frac{(1.54370)\,F}{t}\right)\right]=(1.54370)\,F. \tag{33}$$

From (32) and (33) it is clear that country 1 receives an equal tax revenue everywhere on the support. We need to check that the same holds for country B. Suppose country B sets $t\in[(0.54370)\,F,\ (0.83929)\,F]$ then the tax revenue is equal to $t\left[1-\mathcal{F}_A\left(t+F\right)\right]$. Note that if $t\in\left[\left(0.54370\right)F,\ \left(0.83929\right)F\right]$ then $t+F\in\left[\left(1.54370\right)F,\ \left(1.83929\right)F\right]$. Hence, the tax revenue of country B is

$$t+t\left[1-\left(2-\frac{\left(0.83929\right)F}{t+F-F}\right)\right]=\left(0.83929\right)F. \tag{34}$$

Similarly, if the government sets $t\in\left[\left(0.83929\right)F,\ \left(1.54370\right)F\right]$ then its tax revenue is $t\left(1-\mathcal{F}_A\left(t\right)\right)$. Using (26), the tax revenue equals

$$t\left[1-\left(1-\frac{\left(0.83929\right)F}{t}\right)=\left(0.83929\right)F\right]. \tag{35}$$

From (34) and (35), it is clear that country B also receives an equal tax revenue everywhere on the support. Now in step 2, we show that no country can do strictly better from unilateral deviation.

Step 2 : First, I prove that country A do not find it beneficial to set a tax rate outside the support. Suppose country A sets a tax rate greater than $\left(1.83929\right)F$. Using (27), the expected tax revenue of country A at the tax rate t is equal to

$$\begin{aligned} TR_{A2}= \quad & t\left[1-\mathcal{F}_B\left(t-F\right)\right]=\frac{t\left[TR_{A2}-\left(t-F\right)\right]}{t-F}=\frac{tTR_{A2}}{t-F}-t \\ \Rightarrow \quad & \frac{TR_{A2}}{\partial t}=\frac{\left(t-F\right)TR_{A2}-tTR'_{A2}}{\left(t-F\right)^2}=-\frac{FTR_{A2}}{\left(t-F\right)^2}-1<0. \end{aligned} \tag{36}$$

Eq (36) shows that country A cannot do better by setting a tax rate higher than $\left(1.83929\right)F$. Now, suppose country A sets a tax rate t which is lower than infimum of the support of mixed strategy Nash equilibrium. Note that if it sets a tax rate equal to or lower than $\left(0.54370\right)F$ then the maximum tax revenue it can obtain is equal to $\left(0.54370\right)2F$, which is less than what it obtains in mixed strategy Nash equilibrium. Hence, we only need to verify that tax revenue of country A is for $t>\left(0.54370\right)F$. From (27), the tax revenue of country A for $t>\left(0.54370\right)F$ can be written as

$$TR_{A2}=t+t\left[1-\mathcal{F}_B\left(t\right)\right]=t+t\left[\frac{TR_{A2}-t}{t}\right]=TR_{A2}. \tag{37}$$

From (36) and (37), it is clear that country A cannot do better if it sets a tax rate outside the proposed support for mixed strategy Nash equilibrium. Now, we need to show that the same is true for country B as well. Suppose country B deviates and sets a tax rate which is less then the infimum of the support. If it sets $\left(0.83929\right)F-F$ or less, it can attract both investors with probability 1 but we can see it will earn a negative tax revenue. Given this we concentrate on the range of taxes which is lower than infimum of the support of country B but country B also attract one investor with a positive probability. Without a loss of generality, let us suppose country B sets the tax rate equal to t. The tax revenue of country B is $t+t\left[1-\mathcal{F}_B\left(t+F\right)\right]$ which using (26) can be written as

$$TR_{B2}=t+t\left[1-\left(2-\frac{TR_{B2}}{t+F-F}\right)\right]=TR_{B2} \tag{38}$$

where TR_{B2} is the tax revenue of country B in mixed strategy Nash equilibrium. Now, if country B sets a tax rate above the supremum of the support of country A, it gets tax revenue equal to 0. Suppose country B sets a tax rate t which is greater than the supremum of the support if country B but less than the supremum of the support of country A. The tax revenue of country B for such a tax rate is $t\left[1-\mathcal{F}_A(t)\right]$, which using (26) can be represented as

$$TR_{B2} = t\left[1-\mathcal{F}_A(t)\right] = t\left(\frac{TR_{B2}}{t}\right) = TR_{B2} \tag{39}$$

From (38) and (39), it is clear that country B cannot do strictly better by setting a tax rate outside its support for proposed mixed strategy Nash equilibrium. The proof is complete. ■

Table 2 depicts tax revenues of competing countries. The blue line is tax revenue of country A and the red line tax revenue of country B. Tax revenue of both countries decreases monotonically as F decreases.

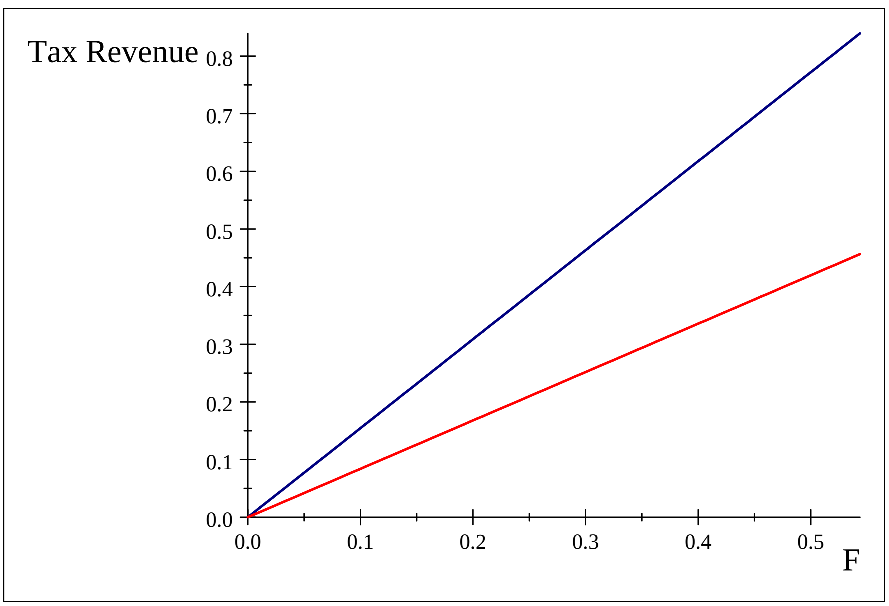

Table 2

Proposition 5 *Under a non-preferential taxation scheme, in period* 2*, tax revenue of competing countries decreases continuously and monotonically as* F *decreases.*

3.2 Tax Competition in Period 1 under Non-preferential Taxation

Country which is able to attract the investor in period 1 will also receive a higher tax revenue in period 2. Note that country which does not receive investment in period 1 also receives strictly positive tax revenue in period 2 when $F > 0$. Depending on F, suppose that the tax revenue of country A and country B in period 2 is TR_{A2} and TR_{B2}, respectively. Given $\partial = TR_{A2} - TR_{B2} > 0$, countries compete to attract the only investor in period 1. Because, ∂ is equal to the gain in period 2, from able to attract the investor in period 1, competing countries set the tax rate equal to $-\partial$ in period 1. Hence, in equilibrium tax revenue of competing countries is equal to what a country receives in period 2 when it is not able to attract the investor in period 1.

Proposition 6 *Under a non-preferential taxation scheme, in a subgame-perfect Nash equilibrium, tax revenue of competing countries is equal to* $\frac{1}{2}$ *when* $F \geq \frac{2}{3}$, ϕ *when* $\frac{1}{(1.83929)} < F < \frac{2}{3}$ *and* $(0.83929)\, F$ *when* $F < \frac{1}{(1.83929)}$. *When* $F \geq \frac{2}{3}$, *competing country sets the tax rate equal to* $-\frac{1}{2}$. *When* $\frac{1}{(1.83929)} < F < \frac{2}{3}$, *competing countries set the tax rate equal to* $-\frac{\phi^2}{1-\phi}$. *When* $F < \frac{1}{(1.83929)}$, *competing countries set the tax rate equal to* $-\,(0.70441)\, F$.

4 Preferential Taxation

Under a preferential taxation scheme, a country is free to set different tax rates for domestic and foreign capital. First, we look at the outcome in period 2.

4.1 Tax Competition in Period 2 under Preferential Taxation

Without loss of generality, suppose country A receives investments in period 1. Under a preferential taxation scheme, the government of country A can set different tax rates for domestic capital (investments from period 1) and foreign capital.

Proposition 7 *In a unique pure strategy Nash equilibrium country* $\not{A}$ *sets the tax rates* F *and* 0 *respectively, on domestic and foreign capital. Country* B *sets the tax rate equal to* 0 *on foreign capital.*

4.2 Tax Competition in Period 1 under Preferential Taxation

Proposition 8 describe the subgame-perfect equilibrium outcome under a preferential taxation scheme. The outcome supports the race to bottom effect under a preferential taxation scheme in a dynamic setting. While a country which receives investment in period 1 also receive a positive tax revenue in period 2, it has to offer tax discounts in period 1 which drives down the total tax revenue to 0.

Proposition 8 *In a unique pure strategy subgame-perfect Nash equilibrium both countries set the tax rate equal to* $-F$ *in period* 1. *The tax revenue of competing countries is equal to* 0.

5 Preferential Vs Non-preferential Taxation

Now we compare tax revenue under a preferential and a non-preferential regime. From proposition 8 it is clear that under a preferential regime competing country's tax revenue is equal to 0. Under a preferential regime, only the country which receives an investment in period 1 gets a positive tax revenue in period 2. Because the country which does not receive an investment in period 1, get 0 tax revenue in period 2, competition to attract an investment in period 1 is intense. The main result of the paper is states in proposition 9 below.

Proposition 9 *Competing countries earn strictly a strictly higher tax revenue under a non-preferential taxation scheme compared to a preferential taxation scheme. The gain from having a non-preferential taxation scheme is strictly increasing with home bias.*

Proposition 10 *In period* 2*, tax revenue under a non-preferential regime is higher compared to a preferential regime. It is true for the country which receives an investment in period* 1*, as well as the country which does not receive an investment in period* 1*.*

The outcome of competition for foreign investment complements the result of Haupt and Peters (2005). While Haupt and Peters (2005) considered a continuum of investors with different home bias, we consider large investors. The outcome is relevant because a bulk of foreign investments are made by large multinationals. In Haupt and Peters (2005), countries compete over two tax bases with home bias. In our model, only one of the capital bases have home bias, hence, the result also captures when only of the capital bases has home bias. Wilson (2005) shows that when one of the capital bases is perfectly mobile and the other is imperfectly immobile a preferential regime generates higher tax revenue compared to a non-preferential regime. Our result is opposite of Wilson (2005), a non-preferential regime generates higher tax revenue compared to a preferential regime. While Wilson (2005) considered a continuum of investors with different cost of mobility, we consider large investor with a discrete cost of mobility.

From proposition 8 it is clear that under a preferential taxation scheme, in period 1, competing countries offer tax discounts equal to F. From proposition 6, when $F \geq \frac{2}{3}$, the tax discount offered in period 1 under a non-preferential regime is equal to $\frac{1}{2}$, which is strictly less than F. When $F \leq \frac{1}{(1.83929)}$, the tax discount offered in period 1 is equal to $(0.70441)\,F$ which is strictly less than F. When $\frac{1}{(1.83929)} < F \leq \frac{2}{3}$, the tax discount offered in period 1 is equal to $\frac{\phi^2}{1-\phi}$. Table 3 depicts the tax discount offered in period 1 for different value of F. The red line is $\frac{\phi^2}{1-\phi}$ and the blue line is F. It is clear that, the tax discount offered in period 1 is less than F. This result is states in proposition 11.

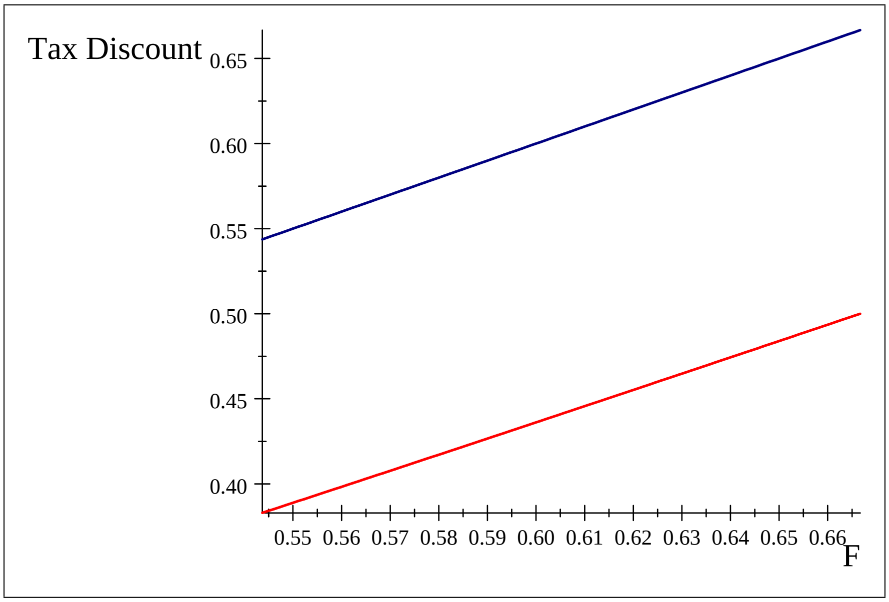

Table 3

Proposition 11 *In period* 1*, tax discounts offered to investor is lower under a non-preferential regime compared to a preferential regime.*

This states that in a dynamic setting the gain from having a non-preferential regime is even higher. Under a preferential taxation scheme, in period 2, the difference between the country which receives investment and the country which does not receives investment is very high. In fact, the country which does not receive investment in period 1 is equal to zero. This asymmetry in generated tax revenue in period 2, make countries offer higher tax discounts in period 1, which reduces tax revenue. On the other hand, under a non-preferential regime, even the country which does not receive investment in period 1, receives strictly positive expected tax revenue in period 2.

6 A Case for unilateral commitment

Without a loss of generality suppose country A commits to a non-preferential agreement while country B adopts a preferential taxation strategy. Suppose, country B receives an investment in period 1. Then, we know from proposition 11 that country B and country A receive F and 0 respectively, as tax revenue in period 2. Similarly, if country A receives an investment in period 1, then proposition $2-4$ provide equilibrium tax revenue of competing countries. From proposition $2-4$, it is clear that tax revenue of country A is higher if it receives investment in period 1. At the same time, country B earns a positive tax revenue in period 2, if country A receives an investment in period 1. Hence, country

B has no incentive to undercut country A in period 1. The formally stated in proposition 12.

Proposition 12 *A country has an incentive to unilaterally commit to a non-preferential agreement.*

Literature on tax competition compare the equilibrium tax revenue of competing countries under two different regimes; when competing countries commit to a non-preferential regime or when competing countries adopt a preferential taxation strategy. Proposition 12 states that a country has an incentive to unilaterally commit to a non-preferential agreement. In the absence of competition, kishore (2014) shows that a country has an incentive to commit to a non-preferential agreement if it cannot commit to future tax rates. Proposition 12 shows that even when two countries are competing to attract investors, a country has an incentive to commit to a non-preferential agreement.

7 Conclusion

In a dynamic two-period model of tax competition, where an investor has home bias for the country where he/she invests in the initial period, we show that tax revenue under a non-preferential taxation scheme is strictly higher compared to a preferential taxation scheme. A non-preferential taxation scheme not only increases tax revenue in the later period, it also reduces competition in the initial period. The fact that a non-preferential agreement reduces tax incentives provided to investors in the initial period is very important. A credit constraint government may prefer having a non-preferential agreement. The gain from having a non-preferential regime is strictly increasing in home bias as long as home bias is not large enough. When home bias is above a critical level, the gain from having a non-preferential agreement is independent of home bias. While the literature on tax competition has identified that "home bias" can make non-preferential taxation preferable to a preferential regime when investors are small with heterogeneous home bias, we show that even when investors are large with a discrete home bias, a non-preferential regime generates higher tax revenue compared to a preferential regime. Moreover, we show that even when only one of the capital bases has home bias, a non-preferential regime generates higher tax revenue compared to a preferential regime. This paper also quantify the gain from a non-preferential regime with a parameter which captures home bias and provide clear comparative statics. Moreover, we also show that a government has an incentive to commit to a non-preferential agreement unilaterally. This result is significant and a future study should analyze, if a country has an incentive to commit to a non-preferential regime when competition for FDI is between asymmetric countries.

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