Discussion Papers In Economics And Business

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Discussion Paper 20-21-Rev.

July 2021

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Electoral Commitment in Asymmetric Tax-competition Models

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March 19, 2021

Abstract

This study examines the political process of tax competition among asymmetric countries, highlighting the role of the commitment to the electoral promises. The median voters deliberately elect a delegate whose preferences differ from their own (strategic delegation), which is self-enforcing under symmetric countries. We first show that the outcome of strategic delegation is replicated when the candidates do not make binding campaign promises in both countries, and the opposite scenario of the binding commitments to the platforms leads to the self-representation by the median voters. We then amplify the model by adding the pre-election stage where the citizens choose whether the credibility of election promises is critical, through subscription numbers of newspapers and social media which determine the cost of betrayal of the proposed platforms (or the lack of the proposal). We then show that, depending on the type of asymmetries under consideration, sufficient asymmetry or sufficiently equal income distribution generates the commitment to the election campaign promises as the equilibrium outcome.

Keywords: Capital-tax competition; Election campaign promises; Asymmetric countries; Voting
JEL classification: C72, D72, D78, H23, H87.

1 Introduction

Whether the elected politicians would keep their campaign promises in the office is a controversial topic. In the globalized economy, political candidates' (lack of) commitment to tax policies proposed during the election campaign affects economic activities across countries, which in turn affect citizens' welfare. Unless the fulfillment of the promises is important per se, non-commitment to the campaign promises is often found useful. Nevertheless, regarding corporate taxes which are subject to tax competition, elected politicians often fulfill their campaign promises, even if they seek strategic advantages by not doing so. For example, in the U.K., the 2010 Manifesto of the

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Conservative Party mentioned a reduction in the corporate tax rate. After the 2010 election, the Cameron ministry executed the tax cut as specified in the Manifesto, with the U.K.'s tax rate eventually falling below the OECD average. In addition, in the 2012 presidential election in the U.S., the Democrat candidate Barack Obama pledged to reduce the corporate tax rate from 35% to 28%. This promise was made partly to compete with the Republican candidate Mitt Romney, who promised a reduction to 25%. After the election, President Obama proposed a reduction in the corporate tax rate in the Budget Proposal of the United States Government.[1]

A variety of treatments has been made in the literature of political economics. Downs (1957) (with office-motivated candidates) and Wittman (1973) (with policy-motivated candidates) suppose that candidates can completely commit to their campaign promises.[2] In contrast, in the conventional citizen-candidate models without inter-jurisdictional policy spillovers such as Besley and Coate (1997) and Osborne and Slivinski (1996), each citizen is allowed to become a candidate for an election, and the elected candidate who can choose a policy after the election cannot credibly commit to different positions at the time of the election. To have a realistic situation of partially binding platforms, Asako (2015) introduced the cost of betrayal for the politician who implements a policy different from his/her platform, which Banks (1990), Grossman and Helpman (2005), and Callander and Wilkie (2007) also employed.

In the context of tax competition, Persson and Tabellini (1992) considered the two-stage game with elections and policy-making. In the election stage, each country selects a policymaker through majority voting. In the policy-making stage, the elected politicians noncooperatively choose the tax policies of the respective country. Assuming that the voters do not take the foreign policy as given in the election stage, they found that the median voter of each country deliberately elects a delegate whose preferences differ from their own (*strategic delegation*) to affect the decision-making of another country. Assuming that countries are symmetric, Persson and Tabellini (1992) found that the median voters become better off by this strategic delegation. They concluded that strategic delegation is self-enforcing (Persson and Tabellini (1992, p. 698)). In the subsequent literature of the international decision-making, strategic delegation in the domestic politics (representative democracy)[3] is taken for granted (Ihori and Yang (2009), Pal and Sharma (2013), and Ogawa and Susa (2017b)). This paper examines the issue of the commitment to the campaign platforms when countries are asymmetric.

We first show that the outcome of strategic delegation is replicated when the candidates do not make binding campaign promises in both countries. In contrast, if the candidates make commit-

[1] Needless to say, the structure of corporate income tax is not characterized by the tax rate alone. In both the U.K. and the U.S.'s case, policies including the enforcement of controlled foreign companies rules and tax enforcement in relation to multinational corporates were crucial issues. Candidates clearly stated their policy proposals regarding these issues, which were then executed after the respective elections.

[2] Calvert (1985) considered the issue of convergence to the median when the candidates care about the election's policy outcomes, and they are also uncertain about voters' responses.

[3] We do not consider the direct democracy in this paper (see Redoano and Scharf (2004) and Ogawa and Susa (2017a)).

ments to their campaign promises, the equilibrium policy-making is equivalent to the case when the median voter becomes the policymaker in both countries, the case of *self-representation* following Segendorff (1998) (Proposition 1.(i) and (ii)). We also show that, depending on the types of asymmetries under consideration, the median voters (and the majority of the citizens of both countries) can in fact become *worse off* as a result of the lack of commitment to election campaign promises (Proposition 3.(ii) and Proposition 5).

Having observed that the lack of commitment is not necessarily desirable for the median voters in asymmetric countries, we consider the following pre-election stage; prior to the election, a majority of the citizens of each country chooses whether the credibility of election promises is critical (Regime C) or not critical (Regime N). Such a choice (influence) by the public is captured by, for example, the circulation (subscription) numbers of newspapers and social media that are critical of the politicians breaking (or not making) election promises. Accordingly, the candidates at the election stage make binding campaign promises (commitments) under Regime C, and they do not make commitments to election promises under Regime N. In hybrid cases when the representative in one country commits to the campaign promises while the other representative does not commit to them, the policy outcome is identical to that of Stackelberg tax competition (Proposition 1.(iii)). We then examine the citizens' choice at the pre-election stage regarding (the lack of) commitment. When the countries differ in terms of population size (Bucovetsky (1991), Wilson (1991)) or income distribution, we show that, regardless of the extent of asymmetry, non-commitment is not only a better outcome than commitment for the median voters, but also the dominant-strategy outcome (Propositions 2 and 4). However, when the countries are different in productivities of capital (Hindriks and Nishimura (2017)) or capital endowments (Hwang and Choe (1995), Peralta and van Ypersele (2005)), a divergence regarding the preferred tax rate across countries emerges under sufficiently large asymmetries or sufficiently equal income distribution. As a result, contrary to Persson and Tabellini (1992), commitment to election promises by both countries constitutes the equilibrium outcome (Proposition 3.(ii) and Proposition 5). The determinants of this emergence of binding election promises in the equilibrium synonymous to the second-mover incentives in Hindriks and Nishimura (2017) in the equilibrium of the timing game.

The rest of the paper is organized as follows. Section 2 describes the model and the structure of the game. Section 3 characterizes the equilibrium tax rates in the policy-making stage. Section 4 presents the main results. The proofs of several propositions and lemmas are provided in the Appendices.

2 The Model

There are two countries, denoted by $i = A,\ B$. Let $\overline{K}_i$ and $\overline{L}_i$ $(i = A,\ B)$ denote the capital and labor endowment, respectively, of each country. Let $\overline{k}_i \equiv \overline{K}_i/\overline{L}_i$ represent the per capita capital endowment. Later, we introduce possible asymmetries with respect to population size ($\overline{L}_A > \overline{L}_B$ and $\overline{k}_A = \overline{k}_B$) and the capital–labor ratio ($\overline{k}_A > \overline{k}_B$ and $\overline{L}_A = \overline{L}_B$). The former is analyzed by

Bucovetsky (1991) and Wilson (1991), where country A has a higher population, and the latter is analyzed by Hwang and Choe (1995) and Peralta and van Ypersele (2005), where country A has a higher capital endowment.

Capital is perfectly mobile across borders, while labor is perfectly immobile. We refer to country i's capital in its per capita form $k_i \equiv K_i/\overline{L}_i$. The production in country i is defined in its per capita form by the function $f_i(k_i)$, with $f_i(0) = 0$ and $f_i'(k_i) > 0 > f_i''(k_i)$. To make our analysis more explicit, we use later a quadratic production function $f_i(k_i) = a_i k_i - k_i^2$ with $a_A \geq a_B > 0$. This case is analyzed by Hindriks and Nishimura (2017).

Each country levies a source tax at rate t_i per unit of capital employed. Under capital mobility, the arbitrage condition involves:

$$f_A'(k_A) - t_A = f_B'(k_B) - t_B = r, \tag{1}$$

where r is the price of capital.

Let $s_i \equiv \overline{L}_i/(\overline{L}_A + \overline{L}_B)$ be the share of the population in country i, where we assume $s_A \geq s_B$. The market-clearing condition is:

$$s_A k_A + s_B k_B = s_A \overline{k}_A + s_B \overline{k}_B. \tag{2}$$

Resident j in country i has $\theta_{ij}\overline{k}_i$ units of capital. $\theta_{ij} = 1$ means that resident j's capital holding is at the average of country i. We denote the position of the median in country i as θ_{im}. We assume that each country has a right-skewed capital endowment distribution with $\theta_{Am} < 1$ and $\theta_{Bm} < 1$.

The government in country i provides an equal lump-sum transfer, γ_i, to each citizen, which is solely financed by taxation on capital: $\gamma_i = t_i k_i$. A citizen in country i with a capital share of θ_{ij} receives (i) labor income $f_i(k_i) - f_i'(k_i)k_i$, (ii) rent from capital $r\theta_{ij}\overline{k}_i$, and (iii) $\gamma_i = t_i k_i$. That is,

$$\begin{aligned} u_{ij} &= f_i(k_i) - f_i'(k_i)k_i + r\theta_{ij}\overline{k}_i + t_i k_i \\ &= f_i(k_i) + r(\theta_{ij}\overline{k}_i - k_i), \end{aligned} \tag{3}$$

where the second equality uses the arbitrage condition $f_i'(k_i) = r + t_i$.

Events in the model unfold as follows:

- In Stage 1, a majority of the citizens of each country chooses whether the credibility of election promises is critical (Regime C) or not critical (Regime N).

- In Stage 2, a policymaker (delegate) is simultaneously elected under majority rule in both countries. Each citizen in country i is allowed to become a candidate for country i's election. If Regime C was chosen at the previous stage in country i, then the candidates make binding commitments to t_i. If Regime N was chosen in country i, then the candidates do not make binding commitments on t_i at this stage.

- In Stage 3, if Regime C was chosen before, then country i applies t_i announced by the elected politician in Stage 2. If Regime N was chosen before, then the elected politician of country i chooses t_i.

- In Stage 4, having observed (t_A, t_B), private investors in both countries make their investment decisions, and production takes place. Accordingly, $\gamma_i = t_i k_i$ is determined.

Prior to the election, a majority of the citizens of each country chooses whether the credibility of election promises is critical. Such a choice (influence) by the public is captured by, for example, the circulation (subscription) numbers of newspapers and social media that are critical of politicians breaking (or not making) election promises. If the citizens of country i chose to be critical of the election promises, then in Stage 2, the candidates of country i make binding commitments on t_i; otherwise, the candidates do not commit to t_i in Stage 2. Under the international mobility of capital, the latter option (non-commitment to t_i in the election stage) potentially has a benefit, since it allows to adjust the tax policies and the associated capital inflow/outflow contingent on the elected politician of the other country.

The formulation in Asako (2015)[4] is helpful. Suppose that the winning candidate in country i announced a platform t_i^p in Stage 2. In Stage 3, if the implemented policy t_i is different from the winning candidate's t_i^p, then the winning candidate incurs the cost of betrayal $\lambda_i c(t_i - t_i^p)$ for $\lambda_i \geq 0$ and a convex cost function $c(\cdot)$ ($c(0) = 0,\ c(t_i - t_i^p) > 0,\ (t_i - t_i^p) \cdot c'(t_i - t_i^p) > 0$ and $c''(t_i - t_i^p) \geq 0$ for all $t_i \neq t_i^p$). Accordingly, writing the citizen-candidate's utility in (3) as $u_{ij}(t_i, t_{-i})$ in terms of the tax policies, the winning candidate maximizes $u_{ij}(t_i, t_{-i}) - \lambda_i c(t_i - t_i^p)$. Naturally, the citizens in country i can influence the parameter λ_i. To make clear-cut results and to have analytical simplicity, here we assume that the citizens in each country choose between (a) $\lambda_i = 0$ and (b) a very high λ_i that induces $t_i = t_i^p$ ($\lambda_i \to \infty$).

3 Analysis

The game is solved by backward induction.

3.1 Capital-market Clearing

In Stage 4, the determination of the capital allocation is standard. Let $\hat{k}_i(t_A, t_B)$ ($i = A, B$) and $\hat{r}(t_A, t_B)$ be the values of k_i ($i = A, B$) and r that satisfy (1) and (2).[5] Then, we have $\dfrac{\partial \hat{k}_i}{\partial t_i} = \dfrac{s_{-i}}{s_{-i} f_i'' + s_i f_{-i}''} < 0$ and $\dfrac{\partial \hat{k}_{-i}}{\partial t_i} = -\dfrac{s_i}{s_{-i}} \dfrac{\partial \hat{k}_i}{\partial t_i} > 0$ ($i, -i = A, B,\ -i \neq i$). Since $\dfrac{\partial \hat{r}}{\partial t_i} = f_{-i}'' \dfrac{\partial \hat{k}_{-i}}{\partial t_i} < 0$, the capital importing (exporting) country tends to benefit from a lower (higher) interest rate (see the second line of (3)). This is called the terms-of-trade effect.

[4] See also Banks (1990), Grossman and Helpman (2005), and Callander and Wilkie (2007).

[5] A closed-form expression of $\hat{k}_i(t_A, t_B)$ and other variables are relegated to the Appendix.

3.2 Policymaker's Choice of Tax Rate (Regime N in Country i)

The analysis in Stage 3 depends on the choice of the regimes in each country at Stage 1. If Regime C was chosen by country i in Stage 1, then the t_i announced by the election winner in Stage 2 is applied. In this subsection, we analyze the cases when Regime N was chosen in country i.

We begin with the case where country $-i$ also chose Regime N in Stage 1. Let us represent a policymaker's type in country i by θ_{iP}. In Stage 3, given θ_{-iP}, the policymaker with $\theta_{ij} = \theta_{iP}$ maximizes his/her utility u_{iP} in (3) by choosing t_i, taking account of $\hat{k}_i(t_A, t_B)$ $(i = A, B)$ and $\hat{r}(t_A, t_B)$ determined in the subsequent stage. The first-order condition for country i's policymaker is:

$$\frac{\partial u_{iP}}{\partial t_i} = (f_i'(k_i) - r)\frac{\partial \hat{k}_i}{\partial t_i} + (\theta_{iP}\bar{k}_i - k_i)\frac{\partial \hat{r}}{\partial t_i} = t_i\frac{\partial \hat{k}_i}{\partial t_i} + (\theta_{iP}\bar{k}_i - k_i)\frac{\partial \hat{r}}{\partial t_i} = 0. \tag{4}$$

For Regime (N, N), t_{-i} is simultaneously decided with t_i. The expression in (4) defines implicitly the tax reaction function $t_i \equiv \tau_i(t_{-i}; \theta_{iP})$ that depends on the foreign country's t_{-i} and the policymaker's type θ_{iP}. As the intersection of the tax reaction functions, the Stage-2 tax rates $(t_A(\theta_{AP}, \theta_{BP}), t_B(\theta_{AP}, \theta_{BP}))$ are determined, as functions of $(\theta_{AP}, \theta_{BP})$.

Next, we examine the case when country i chose Regime N but country $-i$ chose Regime C. In this case, country i's choice of t_i is represented by (4) but now t_{-i} is given in Stage 2. According to the commitment structure, the tax choice is made sequentially, equivalent to the Stackelberg tax choices (see Proposition 1.(iii)).

3.3 The Outcome of the Elections

In Stage 2, country i chooses the tax rate t_i under Regime C, and it chooses the policymaker iP's type under Regime N. Here we fully characterize the equilibrium tax rates depending on the regimes. We show our first proposition:

Proposition 1 *(i) If both countries choose Regime C in Stage 1, the equilibrium tax rates are those of the Nash equilibrium decided by the median voters of each country.*

(ii) If both countries choose Regime N in Stage 1, the median voters strategically elect the politicians whose preferences may differ from their own.

(iii) Suppose that country i chooses Regime N in Stage 1, and country $-i$ chooses Regime C. Then the equilibrium tax rates are equivalent to the Stackelberg tax equilibrium with country $-i$ being the Stackelberg leader, where the tax rates are chosen by the median voter of each country.

Proof: (i) Suppose that citizen-candidates in each country make binding commitments on the preferred tax rate in Stage 2. Then, the election of a policymaker is equivalent to the choice of the tax rate. Given t_{-i}, which is also credible in Stage 1, the citizen-candidate of type θ_{ij} announces t_i along the tax-reaction function determined by (4). The utility function (3) is linear in terms of one-dimensional parameter θ_{ij}. Therefore, as in cases (ii) and (iii) below, the median voter is pivotal in the voting (see also Lemma 1 below). Therefore, given t_{-i}, the elected representative announces $t_i = \tau_i(t_{-i}; \theta_{im})$.[6] The equilibrium tax rates are characterized by the intersection of these tax reaction functions: $(t_A, t_B) = (t_A(\theta_{Am}, \theta_{Bm}), t_B(\theta_{Am}, \theta_{Bm}))$.

(ii) If election campaign promises by any citizen-candidate are not binding in Stage 1, country i's median voter's problem is given as follows:

$$\begin{aligned} \max_{\theta_{iP}} \quad & f_i(\hat{k}_i(t_i, t_{-i})) + \hat{r}(t_i, t_{-i})(\theta_{im}\overline{k}_i - \hat{k}_i(t_i, t_{-i})) \\ & \text{s.t. } t_i = t_i(\theta_{iP}, \theta_{-iP}) \text{ and } t_{-i} = t_{-i}(\theta_{iP}, \theta_{-iP}). \end{aligned} \tag{5}$$

In Stage 2, the voters take the foreign election outcome (θ_{-iP}) as given in (5), and the elected policymakers solve (4) to choose $t_i = t_i(\theta_{iP}, \theta_{-iP})$. These policy outcome *functions* are acknowledged in (5), but the *outcomes* t_i and t_{-i} cannot be given in Stage 2. The first-order condition with respect to θ_{iP} derives the following formula (see the Appendix for the derivation):

$$\theta_{iP} \lesseqgtr \theta_{im} \iff \theta_{im}\overline{k}_i - k_i \lesseqgtr 0. \tag{6}$$

From (2), we conclude that at least one country chooses $\theta_{iP} < \theta_{im}$.

(iii) Suppose that the representative in country $-i$ commits to t_{-i} in Stage 2 and the other representative (country i) does not commit to t_i. As mentioned in Section 3.2, country i's tax choice in Stage 3 is determined by (4) (applied to $iP = im$; again, the tax choice is according to the median voter's preference). Then, along $t_i = \tau_i(t_{-i}; \theta_{im})$, country $-i$ can decide on t_{-i} in Stage 2 in order to maximize u_{-im}: namely, $\max_{t_{-i}} f_{-i}(\hat{k}_{-i}(t_{-i}, t_i)) + \hat{r}(t_{-i}, t_i)(\theta_{-im}\overline{k}_{-i} - \hat{k}_{-i}(t_{-i}, t_i))$ s.t. $t_i = \tau_i(t_{-i}; \theta_{im})$. These tax choices are equivalent to the Stackelberg tax competition outcome where country $-i$'s citizen m is the Stackelberg tax leader and country i's citizen m is the Stackelberg tax follower. *Q.E.D.*

3.4 The Structure of the Game and Countries' Incentives

Table 1 characterizes the outcome of the pre-election stage (Stage 1) with respect to (t_A, t_B). When both countries choose commitment C (i.e., to be critical on the election promises), the outcome is equivalent to the *self-representation* (following Segendorff (1998)) where $\theta_{iP} = \theta_{im}$ for both countries. In contrast, when both countries choose non-commitment N, the outcome with *strategic delegation* appears where $\theta_{iP} \neq \theta_{im}$ at least in one country. Denote $t_i(\theta_{iP}, \theta_{-iP})$ in Regime (N, N) as t_i^S. In the hybrid cases where one country chooses C and the other chooses N, the superscript L and F denote the Stackelberg leader and the follower respectively.[7]

[6] Equivalently, the median voter himself/herself becomes the elected policymaker who announces the preferred tax rate.

[7] The structure of this commitment game is different from that of the timing game (e.g., Hindriks and Nishimura (2017) and Ogawa and Susa (2017a)). In particular, different from the timing-game literature in the asymmetric tax competition, we show below that the Stackelberg outcomes never constitute a subgame-perfect equilibrium.

If country $-i$ chooses C, then, country i faces a choice between the Nash-tax competition (by choosing C) and the Stackelberg follower (by choosing N). Here, the country's choice depends on whether there is a *second-mover incentive.* This issue in the asymmetric tax competition is analyzed by Hindriks and Nishimura (2017) in the context of $a_A > a_B$ in the parametric form of the production function. If country $-i$ chooses N, then country i's choice depends on whether the Stackelberg leader (choice of t_i) is more beneficial than the strategic delegation (choice of $\theta_{iP} \neq \theta_{im}$) in Stage 1.

		Country B	
		Commit	*No Commit*
Country A	*Commit*	$(t_A(\theta_{Am}, \theta_{Bm}), t_B(\theta_{Am}, \theta_{Bm}))$	$(t_A^L,\ t_B^F)$
	No Commit	$(t_A^F,\ t_B^L)$	(t_A^S, t_B^S)

Table 1: Outcomes of the Commitment Game

The citizens (public) in Stage 1 influence the policymakers' decision-making by the adoption of the media that are critical of breaking election promises. We assume that the choice of the Regimes C and N is made by the majority of citizens, which corresponds to the subscription numbers of newspapers and the participants of social media. Then, the following lemma shows that it is sufficient to check the preference of the median voter for Stage 1's choice of regimes:

Lemma 1 *For any pair of the outcomes whose tax rates are (t_A^1, t_B^1) and (t_A^2, t_B^2), the preference of the median voter is consistent with that of the majority of the same country.*

Let us denote the tax rates in each cell of Table 1 as functions of the regime choice of each country. Namely, $t_i^*(C,C) \equiv t_i(\theta_{im}, \theta_{im})$, $t_i^*(N,N) \equiv t_i^S$, $(t_A^*(C,N),\ t_B^*(C,N)) \equiv (t_A^L,\ t_B^F)$, and $(t_A^*(N,C),\ t_B^*(N,C)) \equiv (t_A^F,\ t_B^L)$. Accordingly, the Stage-4 values are determined by, for example, $k_i^*(C,C) \equiv \hat{k}_i(t_i^*(C,C), t_{-i}^*(C,C))$ and $r^*(C,C) \equiv \hat{r}(t_i^*(C,C), t_{-i}^*(C,C))$. Substituting these values to (3), u_{ij} is denoted as functions of the regime choice of each country.

4 Equilibrium Electoral Commitment and Voter Welfare

4.1 Countries with Different Population Sizes ($s_A > s_B,\ a_A = a_B = a,\ \theta_{Am} = \theta_{Bm} = \theta_m,\ \overline{k}_A = \overline{k}_B = \overline{k}$)

From now on, we explicitly derive the equilibrium outcome and voters' welfare under the quadratic production function $f_i(k_i) = a_i k_i - k_i^2$ with $a_A \geq a_B$. We first consider a framework developed by Bucovetsky (1991) and Wilson (1991) in which the population size differs between countries ($s_A > s_B$).

Proposition 2 *Suppose that countries differ in population size.*

(i) The choice of no-commitment is the dominant strategy for both countries.

(ii) Both median voters are made better off under (N, N) than under (C, C).

Since (N, C) or (C, N) never constitutes an equilibrium, here we compare the outcome of no-commitment to commitment. The latter (the tax-competition outcome through self-representation) is a natural benchmark to recollect the previous results on the asymmetric tax competition. We have $t_A^*(C, C) = t_A(\theta_{Am}, \theta_{Bm}) > t_B^*(C, C)$. When there is no asymmetry in other dimensions ($a_i = a,\ \overline{k}_i = \overline{k},\ \theta_{im} = \theta_m$), the low-population country (country B) obtains higher per capita capital ($k_B^*(C, C) > k_A^*(C, C)$). This causes the so-called *benefit of smallness* in which $u_{Aj}^*(C, C) < u_{Bj}^*(C, C)$ for all j such that $\theta_{Aj} = \theta_{Bj}$, as well as inefficiency in capital allocation (the total output $\sum_i f_i(k_i)\overline{L}_i$ is not maximized when $f_A'(k_A) > f_B'(k_B)$). All these properties are shown in the Appendix.

In contrast, under (N, N), we show in the Appendix that $\theta_{AP} > \theta_{BP}$ for $s_A > 0.5 > s_B$. That is, under non-commitment to the tax rates, the high-population country sends a policymaker who is richer than that of the low-population country to counteract the disadvantage generated by the capital-tax competition. As a result, the difference and inefficiency of the allocation of the capital is reduced. We show in the Appendix the following:

Lemma 2 *Suppose that countries differ in population size. Non-commitment reduces the inefficiency of the allocation of the capital:* $f_A'(k_A^*(C, C)) - f_B'(k_B^*(C, C)) > f_A'(k_A^*(N, N)) - f_B'(k_B^*(N, N)) > 0$.

In this scenario, the low-population country (country B) has higher capital demand elasticity (sensitivity of the tax base to fiscal rates): from (1) and (2), $-\dfrac{\partial \hat{k}_A}{\partial t_A} = -\dfrac{s_B}{s_A}\dfrac{\partial \hat{k}_B}{\partial t_B} < -\dfrac{\partial \hat{k}_B}{\partial t_B}$. This effect tends to make country B's tax rate lower than that of country A. However, the terms-of-trade effect works in the opposite direction because higher tax rates benefit the capital importer and harm the capital exporter through lower interest rates. In conventional models, the terms-of-trade effect is no more important than the tax-base-elasticity effect (Bucovetsky (2009, Lemma 3)). Here, however, strategic delegation works to increase the capital importer's tax rate to a greater extent than that of the capital exporter.

Also, in this subsection, as well as the following subsections, non-commitment reduces the return of capital ($r^*(N, N) - r^*(C, C) < 0$: see the Appendix). From (3) and $\theta_{im} < 1$, non-commitment tends to increase the utility of the median voters.

Noncooperative choice of the regime is consistent with the fact that median voters are made better off under non-commitment. Here, there is no benefit of commitment to t_i in either country, regardless of the other country's choice.

4.2 Countries with Different Productivity ($a_A > a_B,\ s_A = s_B,\ \theta_{im} = \theta_m,\ \overline{k}_i = \overline{k}$)

In this subsection, we consider the case of $a_A > a_B$ where country A has higher capital productivity, keeping symmetry on other dimensions ($s_i = 0.5,\ \theta_{im} = \theta_m,\ \overline{k}_i = \overline{k}$). For convenience, we define the term $\delta \equiv \dfrac{a_A - a_B}{\overline{k}} > 0$.

In Stage 4, due to the difference in national productivity ($a_A > a_B$), country A becomes a capital importer and country B becomes a capital exporter. This effect causes the *tax-the-foreigner effect*, which results in $t_A > t_B$ in the third stage. From (1), we have $f'_A(\hat{k}_A(t_A, t_B)) > f'_B(\hat{k}_B(t_A, t_B))$, i.e., the allocation of capital is inefficient.

Regarding the second-mover incentives ($u^*_{im}(N, C) > u^*_{im}(C, C)$), we apply Hindriks and Nishimura (2017) here, in which the likelihood of the second-mover incentives is higher when (a) δ is low and/or (b) θ_m is low.[8] When asymmetry increases, the preferred tax rate in region A (capital importer) and region B (capital exporter) tends to diverge. This divergence of the interest across policymakers makes the sequential move less attractive, and both countries try to take a lead in setting the tax rates. Thus, simultaneous-move (commitment to t_i by both countries) becomes more likely to happen. Greater capital ownership by the median voter generates the same effect. The similar tendency exists for the other margin ($u^*_{im}(N, N) > u^*_{im}(C, N)$): the choice of the strategic-delegation outcome against the Stackelberg leader is more likely when δ and/or θ_m are low. As for the tax choices with non-commitment, a country with lower tax-base elasticity[9] is a capital *importer*, so the tax gap increases through non-commitment. In the Appendix, we show:

$$t_A(\theta_{AP}, \theta_{BP}) - t_B(\theta_{AP}, \theta_{BP}) = \frac{\delta\overline{k}}{2} - (\theta_{AP} - \theta_{BP})\overline{k}. \tag{7}$$

Again, we compare the regimes (C, C) and (N, N) which are the only possible equilibrium regimes. The first term on the right-hand side of (7) captures the tax-the-foreigner effect by the high-productive country, which is present even under commitment ($t_A > t_B$ when $\theta_{iP} = \theta_m = \theta_{-iP}$). Under non-commitment, the second term strengthens the difference ($\theta_{AP} < \theta_{BP}$ as shown in the Appendix) so that the tax gap is widened under non-commitment ($t^*_A(N, N) - t^*_B(N, N) > t^*_A(C, C) - t^*_B(C, C) > 0$), which reduces capital import from country A to country B and makes the extent of allocation inefficiency worse under non-commitment: from (1), we have $f'_A(k^*_A(N, N)) - f'_B(k^*_B(N, N)) > f'_A(k^*_A(C, C)) - f'_B(k^*_B(C, C)) > 0$).

Lemma 3 *Suppose that countries differ in productivity of the capital. Non-commitment worsens the inefficiency of the allocation of the capital.*

Regarding the choice of regimes in Stage 1, we have:

Lemma 4 *Suppose that countries differ in productivity of the capital, with $a_A = a_B + \delta\overline{k}$. There exist $0 < \delta^1 < \delta^2 < \delta^3 < \delta^4$ such that:*

[8] In Hindriks and Nishimura (2017), θ denotes the share of the domestic ownership of the capital. What matters is the extent that the policymaker or the decisive voter cares about the value of the capital endowment. The case of $\theta_m \to 1$ which we analyze below corresponds to that of the full domestic capital ownership addressed in Ogawa (2013).

[9] For the case of $a_A > a_B$, evaluated at equal tax rates, the capital demand elasticities at $t_A = t_B = t$ are $|\varepsilon_{k_i/t_i}| = -\dfrac{\partial k_i}{\partial t_i}\dfrac{t_i}{k_i} = \dfrac{t}{a_i - a_{-i} + 4\overline{k}}$. Therefore, country A has lower capital demand elasticity than country B.

(i) For $\delta \in (0, \delta^1)$, non-commitment by both countries constitutes the dominance-solvable equilibrium.

(ii) For $\delta \in (\delta^1, \delta^2)$, the equilibrium outcomes are (N, N) and (C, C). Both median voters are made better off under (N, N) than under (C, C).

(iii) For $\delta > \delta^2$, commitment by both countries constitutes the dominance-solvable equilibrium.

(iv) For $\delta < \delta^3$, both median voters are made better off under (N, N) than under (C, C). For $\delta > \delta^4$, both median voters are made better off under (C, C) than under (N, N).

δ^d $(d = 1, 2, 3, 4)$ are decreasing in θ_m: with greater θ_m, commitment by both countries is more likely to be an equilibrium.

For low values of δ, N is not only a plausible but also a desirable outcome. However, with sufficiently high asymmetry or sufficiently high θ_m, commitment by both countries becomes not only the equilibrium outcome but also the desirable outcome for the median voters. In some intermediate range of the degree of asymmetry, there is a discrepancy between the equilibrium outcomes and the welfare (of the median voters): in case (ii), a welfare inferior outcome of (C, C) appears as another equilibrium; moreover, for $\delta \in (\delta^2, \delta^3) \approx (9.82(1-\theta_m), 9.85(1-\theta_m))$, the equilibrium outcome (C, C) is worse than (N, N) for median voters: there is a prisoners'-dilemma situation in Stage 1, since the divergence of the preferred tax rates by median voters makes both countries take a lead through commitments on t_i.

The following proposition illuminates the determinants of the equilibrium commitment, with the descriptions of representative limit cases:

Proposition 3 *Suppose that countries differ in productivity of the capital, with $a_A = a_B + \delta\bar{k}$.*

(i) Suppose that $\delta \to 0$. Then, for all $\theta_m < 1$, (a) the choice of no-commitment is the dominant strategy for both countries; and (b) both median voters are made better off under (N, N) than under (C, C).

(ii) Suppose that $\theta_m \to 1$. Then, for all $\delta > 0$, (a) the choice of commitment is the dominant strategy for both countries; and (b) both median voters are made better off under (C, C) than under (N, N).

Proposition 3.(i) is consistent with Persson and Tabellini (1992) which dealt with symmetric countries of $\theta_m < 1$. In contrast, Proposition 3.(ii) refers to the case when the decisive voter cares the average of the national capital endowment, or the case where the inequality of income distribution is not a driving force of determining t_i. In short, contrary to Persson and Tabellini (1992), with more equal distribution of the capital endowment *within* each country and with sufficiently high asymmetry *across* countries, commitment by both countries becomes the equilibrium outcome.

4.3 Countries with Different Median Voters ($\theta_{Am} > \theta_{Bm},\ s_A = s_B,\ a_i = a,\ \overline{k}_i = \overline{k}$)

In this subsection, we discuss the case where the median voters' endowments differ ($\theta_{Bm} < \theta_{Am} < 1$). The case of different θ_{im}'s is due to different income distribution,[10] which is discussed in the strategic-delegation literature since Persson and Tabellini (1992).

In this case, the poorer median voter (in country B) aims for higher tax due to stronger redistributive motive, so that $\theta_{BP} < \theta_{AP}$ under the regime (N, N). Capital flows to the low-tax country (country A), but the difference in the redistributive motive dominates the tax-the-foreigner effect, so non-commitment widens the tax gap ($t^*_B(N, N) - t^*_A(N, N) > t^*_B(C, C) - t^*_A(C, C) > 0$) which leads to the following conclusion:

Lemma 5 *Suppose that countries differ in income distribution. Non-commitment worsens the inefficiency of the allocation of the capital:* $f'_B(k^*_B(N, N)) - f'_A(k^*_A(N, N)) > f'_B(k^*_B(C, C)) - f'_A(k^*_A(C, C)) > 0$*).*

However, we obtain the following result:

Proposition 4 *Suppose that countries differ in income distribution. For all* $1 > \theta_{Am} > \theta_{Bm} > 0$*,*
(i) The choice of no-commitment is the dominant strategy for both countries.
(ii) Both median voters are made better off under (N, N) *than under* (C, C)*.*

In contrast with Section 4.1 (differences in population), when the relevant dimension of country heterogeneity is income distribution, the inefficiency of the allocation of capital is worsened by non-commitment. However, as in Proposition 2, Regime (N, N) is not only an equilibrium outcome but also a desirable outcome in terms of the utility of the majority of citizens in both countries. However, regarding the welfare of the citizens, since non-commitment reduces production in country B and the equilibrium interest rate, the choice of (N, N) unambiguously reduces the welfare of richer citizens in country B.

4.4 Countries with Different Capital Endowments ($\overline{k}_A > \overline{k}_B,\ s_A = s_B,\ a_i = a,\ \theta_{im} = \theta_m$)

Suppose that country A has a higher capital endowment. In this case, country A becomes a capital exporter and tends to lower the tax rate. However, country A also has a bigger tax base, and thus can obtain a higher level of tax revenue from the same tax rates. The tax competition leads to $f'_A(k_A) < f'_B(k_B)$. Parallel to the previous propositions, we obtain the following:

Proposition 5 *Suppose that countries differ in capital endowments, with* $\overline{k}_A = \overline{k}_B(1 + \xi)$*. With more equal distribution of the capital endowment within each country and with sufficiently high*

[10] Alternatively, it can result from different political participation across citizens in different income classes, as in Benabou (2000).

asymmetry across countries, commitment by both countries is more likely to become the equilibrium outcome.[11]

As to the tax gap, $t_B^*(N,N) - t_A^*(N,N) > t_B^*(C,C) - t_A^*(C,C) > 0$ as in Section 4.2 (see the Appendix), so that non-commitment leads to more inefficient allocation of capital. With more equal distribution of the capital and more country asymmetry, the difference in interests between the capital importer and the capital exporter becomes more pronounced. These are the drivers to make commitment by both countries become the equilibrium outcome.

4.5 General Remarks

One of the general features in this section is as follows: regardless of the types of asymmetry under consideration, asymmetric regimes (namely, (C,N) and (N,C)), equivalently, the Stackelberg outcomes, never constitute (pure-strategy) equilibrium. In Sections 4.1 and 4.3, the second-mover incentives ($u_{im}^*(N,C) > u_{im}^*(C,C)$) and the non-commitment in the other margin ($u_{im}^*(N,N) > u_{im}^*(C,N)$) persist, regardless of the degree of asymmetries. In Sections 4.2 and 4.4, the second-mover incentives cease to hold under sufficient asymmetry, but the critical degree of asymmetry that switches the second-mover incentives (δ^1 for country B in Lemma 4)[12] is lower than that of the other margin (δ^2 for country B in Lemma 4).[13] In short, N is more likely to be the best-response against N than against C. Starting from (N,N) being the equilibrium under symmetric countries, we find a sufficiently high degree of asymmetries (or sufficiently high θ_{im}) at which both countries have C to be the best-response to C.

In Sections 4.2 and 4.4, in some intermediate range of the degree of asymmetry, the above tendency to choose C generates a prisoners'-dilemma situation in which the equilibrium outcome (C,C) is worse than (N,N) for median voters ($\delta \in (\delta^2, \delta^3)$ in Lemma 4).

Appendix

Derivation of (6)

From (4), $\dfrac{\partial u_{im}}{\partial t_i} = t_i \dfrac{\partial \hat{k}_i}{\partial t_i} + (\theta_{im}\overline{k}_i - k_i)\dfrac{\partial \hat{r}}{\partial t_i} = (\theta_{im} - \theta_{iP})\overline{k}_i \dfrac{\partial \hat{r}}{\partial t_i}$. Also, $\dfrac{\partial u_{im}}{\partial t_{-i}} = t_i \dfrac{\partial \hat{k}_i}{\partial t_{-i}} + (\theta_{im}\overline{k}_i - k_i)\dfrac{\partial \hat{r}}{\partial t_{-i}}$. Since $\dfrac{\partial \hat{k}_i}{\partial t_{-i}} = -\dfrac{\partial \hat{k}_i}{\partial t_i}$ and $\dfrac{\partial \hat{r}}{\partial t_{-i}} = -\dfrac{\partial \hat{r}}{\partial t_i} - 1$, we have $\dfrac{\partial u_{im}}{\partial t_{-i}} = (\theta_{iP}\overline{k}_i - k_i)\dfrac{\partial \hat{r}}{\partial t_i} - (\theta_{im}\overline{k}_i - k_i)\left(\dfrac{\partial \hat{r}}{\partial t_i} + 1\right)$. From $\dfrac{\partial t_{-i}}{\partial \theta_{iP}} = \dfrac{\partial t_i}{\partial \theta_{iP}} \dfrac{\partial \tau_{-i}}{\partial t_i}$ derived below in (A.4), the first-order condition of (5) with respect to θ_{iP}

[11] The formal description that supports the statement here is relegated to Lemma 6 in the Appendix. Also, the statement of Proposition 3 holds here with respect to the asymmetry parameter ξ.

[12] The same nature is observed for Section 4.4. Here, we write the case of Lemma 4 for a representative illustration.

[13] The same features apply to country A, as shown in the Appendix.

derives:

$$\frac{\partial u_{im}}{\partial t_i}\frac{\partial t_i}{\partial \theta_{iP}} + \frac{\partial u_{im}}{\partial t_{-i}}\frac{\partial t_{-i}}{\partial \theta_{iP}} = (\theta_{im} - \theta_{iP})\overline{k}_i\left(1 - \frac{\partial \tau_{-i}}{\partial t_i}\right)\frac{\partial \hat{r}}{\partial t_i}\frac{\partial t_i}{\partial \theta_{iP}} - (\theta_{im}\overline{k}_i - k_i)\frac{\partial \tau_{-i}}{\partial t_i}\frac{\partial t_i}{\partial \theta_{iP}} = 0. \quad (A.1)$$

Below we show that $\left(1 - \frac{\partial \tau_{-i}}{\partial t_i}\right)\frac{\partial \hat{r}}{\partial t_i}\frac{\partial t_i}{\partial \theta_{iP}} > 0$ and $\frac{\partial \tau_{-i}}{\partial t_i}\frac{\partial t_i}{\partial \theta_{iP}} < 0$, so that (A.1) derives (6).

Since $\frac{\partial \hat{r}}{\partial t_i} = -f''_{-i}\frac{s_i}{s_{-i}}\frac{\partial \hat{k}_i}{\partial t_i}$, (4) is rearranged to

$$\frac{\partial u_{im}}{\partial t_i} = \left(t_i - (\theta_{iP}\overline{k}_i - k_i)f''_{-i}\frac{s_i}{s_{-i}}\right)\frac{\partial \hat{k}_i}{\partial t_i} \equiv \beta_i(t_i, t_{-i})\frac{\partial \hat{k}_i}{\partial t_i} = 0, \quad (A.2)$$

where $\beta_i \equiv t_i - (\theta_{iP}\overline{k}_i - k_i)f''_{-i}\frac{s_i}{s_{-i}}$. Note that $\frac{\partial \hat{k}_i}{\partial t_i} < 0$. A total differentiation of the first-order condition yields[14]

$$\frac{\partial \tau_i(t_{-i};\theta_{iP})}{\partial t_{-i}} = -\frac{\partial \beta_i/\partial t_{-i}}{\partial \beta_i/\partial t_i}. \quad (A.3)$$

When $f'''_{-i} = 0$, using $\frac{\partial \hat{k}_i}{\partial t_{-i}} = -\frac{\partial \hat{k}_i}{\partial t_i}$, we have $\frac{\partial \tau_i(t_{-i};\theta_{iP})}{\partial t_{-i}} = -\frac{\frac{s_i}{s_{-i}}f''_{-i}\frac{\partial \hat{k}_i}{\partial t_{-i}}}{1 + \frac{s_i}{s_{-i}}f''_{-i}\frac{\partial \hat{k}_i}{\partial t_i}} = \frac{\frac{s_i}{s_{-i}}f''_{-i}\frac{\partial \hat{k}_i}{\partial t_i}}{1 + \frac{s_i}{s_{-i}}f''_{-i}\frac{\partial \hat{k}_i}{\partial t_i}} \in (0,1)$.

Totally differentiating the system of $\beta_i(t_i, t_{-i}) = 0$ and $\beta_{-i} \equiv t_{-i} - (\theta_{-iP}\overline{k}_{-i} - k_{-i})f''_i\frac{s_{-i}}{s_i} = 0$, we have

$$\begin{pmatrix} \partial\beta_i/\partial t_i & \partial\beta_i/\partial t_{-i} \\ \partial\beta_{-i}/\partial t_i & \partial\beta_{-i}/\partial t_{-i} \end{pmatrix}\begin{pmatrix} dt_i \\ dt_{-i} \end{pmatrix} = \begin{pmatrix} \overline{k}_i f''_{-i}\frac{s_i}{s_{-i}}d\theta_{iP} \\ 0 \end{pmatrix}.$$

We therefore have

$$\begin{pmatrix} \partial t_i/\partial\theta_{iP} \\ \partial t_{-i}/\partial\theta_{iP} \end{pmatrix} = \frac{\overline{k}_i f''_{-i}\frac{s_i}{s_{-i}}}{\Delta}\begin{pmatrix} \partial\beta_{-i}/\partial t_{-i} \\ -\partial\beta_{-i}/\partial t_i \end{pmatrix} = \frac{\overline{k}_i f''_{-i}\frac{s_i}{s_{-i}}}{\Delta}\frac{\partial \beta_{-i}}{\partial t_{-i}}\begin{pmatrix} 1 \\ \partial\tau_{-i}/\partial t_i \end{pmatrix}, \quad (A.4)$$

where $\Delta \equiv \frac{\partial \beta_i}{\partial t_i}\frac{\partial \beta_{-i}}{\partial t_{-i}} - \frac{\partial \beta_i}{\partial t_{-i}}\frac{\partial \beta_{-i}}{\partial t_i}$.

The last equation of (A.4) follows from the formula of the reaction function (A.3) applied to country $-i$. Note that $\frac{\partial \beta_{-i}}{\partial t_{-i}} > 0$ from the second-order condition, and $\Delta = \frac{\partial \beta_i}{\partial t_i}\frac{\partial \beta_{-i}}{\partial t_{-i}}\left(1 - \frac{\partial \tau_i}{\partial t_{-i}}\frac{\partial \tau_{-i}}{\partial t_i}\right) >$

[14] In the derivation for (A.1) and (A.4), we do not rely on the quadratic production function. To derive (6), we only need to assume strategic complementarity in tax rates ($\partial\tau_{-i}/\partial t_i > 0$) which is conventional in the tax-competition literature. Instead of a mechanical derivation based on the quadratic production function, we adopted a general illustration here.

0. We therefore have $\dfrac{\partial t_i}{\partial \theta_{iP}} < 0$ and $0 < \dfrac{\partial \tau_{-i}}{\partial t_i} < 1$, so $\left(1 - \dfrac{\partial \tau_{-i}}{\partial t_i}\right) \dfrac{\partial \hat{r}}{\partial t_i} \dfrac{\partial t_i}{\partial \theta_{iP}} > 0$ and $\dfrac{\partial t_{-i}}{\partial \theta_{iP}} = \dfrac{\partial t_i}{\partial \theta_{iP}} \dfrac{\partial \tau_{-i}}{\partial t_i} < 0$ hold.

Proof of Lemma 1

k_i and r in (3) are determined by $k_i = \hat{k}_i(t_A, t_B)$ and $r = \hat{r}(t_A, t_B)$, so we represent $u_{ij} = u_{ij}(t_A^1, t_B^1)$. $u_{ij}(t_A^1, t_B^1) = u_{im}(t_A^1, t_B^1) + \hat{r}(t_A^1, t_B^1) \cdot (\theta_{ij} - \theta_{im}) \overline{k}_i$. Therefore, $u_{ij}(t_A^1, t_B^1) - u_{ij}(t_A^2, t_B^2) = u_{im}(t_A^1, t_B^1) - u_{im}(t_A^2, t_B^2) + (\hat{r}(t_A^1, t_B^1) - \hat{r}(t_A^2, t_B^2)) \cdot (\theta_{ij} - \theta_{im}) \overline{k}_i$. Suppose that $u_{im}(t_A^1, t_B^1) - u_{im}(t_A^2, t_B^2) > 0$. Then, if $\hat{r}(t_A^1, t_B^1) > \hat{r}(t_A^2, t_B^2)$, then $u_{ij}(t_A^1, t_B^1) > u_{ij}(t_A^2, t_B^2)$ for all $\theta_{ij} > \theta_{im}$, and if $\hat{r}(t_A^1, t_B^1) < \hat{r}(t_A^2, t_B^2)$, then $u_{ij}(t_A^1, t_B^1) > u_{ij}(t_A^2, t_B^2)$ for all $\theta_{ij} < \theta_{im}$. If $\hat{r}(t_A^1, t_B^1) = \hat{r}(t_A^2, t_B^2)$, then $u_{ij}(t_A^1, t_B^1) > u_{ij}(t_A^2, t_B^2)$ for all θ_{ij}. In all cases, the preference of the majority is consistent with that of the median voter. *Q.E.D.*

Proof of Proposition 2 and Lemma 2

Begin with the Stage-4 equilibrium allocation of capital. In the quadratic model, solving (1) and (2) gives:

$$\hat{k}_i(t_A, t_B) = s_i \overline{k}_i + s_{-i} \overline{k}_{-i} + \frac{s_{-i}}{2} \left((a_i - a_{-i}) - (t_i - t_{-i})\right). \tag{A.5}$$

Also,

$$\hat{r}(t_A, t_B) = \sum_{i=A,B} \left(s_i(a_i - 2\overline{k}_i - t_i)\right) \tag{A.6}$$

Substituting $(k_A, k_B) = (\hat{k}_A(t_A, t_B), \hat{k}_B(t_A, t_B))$ into (A.2) $(i = A,\ B)$ yields $(t_A, t_B) = (t_A(\theta_{AP}, \theta_{BP}), t_B(\theta_{AP}, \theta_{BP}))$.

In the quadratic model, with $k_i(\theta_{iP}, \theta_{-iP}) \equiv \hat{k}_i(t_i(\theta_{iP}, \theta_{-iP}), t_{-i}(\theta_{iP}, \theta_{-iP}))$, (A.1) in Stage 2 at Regime (N, N) is equivalent to:

$$\theta_{im} - \theta_{iP} = -\frac{s_{-i}}{s_i} \left(\theta_{im} - \frac{k_i(\theta_{iP}, \theta_{-iP})}{\overline{k}_i}\right). \tag{A.7}$$

Under the suppositions of $a_i = a_{-i} = a$, $\overline{k}_i = \overline{k}_{-i} = \overline{k}$ and $\theta_{im} = \theta_{-im} = \theta_m$, from (A.2) and (A.5), we derive

$$t_i(\theta_{iP}, \theta_{-iP}) = -\frac{(-\theta_{iP} s_{-i}^2 + \theta_{-iP} s_{-i}^2 + \theta_{iP} - 1)\overline{k}}{s_{-i}},\ k_i(\theta_{iP}, \theta_{-iP}) = \frac{(-\theta_{-iP} s_{-i}^2 + \theta_{iP} s_i^2 + 1)\overline{k}}{2s_i}. \tag{A.8}$$

Solving (A.7) and (A.8) derives the delegate's type in Regime (N, N) as

$$\theta_{iP} = \frac{-(1 - s_i^2) + \theta_m(1 + 2s_i^2)}{3s_i^2}. \tag{A.9}$$

We have $\theta_{AP} - \theta_{BP} = \dfrac{(2s_A - 1)(1-\theta_m)}{3s_A^2 s_B^2} > 0$. In our notation here, $k_i^*(N,N) = k_i(\theta_{iP}, \theta_{-iP})$ (where θ_{iP}s are those of (A.9)) and $k_i^*(C,C) = k_i(\theta_m, \theta_m)$. From (A.8), we have

$$k_i^*(N,N) = \frac{(2s_i\theta_m + s_i - \theta_m + 1)\overline{k}}{3s_i},\ k_i^*(C,C) = \frac{(2s_i\theta_m - \theta_m + 1)\overline{k}}{2s_i},$$

from which we have $k_B^*(C,C) - k_A^*(C,C) > k_B^*(N,N) - k_A^*(N,N) > 0$. In addition, from (A.6), we have $r^*(N,N) - r^*(C,C) = \dfrac{(-2s_A^2 + 2s_A + 1)(\theta_m - 1)\overline{k}}{3s_A s_B} < 0$.

Regarding the benefit of smallness,

$$\begin{aligned} u_{Aj}^*(C,C) - u_{Bj}^*(C,C) &= \frac{(1-\theta_m)^2(1-2s_A)\overline{k}^2}{4s_A^2 s_B^2} < 0 \text{ for all } \theta_{Aj} = \theta_{Bj}. \\ u_{Aj}^*(N,N) - u_{Bj}^*(N,N) &= \frac{(1-\theta_m)^2(1-2s_A)\overline{k}^2}{3s_A^2 s_B^2} < 0 \text{ for all } \theta_{Aj} = \theta_{Bj}. \end{aligned}$$

The Stackelberg tax rates are the tax rates that satisfy $\dfrac{\partial u_{im}}{\partial t_i} + \dfrac{\partial u_{im}}{\partial t_{-i}}\dfrac{\partial \tau_{-i}}{\partial t_i} = 0$ and (4) (equivalently, (A.2)) applied to country $-i$ and $-iP = -im$. We have:

$$t_i^L = \frac{2\overline{k}(1-\theta_m)}{s_i(1-s_i)(3-s_i)},\ t_{-i}^F = \frac{2\overline{k}(1-\theta_m)(1+s_{-i})}{(1-s_{-i})(2+s_{-i})}.$$

We proceed to calculate the choice of Stage-1 strategy in Table 1.

$$u_{im}^*(N,C) - u_{im}^*(C,C) = \frac{(1-\theta_m)^2(1+s_i)(4+3s_i)\overline{k}^2}{4s_i(1-s_i)(2+s_i)^2} > 0 \quad (i = A,\ B).$$

Moreover,

$$u_{im}^*(N,N) - u_{im}^*(C,N) = \frac{(1-\theta_m)^2(2-s_i)(6+2s_i-s_i^2)\overline{k}^2}{9s_i(1-s_i)(3-s_i)} > 0 \quad (i = A,\ B).$$

Therefore, playing N is the dominant strategy for both countries, for all parameter values. Also,

$$u_{im}^*(N,N) - u_{im}^*(C,C) = \frac{(1-\theta_m)^2(1+s_i)(-4s_i^2+8s_i+3)\overline{k}^2}{36s_i^2(1-s_i)} > 0 \quad (i = A,\ B).$$

Thus Proposition 2.(ii) is verified. *Q.E.D.*

Proof of Lemma 3, Lemma 4 and Proposition 3

Under the suppositions of $s_i = s_{-i} = 0.5$, $\overline{k}_i = \overline{k}_{-i} = \overline{k}$ and $\theta_{im} = \theta_{-im} = \theta_m$, from (A.2) and (A.5), we have

$$t_i(\theta_{iP}, \theta_{-iP}) = 2\overline{k} + \frac{a_i - a_{-i}}{4} - \frac{(3\theta_{iP} + \theta_{-iP})\overline{k}}{2},\ k_i(\theta_{iP}, \theta_{-iP}) = \overline{k} + \frac{1}{8}\left((a_i - a_{-i}) + 2(\theta_{iP} - \theta_{-iP})\overline{k}\right). \tag{A.10}$$

Solving (A.7) and (A.10) derives the delegate's type in Regime (N, N) as

$$\theta_{AP} = -1 + 2\theta_m - \frac{\delta}{12},\ \theta_{BP} = -1 + 2\theta_m + \frac{\delta}{12}. \tag{A.11}$$

From (A.6), we have $r^*(N,N) - r^*(C,C) = 2\overline{k}(\theta_m - 1) < 0$. In addition, we have $\theta_{AP} < \theta_{BP}$. (A.10) shows (7) in the text and $t^*_A(N,N) - t^*_B(N,N) > t^*_A(C,C) - t^*_B(C,C) > 0$. (1) derives the conclusion of Lemma 3.

The Stackelberg tax rates are, for $I(A) \equiv 1$ and $I(B) \equiv 2$:

$$t_i^L = \frac{16\overline{k}}{5}(1-\theta_m) - \frac{2}{5}(-1)^{I(i)}\delta\overline{k},\ t_{-i}^F = \frac{12\overline{k}}{5}(1-\theta_m) + \frac{1}{5}(-1)^{I(i)}\delta\overline{k}.$$

We proceed to calculate the choice of Stage-1 strategy in Table 1.

$$u^*_{Am}(N,C) - u^*_{Am}(C,C) = -\frac{27\overline{k}^2}{1600}\left(\delta - 8(1-\theta_m)\right)\left(\delta + \frac{88}{9}(1-\theta_m)\right) \gtreqless 0$$
$$\iff \delta \lesseqgtr 8(1-\theta_m) \equiv \delta^0. \tag{A.12}$$

$$u^*_{Bm}(C,N) - u^*_{Bm}(C,C) = -\frac{27\overline{k}^2}{1600}\left(\delta + 8(1-\theta_m)\right)\left(\delta - \frac{88}{9}(1-\theta_m)\right) \gtreqless 0$$
$$\iff \delta \lesseqgtr \frac{88}{9}(1-\theta_m) \equiv \delta^1. \tag{A.13}$$

$$u^*_{Am}(N,N) - u^*_{Am}(C,N) = -\frac{11\overline{k}^2}{720}\left(\delta - 12(1-\theta_m)\right)\left(\delta + \frac{108}{11}(1-\theta_m)\right) \gtreqless 0$$
$$\iff \delta \lesseqgtr 12(1-\theta_m) \equiv \delta^5. \tag{A.14}$$

$$u^*_{Bm}(N,N) - u^*_{Bm}(N,C) = -\frac{11\overline{k}^2}{720}\left(\delta + 12(1-\theta_m)\right)\left(\delta - \frac{108}{11}(1-\theta_m)\right) \gtreqless 0$$
$$\iff \delta \lesseqgtr \frac{108}{11}(1-\theta_m) \equiv \delta^2. \tag{A.15}$$

Note that we have $\delta^0 < \delta^1 < \delta^2 < \delta^5$. Suppose first that $\delta < \delta^1$. From (A.13) and (A.15), non-commitment is the dominant strategy for country B. Then, given country B's choice of N, from (A.14), country A chooses N. Therefore, (N, N) is the dominance-solvable equilibrium. Next, suppose that $\delta \in (\delta^1, \delta^2)$. Then, from (A.12) and (A.13), C is the best-response to C for each other, and from (A.14) and (A.15), N is the best-response to N for each other. Finally, suppose that $\delta > \delta^2$. From (A.13) and (A.15), commitment is the dominant strategy for country B. Then, given country A's choice of C, from (A.14), country A chooses C. Therefore, (C, C) is the dominance-solvable equilibrium. Since δ^d $(d = 1, 2)$ are decreasing in θ_m, with greater θ_m, (C, C) is more likely to be an equilibrium.

$u^*_{im}(N, N) - u^*_{im}(C, C) > 0$ for $i = A, B$ if $\delta < 24(\sqrt{15} - 1)(1 - \theta_m)/7 \equiv \delta^3 > \delta^2$. $u^*_{im}(N, N) - u^*_{im}(C, C) < 0$ for $i = A, B$ if $\delta > \delta^4 \equiv 24(\sqrt{15} + 1)(1 - \theta_m)/7 \equiv \delta^4 > \delta^3$. This proves Lemma 4.

For $\delta < \delta^0$, (i) and (iv) of Lemma 4 apply to conclude Proposition 3.(i). In contrast, for $\theta_m \to 1$, then δ^d $(d = 0, 1, 2, 3, 4, 5)$ becomes 0, so (iii) and (iv) of Lemma 4 apply to conclude Proposition 3.(ii). *Q.E.D.*

Proof of Proposition 4 and Lemma 5

Under the suppositions of $s_i = s_{-i} = 0.5$, $a_i = a_{-i} = a$ and $\overline{k}_i = \overline{k}_{-i} = \overline{k}$, from (A.2) and (A.5) we derive

$$t_i(\theta_{iP}, \theta_{-iP}) = 2\overline{k} - \frac{(3\theta_{iP}\overline{k} + \theta_{-iP}\overline{k})}{2},\ k_i(\theta_{iP}, \theta_{-iP}) = \overline{k} + \frac{1}{4}\left(\theta_{iP}\overline{k} - \theta_{-iP}\overline{k}\right). \tag{A.16}$$

Solving (A.7) and (A.16) derives the delegate's type in Regime (N, N) as

$$\theta_{iP} = -1 + \frac{5}{3}\theta_{im} + \frac{1}{3}\theta_{-im}, \tag{A.17}$$

from which $r^*(N, N) - r^*(C, C) = \overline{k}(\theta_{Am} + \theta_{Bm} - 2) < 0$. In addition, we have $\theta_{AP} - \theta_{BP} > \theta_{Am} - \theta_{Bm} > 0$. (A.16) shows $t^*_B(N, N) - t^*_A(N, N) > t^*_B(C, C) - t^*_A(C, C) > 0$. (1) derives the conclusion of Lemma 5.

The Stackelberg tax rates are:

$$t_i^L = \frac{4\overline{k}_B}{5}(4 - 3\theta_{im} - \theta_{-im}),\ t_{-i}^F = \frac{4\overline{k}_B}{5}(3 - 2\theta_{-im} - \theta_{im}).$$

We proceed to calculate the choice of Stage-1 strategy in Table 1.

$$u^*_{im}(N, C) - u^*_{im}(C, C) = \frac{3(4 - \theta_{im} - 3\theta_{-im})(44 - 31\theta_{im} - 13\theta_{-im})\overline{k}^2}{400} > 0.\ \ (i = A,\ B)$$

Moreover,

$$u^*_{im}(N, N) - u^*_{im}(C, N) = \frac{(3 - \theta_{im} - 2\theta_{-im})(27 - 19\theta_{im} - 8\theta_{-im})\overline{k}^2}{45} > 0.\ \ (i = A,\ B)$$

Therefore, playing N is the dominant strategy for both countries for all parameter values. Also, for $\eta_i \equiv \theta_{im} - \theta_{-im}$, we have:

$$u_{im}^*(N,N) - u_{im}^*(C,C) = \frac{77\overline{k}^2}{144}\left(\eta_i - \left(\frac{156}{77} + \frac{12\sqrt{15}}{77}\right)(1-\theta_{-im})\right)\left(\eta_i - \left(\frac{156}{77} - \frac{12\sqrt{15}}{77}\right)(1-\theta_{-im})\right). \quad (i = A,\ B)$$

Our supposition of $\theta_{im} = \theta_{-im} + \eta_i < 1$ is equivalent to $\eta_i < 1 - \theta_{-im}$. For $\eta_i < 1 - \theta_{im}$, we have:

$$\eta_i - \left(\frac{156}{77} + \frac{12\sqrt{15}}{77}\right)(1-\theta_{-im}) < \eta_i - \left(\frac{156}{77} - \frac{12\sqrt{15}}{77}\right)(1-\theta_{-im}) \approx \eta_i - 1.4224(1-\theta_{im}) < 0. \ (i = A,\ B)$$

Thus Proposition 4.(ii) is verified. *Q.E.D.*

Proof of Proposition 5

Under the suppositions of $s_i = s_{-i} = 0.5$, $a_i = a_{-i} = a$ and $\theta_{im} = \theta_{-im} = \theta_m$, from (A.2) and (A.5) we derive

$$t_i(\theta_{iP}, \theta_{-iP}) = \overline{k}_A + \overline{k}_B - \frac{(3\theta_{iP}\overline{k}_i + \theta_{-iP}\overline{k}_{-i})}{2},\ k_i(\theta_{iP}, \theta_{-iP}) = \frac{1}{2}(\overline{k}_A + \overline{k}_B) + \frac{1}{4}\left(\theta_{iP}\overline{k}_i - \theta_{-iP}\overline{k}_{-i}\right). \tag{A.18}$$

Solving (A.7) and (A.18) derives the delegate's type in Regime (N,N) as

$$\theta_{AP} = -1 + 2\theta_m + \frac{\xi}{1+\xi}\left(\frac{1}{2} - \frac{1}{3}\theta_m\right),\ \theta_{BP} = -1 + 2\theta_m - \xi\left(\frac{1}{2} - \frac{1}{3}\theta_m\right). \tag{A.19}$$

From (A.18), we have $t_B^*(N,N) - t_A^*(N,N) = \frac{4}{3}\xi\theta_m\overline{k}_2 = \frac{4}{3}\left(t_B^*(C,C) - t_A^*(C,C)\right) > 0$. Also, from (A.6), we have $r^*(N,N) - r^*(C,C) = (\overline{k}_A + \overline{k}_B)(\theta_m - 1) < 0$.

The Stackelberg tax rates are:

$$t_A^L = \frac{4\overline{k}_B}{5}(4(1-\theta_m) + 2\xi - 3\theta_m\xi),\ t_B^F = \frac{2\overline{k}_B}{5}(6(1-\theta_m) + 3\xi - 2\theta_m\xi),$$

and:

$$t_B^L = \frac{4\overline{k}_B}{5}(4(1-\theta_m) + 2\xi - \theta_m\xi),\ t_A^F = \frac{2\overline{k}_B}{5}(6(1-\theta_m) + 3\xi - 4\theta_m\xi).$$

Regarding the choice of regimes in Stage 1, we now prove the following lemma that leads to Proposition 5:

Lemma 6 *Suppose that countries differ in capital endowments, with* $\overline{k}_A = \overline{k}_B(1+\xi)$*. For* $0 < \xi^1 < \xi^2 < \xi^3 < \xi^4$ *we have:*

(i) For $\xi \in (0, \xi^1)$*, non-commitment by both countries constitutes the dominance-solvable equilibrium.*

(ii) For $\xi \in (\xi^1, \xi^2)$*, the equilibrium outcomes are* (N, N) *and* (C, C)*. Both median voters are made better off under* (N, N) *than under* (C, C)*.*

(iii) For $\xi > \xi^2$*, commitment by both countries constitutes the dominance-solvable equilibrium.*

(iv) For $\xi < \xi^3$ *or sufficiently low* θ_m*, both median voters are made better off under* (N, N) *than under* (C, C)*. For* $\xi > \xi^4$ *and sufficiently high* θ_m*, both median voters are made better off under* (C, C) *than under* (N, N)*.*

With greater θ_m*, commitment by both countries is more likely to be an equilibrium.*

Proof of Lemma 6:

$$u^*_{Am}(N,C) - u^*_{Am}(C,C) = \frac{(\overline{k}_2)^2 \cdot 33}{25}\left((1-\theta_m) - \left(\frac{31}{44}\theta_m - \frac{1}{2}\right)\xi\right)\left(1 - \theta_m + \frac{1}{2}\xi - \frac{1}{4}\theta_m\xi\right) > 0$$
$$\iff \xi < \frac{1-\theta_m}{\frac{31}{44}\theta_m - \frac{1}{2}} \equiv \xi^1 \text{ or } \theta_m < \frac{22}{31} \equiv \theta^1. \tag{A.20}$$

$$u^*_{Bm}(C,N) - u^*_{Bm}(C,C) = \frac{(\overline{k}_2)^2 \cdot 33}{25}\left((1-\theta_m) - \left(\frac{3}{4}\theta_m - \frac{1}{2}\right)\xi\right)\left(1 - \theta_m + \frac{1}{2}\xi - \frac{13}{44}\theta_m\xi\right) > 0$$
$$\iff \xi < \frac{1-\theta_m}{\frac{3}{4}\theta_m - \frac{1}{2}} \equiv \xi^0 \text{ or } \theta_m < \frac{2}{3} \equiv \theta^0. \tag{A.21}$$

$$u^*_{Am}(N,N) - u^*_{Am}(C,N) = \frac{(\overline{k}_2)^2 \cdot 9}{5}\left((1-\theta_m) - \left(\frac{19}{27}\theta_m - \frac{1}{2}\right)\xi\right)\left(1 - \theta_m + \frac{1}{2}\xi - \frac{1}{3}\theta_m\xi\right) > 0$$
$$\iff \xi < \frac{1-\theta_m}{\frac{19}{27}\theta_m - \frac{1}{2}} \equiv \xi^2 \text{ or } \theta_m < \frac{27}{38} \equiv \theta^2. \tag{A.22}$$

$$u^*_{Bm}(N,N) - u^*_{Bm}(N,C) = \frac{(\overline{k}_2)^2 \cdot 9}{5}\left((1-\theta_m) - \left(\frac{2}{3}\theta_m - \frac{1}{2}\right)\xi\right)\left(1 - \theta_m + \frac{1}{2}\xi - \frac{8}{27}\theta_m\xi\right) > 0$$
$$\iff \xi < \frac{1-\theta_m}{\frac{2}{3}\theta_m - \frac{1}{2}} \equiv \xi^5 \text{ or } \theta_m < \frac{3}{4} \equiv \theta^5. \tag{A.23}$$

We have $\theta^0 < \theta^1 < \theta^2 < \theta^5$.

Suppose first that $\theta_m > \theta^2$. We have $0 < \xi^0 < \xi^1 < \xi^2$. Using (A.20)-(A.23), the proof is analogous to that of Lemma 4 to induce statements (i)-(iii) of Lemma 6 for the cases of (i) $\xi < \xi^1$, (ii) $\xi \in (\xi^1, \xi^2)$, and (iii) $\xi > \xi^2$ respectively. Second, for $\theta_m < \theta^2$, from (A.22) and (A.23), (N, N)

always constitutes an equilibrium. For $\theta_m < \theta^2$, if $\theta_m > \theta^1$ and $\xi > \xi^1 (> \xi^0)$, (C, C) constitutes another equilibrium. Finally, for (a) $\theta_m < \theta^1$ or (b) $\theta_m \in (\theta^1, \theta^2)$ and $\xi < \xi^1$, from (A.20), (A.22) and (A.23), (N, N) is the dominance-solvable equilibrium.

$u_{im}(N, N) - u_{im}(C, C) > 0$ for $i = A, B$ if $\xi < \dfrac{12(13 - \sqrt{15})(1 - \theta_m)}{77\,\theta_m - 78 + 6\sqrt{15}} \equiv \xi^3 > \xi^2$ or $\theta_m < \dfrac{78 - 6\sqrt{15}}{77} \equiv \theta^3 > \theta^2$. $u_{im}(N, N) - u_{im}(C, C) < 0$ for $i = A, B$ if $\xi > \dfrac{12(11 - \sqrt{15})(1 - \theta_m)}{53\,\theta_m - 66 + 6\sqrt{15}} \equiv \xi^4 > \xi^3$ and $\theta_m > \dfrac{66 - 6\sqrt{15}}{53} \equiv \theta^4 > \theta^3$.

Since $\xi^d = 2\dfrac{1 - \theta_m}{\theta_m/\theta^d - 1}$ ($d = 0, 1, 2, 3, 4, 5$, where $\theta^d < 1$) is decreasing in θ_m, commitment by both countries is more likely to be an equilibrium with greater θ_m. *Q.E.D.*

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