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# Preferences over Public Good, Political Delegation and Leadership in Tax Competition

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**ABSTRACT**

Leadership (sequential choice) and political delegation are two mechanisms suggested to restrict 'race-to-the-bottom' in tax competition. In this paper, we analyze whether these two mechanisms when combined together would lead to unilaterally higher taxation or not. We show that political delegation with leadership in tax competition not only restricts 'race-to-the-bottom' but also mitigates the possibility of overprovision of public good. In sequential choice game, only the follower region delegates taxation power to the policy maker but not the leader region. This puts a check on intensity of tax competition and leads to optimal provision of public good.

**Keywords:** Political delegation, Foreign-owned mobile capital, Sequential tax competition, Public good provision, Fiscal competition

**JEL Code:** F21, H25, D70, H42, R50

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## 1. INTRODUCTION

Standard models of tax competition for attracting capital predict countries engage themselves in 'race-to-the-bottom' and thus end up with lower tax rates and under provision of public goods in equilibrium (Zodrow, G. R., & Mieszkowski, 1986; Wilson, 1999). However, empirical evidence seems to contradict such predictions (Marceau et al, 2010). Several attempts have been made to explain this contradiction. Janeba and Peters (1999), Plümper, Troeger, and Winner (2009) and Marceau, Mongrain and Wilson (2010) argue that, if countries differ in terms of size and endowment of immobile capital and fiscal rigidities, competition for mobile capital does not lead to lower tax rate in all the countries involved. Kempf and Rota-Graziosi (2010) demonstrate that equilibrium tax rates are higher under sequential tax competition compared with that under simultaneous tax competition, even in the case of symmetric countries.

Another strand of literature that attempts to explain higher tax rates and no 'race-to the-bottom' among countries focuses on political economy of taxation and public good provision for heterogeneous voters. Persson and Tabellini (1992) demonstrate that in the presence of representative democracies each region's median voter appoints a policy maker who prefers higher tax rate than that of the median voter, if capital endowments of citizens of a region are heterogeneous. In other words, political delegation takes place in each region due to tax competition and harmful race-to-the-bottom in tax rates is restricted. Brueckner (2001) and Ihori and Yang (2009) argue that this result is quite robust to considering the heterogeneity for preference over public good and income respectively[2].

[2] Some other studies that explore this strand are these. Fuest and Huber (2001) consider capital and labour tax as well as political competition. We note here that these papers also deal with the issue of tax coordination, which is

In these strands of literature, we focus on two mechanisms that are explored to provide theoretical justification for empirical evidence on control in 'race-to-the-bottom'. While the first strand's emphasis is on either regional asymmetry or nature of competition (simultaneous, sequential); the second strand highlights the implications of political economy aspect of capital taxation. Though these studies provide independent and plausible justification behind restriction in 'race-to-the-bottom', not much theoretical understanding exists on the interaction of these two mechanisms and their impact on tax rates, capital allocation and related outcomes.

The objective of this paper is to analyze tax competition when these mechanisms are synthesized together[3]. Particularly, we consider the case where regions have a representative democracy and policy maker is elected by majority voting; next policy makers in both the regions decide the tax rate sequentially (i.e. regions act as leader and follower). The focus of this model is to include the features of political delegation and leadership in tax competition. We intend to understand the implication of such structure of decision making on capital taxation. Especially whether combination of these mechanisms can lead to very high tax rates or there is a corrective mechanism which can lead to a check on the increasing tax rates. In other words, we intend to analyze whether there is an optimal level of tax rate that is desirable by the governments arising endogenously (as suggested in Marceau et al., 2010).

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beyond the scope of the present paper. Other papers in this stream of literature do not consider representative democracy. Rauscher (1998) and Edwards and Keen (1996) consider that governments are concerned about size of public sector as in "Leviathan models", Wilson (2005) assume self interested bureaucrats decide the public expenditure policy while electorates decide the tax policy, and Perroni and Scharf (2001) assume direct democracy in competing regions.

[3] There exist a handful of studies analyzing the empirical evidence for leadership in taxation as well as political economy aspect of taxation. Altshuler and Goodspeed (2015), establish that there is leadership in tax rate determination in the context of USA and European countries, with USA acting as leader and European countries follow. In the context of political economy, Ashworth and Heyndels (1997), analyze the politician's preference for local taxation and find that the policy makers have inclination towards moderate and higher tax rates with a focus on getting re-elected. Osterloh and Debus (2012) empirically establish the hypothesis that left leaning policy makers opt for higher tax rates, in the context of European countries.

This study is closer to Ihori and Yang (2009) and Kempf and Rota-Graziosi (2010) in its structure of the model. The main deviations from these papers are as follows. First, we analyze and compare both sequential and simultaneous choice of tax rates by the regions (in the spirit of Kempf and Rota-Graziosi, 2010), which is different from Ihori and Yang (2009), which only consider simultaneous tax competition. Further instead of capital endowment heterogeneity (Ihori and Yang, 2009; Persson and Tabellini, 1992), we focus on public good heterogeneity across citizens. The political delegation through majority voting is in line with Ihori and Yang, (2009). We deviate from Kempf and Rota-Graziosi (2010), in a sense that we do not explicitly model the endogenous choice of leadership in the tax competition. We consider it to be exogenous in the model[4]. The reason is that our main focus remains on the interaction of intra-regional political competition and inter-regional sequential tax competition and their effect on taxation and capital allocation across regions.

The main findings from our model are as follows. We show that, in the first stage of the model, the follower region's voters delegate the task to decide its tax rate on capital to a candidate whose preference for public good is more than that of the median voter, as in the case of simultaneous move game. In other words, such policy maker will levy higher tax rate to provide for public good. On contrary, no such political delegation takes place in the leader region, in which the median voter herself becomes the policy maker and decides the tax rate. This result is new[5].

The intuition behind the result is as follows. In the first stage, the median voters of both the region anticipate that, for any given tax rate of the leader region, the follower region has the

[4] The endogenous choice of leader and follower in tax competition with political delegation can be explored in future research, but remains beyond the scope of this study.

[5] In the literature (Ihori and Yang, 2009; Persson and Tabellini, 1992 and others), we observe that in simultaneous tax competition, the voters in a region have unilateral incentive to delegate the policy making.

incentive to set a lower tax rate in the second stage. However, if the follower region can credibly convey to the leader region that it would prefer not to engage in tax undercutting, which is possible only by delegating the task to decide the tax rate to a policy maker with stronger preference for public goods than that of the median voter, the leader region would set a higher tax rate compared to that in the case of no delegation in the follower region. That is, by making political delegation in the first stage the follower region can induce the leader region not to engage in race-to-the-bottom.

On the other hand, the leader region being at a disadvantageous position, since it needs to set the tax rate first, does not have any incentive to set a tax rate that is higher than its median voter's preferred tax rate. Moreover, the leader region also recognizes that it is harmful to set a tax rate that is lower than the median voter's preferred rate, since that would induce the follower region to set a lower tax rate. As result, no political delegation takes place in the leader region, unlike as in the follower region or in the case of simultaneous move tax competition. Clearly, timings of moves in tax competition have implications for political competition, which, in turn, affect the equilibrium tax rates. These findings also highlight that with implementation of leadership and political delegation, the tax rate imposed by the regions does not shoot up, but there is a corrective mechanism at place due to the following reasons. First, the sequential choice of tax rates restricts the 'race-to-the-bottom' by providing a credible mechanism where one region commits to a tax rate and the follower region though charges a lower tax rate, does not lead to the undercutting race. Second, political delegation with heterogeneous preferences for public good among the citizens, there is a natural restriction on tax rates in race-to-the-bottom due to provision of public good through tax revenue generation. In this model, what is interesting is that regions do not necessarily use both the mechanism to restrict the race but can opt for one or both based on some optimal and desirable level of tax rate and corresponding tax revenue for providing public good to the residents.

The rest of the paper is organized as follows. In section 2, we outline the model with intra-regional political competition and inter-regional tax competition. In section 3, we solve the case of simultaneous tax competition to provide the benchmark case. Followed by that, in section 4, we get the results in sequential tax competition. Section 5 concludes.

## 2. BASIC MODEL

We consider two symmetric regions, i.e. 1 and 2, competing for foreign owned mobile capital using tax rates. Each of the two regions provides local public good, which is fully financed by tax revenue. Each of the two regions is inhabited by $N$ individuals (voters). There are two factors of production: labour $(L)$ and capital $(X)$. Labour is immobile, while capital is fully mobile.

For simplicity, we assume that each region has a fixed endowment of labour, normalized to one i.e L=1. Moreover, each individual is endowed with equal amount of labour, $\theta = \frac{1}{N}$. Total amount of available capital is assumed to be X, which is allocated between the two regions through a perfectly competitive capital market.

The production function of representative firm of region $i$ is given by $Y = F(X_i, L_i)$, $i = 1, 2$, where $X_i$ is capital allocated to region $i$ and $L_i = 1$, assuming full employment. This production function in an intensive form can be written as $y = f(x_i)$, where $x_i = \frac{X_i}{L_i} = X_i$, $f'(x_i) > 0$, $f''(x_i) < 0$, $f'''(x_i) \geq 0$ and $f'''(x_i) = f'''(x_j)$, as in Laussel and Le Burton (1998).

**Capital allocation:** Capital market is assumed to be perfectly competitive, capital is paid according to its marginal productivity net of taxes, $[f'(x_i) - t_i]$, where $t_i$ is the tax rate in region $i$.[6] To rule out the possibility of arbitrage in equilibrium, we have $[f'(x_i) - t_i] = [f'(x_j) - t_j]$; $i, j = 1, 2$; $i \neq j$. We consider that available mobile capital is fully allocated between the two regions ($x_1 + x_2 = X$) and net return from the last unit of investment is positive ($[f'(x_i) - t_i] > 0, \forall i = 1, 2$). Therefore, for any $t_1$, $t_2$, the arbitrage proof allocation of mobile capital between two regions is given by, $f'(x_1) - t_1 = f'(x_2) - t_2 > 0$ and $x_1 + x_2 = X$.

The equilibrium allocation of capital, given the tax rates, between the two regions is as follows: $x_1 = x_1(t_1, t_2)$, $x_2 = x_2(t_1, t_2)$ along with following conditions:

$$\frac{\partial x_i}{\partial t_i} = \frac{1}{f''(x_i) + f''(x_j)} = -\frac{\partial x_i}{\partial t_j} < 0, \qquad (1a)$$

$$\frac{\partial^2 x_i}{\partial {t_i}^2} = \frac{-\left(f'''(x_i) - f'''(x_j)\right)\frac{\partial x_i}{\partial t_i}}{\left(f''(x_i) + f''(x_j)\right)^2} = 0 \qquad (1b)$$

$$\text{and } \frac{\partial^2 x_i}{\partial t_j t_i} = \frac{\left(f'''(x_i) - f'''(x_j)\right)\frac{\partial x_i}{\partial t_i}}{\left(f''(x_i) + f''(x_j)\right)^2} = 0, \qquad (1c)$$

where $i, j = 1, 2$, $i \neq j$; since $f''(x_i) < 0$ and $f'''(x_i) = f'''(x_j)$. To ensure existence of interior solution, we assume that the elasticity ($\eta_i$) of capital allocation to a region with respect to that region's tax rate is less than one:

$$\eta_i = -\frac{t_i}{x_i}\frac{\partial x_i}{\partial t_i} < 1, \qquad i = 1, 2. \qquad (2)$$

[6] Price of good *y* is assumed to be one.

**Individuals' (citizens') characteristics:** Utility function of a typical individual *n* of region $i$ is as follows.

$$U^{n,i}\left(c_{n,i}\ , g_i\right) = c_{n,i} + \alpha_{n,i} v(g_i), \qquad (3)$$

where $c_{n,i}$ is the amount of private good consumed by individual *n* of region *i*, $g_i$is the amount of public good available in region $i$, $\alpha_{n,i}$ $(> 0)$ represents the preference of that individual for public good and $v^{'}(g_i) > 0 > v^{''}(g_i)$ , $i = 1, 2,$ $n = 1,2, \ldots., N$ . Clearly, higher value of $\alpha_{n,i}$ indicates stronger preference for public good, and each individual has singled peaked preference for public good. We assume that distribution of $\alpha_n$ is symmetric across regions, which implies that $\alpha_{n,i} = \alpha_{n,j} = \alpha_n$. The median of distribution of $\alpha_n$ is assumed to be $\beta$, indicating each region's median voter's preference for public good. We also assume that the measure of relative risk aversion with respect to public good consumption is less that one.

$$-\frac{g_i\, v^{''}(g_i)}{v^{'}(g_i)} < 1, \qquad i = 1, 2 \qquad (4)$$

Condition (4) implies that, due to increase in public good, marginal utility of public good decreases less than proportionately than the increase in public good. This means with increase in the income level of individual, the preference for public good still remains strong. This is a standard assumption holding for a large class of utility functions and is in line with the behavioral aspects of individuals (Pratt, 1964).

Moving on, note that, if $x_i$ amount of mobile capital is invested in region *i*, gross returns to the owners of mobile capital from investment in region *i* is $[x_i f^{'}(x_i)]$, since capital is paid according to its marginal productivity. And, the total wage bill paid to region *i* is $[f(x_i) - \ x_i f^{'}(x_i)]$. Each individual supplies $\theta = \frac{1}{N}$ amount of labour, we can write the budget constraint of a typical individual *n* of region *i* as follows.

$$c_{n,i} = \theta[f(x_i) - x_i f^{'}(x_i)],\ i = 1, 2 \tag{5}$$

**Governments' budget constraints:** Since public good is fully financed by the tax revenue, the balanced budget constraint of the government of region *i* can be written as,

$$g_i = t_i x_i,\ i = 1, 2. \tag{6}$$

Substituting (4), (5) and (6) in equation (3), we can write the utility function of a typical individual *n* of region *i* as follows.

$$U^{n,i}(t_i, t_j) = \theta\ c_{n,i}(t_i, t_j) + \ \alpha_{n,i}\ v(t_i, t_j)$$

$$= \ \theta\left[f\left(x_i(t_i, t_j)\right) - x_i(t_i, t_j)\, f^{'}\left(x_i(t_i, t_j)\right)\right] + \alpha_{n,i} v\left(t_i\ x_i(t_i, t_j)\right), \tag{7}$$

where $x_i(t_i, t_j)$ is obtained from capital market condition. To keep the analysis tractable, we assume that the utility function $U^{n,i}(t_i, t_j)$ is concave in $(t_i, t_j)$.

In this setting, how tax rate of own region and the other region affect the provision of public good and utility from it is characterized as follows:

***Lemma 1**: Utility of public good increases at a decreasing rate with increase in own tax rate, and, this effect is increasing in rival region's tax rate:*

$\frac{\partial[\alpha_{n,i}\ v(g_i)]}{\partial t_i} > 0$, $\frac{\partial^2[\alpha_{n,i}\ v(g_i)]}{\partial t_i^2} < 0$ *and* $\frac{\partial^2[\alpha_{n,i}\ v(g_i)]}{\partial t_j \partial t_i} > 0\ \forall\ i, j = 1, 2;\ i \neq j.$

Proof: See Appendix A1.

**Political setup and voting mechanism:** We consider that there is representative democracy in each of the two regions. The representative of citizens i.e. the policy maker, is determined through political competition guided by the majority voting rule, as in Osborne and Slivinski (1996) and Besley and Coate (1997). Next, the policy makers of the two regions decide tax rates. We assume that there is no cost attached to contest in election and, thus, each individual is a possible candidate. Moreover, individuals' preferences over tax rates are assumed to be single peaked.[7] That is, an individual prefers a particular tax rate the most, and her utility is decreasing in absolute difference between that tax rate and the actual tax rate. Therefore, by the median voter theorem, the median voter of a region decides the policy maker of that region.[8] Please refer to the appendix of the paper for detailed definition of single peaked property and median voter theorem.

*Theorem[9]:If tax rate ($t$) is a single dimensional choice and all the voters have single peaked preferences defined over tax rate, the selection of the median voter cannot lose under majority voting rule.*

Proof: See Appendix A2.

Note that the median voter of a region herself need not necessarily be the policy maker of that region. Following the tradition of existing literature, if the policy maker is someone different from the median voter, we say that there is political delegation. On the other hand, we say that there is no political delegation, if median voter herself is the policy maker. Nevertheless, in the case of political delegation, the median voter selects such a policy maker whose optimum policy maximizes the objective of the median voter, since the policy maker must have the support of the majority.

Having outlined the model, the next section analyzes the simultaneous tax competition case.

[7]The policy preference of a voter is said to be single peaked, if his preference ordering for alternative choices is dictated by their relative distance from his\her bliss point (Persson and Tabellini, 2000).
[8]If the individual voters have single peaked preferences over a given ordering of the policy alternatives, a Condorcet winner always exists and coincides with the median voter's policy choice. See, Persson and Tabellini (2000) for an excellent discussion on voting mechanism and median voter theorem.
[9] Dennis Mueller (2003)

# 3. SIMULTANEOUS MOVE TAX COMEPTITION

In this section, we consider that the policy makers of the two regions are engaged in simultaneous move tax competition. The stages of the game involved are as follows.

Stage 1: Policy makers of the two regions are elected through political competition, guided by majority voting rule, in the two regions. In other words, each region's median voter decides whether to delegate the task to determine its tax rate or not.

Stage 2: Policy makers of the two regions decide their respective tax rates simultaneously and independently.

Stage 3: Owners of mobile capital decide the allocation of capital between the two regions.

We note here that Ihori and Yang (2009) also consider a similar setup. Since our primary interest is to examine the implications of timing of move in tax competition, it is important to present the results corresponding to simultaneous move tax competition in order to alienate the effects of timing of move.

We solve the game using standard backward induction method, starting from Stage 3. Note that, in Stage 3, allocation of capital between the two regions is determined by condition (1a) and (1b), irrespective of the nature of tax competition (simultaneous or sequential) and outcome of Stage 1. Moreover, conditions (1a)-(1c) always hold true, irrespective of timing of move in tax competition.

Now, in Stage 2, the problem of the policy maker of region $i$, denoted by ($p$, $i$), can be written as follows.

$$\underset{t_i}{Max} U^{p,i}\left(t_i, t_j\right) = \theta\, c_{p,i}\left(t_i, t_j\right) + \alpha_{p,i}\, v\left(t_i, t_j\right), \tag{8}$$

Where expressions for $c_{p,i}\left(t_i, t_j\right)$ and $v\left(t_i, t_j\right)$ are as in (7) corresponding to $n = p$; $\forall\, i, j = 1, 2$; $i \neq j$ .

The first order condition of problem (8) can be written as,

$$\frac{\partial U^{p,i}(t_i, t_j)}{\partial t_i} = \theta\left[-x_i f''(x_i)\frac{\partial x_i}{\partial t_i}\right] + \alpha_{pi} v'(g_i)\left[t_i \frac{\partial x_i}{\partial t_i} + x_i\right] = 0 \qquad (9a)$$

The second order condition of maximization is satisfied, since *U*(.) is assumed to be concave. Therefore, the tax reaction functions of the two policy makers are given by (9a).

***Lemma 2**: The absolute slope of the tax reaction function of the region j's policy maker, in $t_i - t_j$ plane, is less than one :$\left.\frac{\partial t_j}{\partial t_i}\right|_{p,j} < 1,\ i,j = 1,2,\ i \neq j.$*

Proof: See Appendix A3.

Lemma 2 implies that the slope of the region *i*'s policy maker in $t_i - t_j$ plane, is greater than one, $\left.\frac{\partial t_j}{\partial t_i}\right|_{p,i} > 1$, since $\left.\frac{\partial t_i}{\partial t_j}\right|_{p,i} < 1$.

Now, note that $\frac{\partial^2 U^{p,j}(t_i, t_j)}{\partial t_i \partial t_j} = \left\{\theta\left[x_j f'''(x_j) + f''(x_j)\right]\left(\frac{\partial x_j}{\partial t_j}\right)^2\right\} + \{\alpha_{p,j}\left[v'(g_j) + v''(g_j) g_j (1 - \eta_j)\right]\frac{\partial x_j}{\partial t_i}\}$, $i,j = 1,2,\ i \neq j,$ which can be positive or negative, depending on the nature of the functional forms considered. Because, though the second term is positive (by Lemma 1), the sign of the first term is ambiguous. Therefore, for $\frac{\partial^2 U^{p,j}(t_i, t_j)}{\partial t_i \partial t_j}$ to be negative, the first term must be negative and its magnitude must be greater than the magnitude of the second term. Otherwise, $\frac{\partial^2 U^{p,j}(t_i, t_j)}{\partial t_i \partial t_j}$ is positive. In other words, marginal effect of own tax rate on utility of a policy maker increases due to increase in the rival region's tax rate, i.e. tax rates are strategic complements, if $\frac{\partial^2[\theta c_{p,j}\,(.)]}{\partial t_i\ \partial t_j} > 0$ or $\left|\frac{\partial^2[\theta c_{p,j}\,(.)]}{\partial t_i\ \partial t_j}\right| < \left|\frac{\partial^2[\alpha_{p,j} v(g_j)]}{\partial t_i\ \partial t_j}\right|$. Otherwise, tax rates are strategic substitutes. We summarize these results in Lemma 3.

***Lemma 3**: Tax rates can be either strategic substitutes or strategic complements. If $\frac{\partial^2[\theta c_{p,j}\,(.)]}{\partial t_i\ \partial t_j} > 0$ or $\left|\frac{\partial^2[\theta c_{p,j}\,(.)]}{\partial t_i\ \partial t_j}\right| < \left|\frac{\partial^2[\alpha_{p,j} v(g_j)]}{\partial t_i\ \partial t_j}\right|$, tax rates are strategic complements. Alternatively, if $\frac{\partial^2[\theta c_{p,j}\,(.)]}{\partial t_i\ \partial t_j} < 0$ and $\left|\frac{\partial^2[\theta c_{p,j}\,(.)]}{\partial t_i\ \partial t_j}\right| > \left|\frac{\partial^2[\alpha_{p,j} v(g_j)]}{\partial t_i\ \partial t_j}\right|$, tax rates are strategic substitutes.*

It is straight forward to check that, if tax rates are strategic complements (substitutes), tax reaction functions are positively (negatively) sloped. That is, when tax rates are strategic complements (substitutes), it is optimal for a region to reduce (increase) its tax rate, if there is a decrease in its rival region's tax rate. We here note that existing studies on tax competition either undermines the case for tax rates to be strategic substitutes[10] or such possibilities does not arise due to the choice of specific objective functions of the government.

In the context of this paper, we assume that tax rates are strategic complements in the remaining part of the analysis[11], so that our results can be compared to the existing literature.

It is easy to check that, in the case of strategic complements, tax reaction functions are positively sloped, since $\left.\frac{\partial t_j}{\partial t_i}\right|_{p,j} = -\frac{\partial^2\, U^{p,j}(t_i, t_j)}{\partial t_i \partial t_j} / \frac{\partial^2 U^{p,j}(t_i, t_j)}{\partial {t_j}^2}$ and the denominator is assumed to be negative.

*Assumption: Tax rates are strategic complements and, thus, tax reaction functions of the two regions' policy makers are positively sloped:* $\left.\frac{\partial t_j}{\partial t_i}\right|_{p,j} > 0,\ i, j = 1, 2,\ i \neq j.$

Now, note that equation (9a) implies that $\theta[f''(x_i)\frac{\partial x_i}{\partial t_i}] = \alpha_{pi} v'(g_i)[1 - \eta_i]$, where $\eta_i = -\frac{t_i}{x_i}\frac{\partial x_i}{\partial t_i} < 1$, by (2). Rearranging the terms, we can write the implicit form of the tax reaction function of the policy maker of region *i*, given by (9a), as follows.

$$\frac{1}{v'(g_i)} = \frac{\alpha_{p,i}[1 - \eta_i]}{\theta[f''(x_i)\dfrac{\partial x_i}{\partial t_i}]}, \qquad i, j = 1, 2 \qquad (9b)$$

The second order condition of maximization is satisfied, since *U*(.) is assumed to be concave. Solving the above two equations for region 1 and 2, given by (9b), we get the stage 2 equilibrium tax rates $t_1^S$ and $t_2^S$, where the superscript denotes simultaneous move tax competition:

[10] The reason for the same is as follows. First, strategic substitutability of tax rates is specific condition which hold under certain assumptions and does not necessarily hold in case of some popular functional forms in the relevant literature. Second, in the tax competition literature, the possibility and results in the context of taxes being strategic substitutes has not been explored to that extant. One notable exception to this literature is Vrijburg and de Mooij (2016), who explore the conditions for strategic substitute in tax competition. Please refer to them for further discussion.

[11] The further exploration of outcomes of this game in the context of taxes being strategic substitute is left for future research and remains beyond the scope of this study.

$$t_1^S = t_1^S(\alpha_{p,1}, \quad \alpha_{p,2}) \tag{10a}$$

$$t_2^S = t_2^S(\alpha_{p,1}, \quad \alpha_{p,2}) \tag{10b}$$

Before moving to Stage 1 of the game, let us examine the effects of policy makers' preferences for public good ($\alpha_{p,i}$'s) on equilibrium tax rates. Since public good is financed by tax revenue collected, stronger preference for public good of the policy maker induces the policy maker to ensure higher tax revenue. Also, note that tax revenue of a region is increasing in that region's tax rate: $\frac{\partial\,(t_i x_i)}{\partial t_i} = t_i \frac{\partial x_i}{\partial t_i} + x_i = x_i(1 - \eta_i) > 0$, since $\eta_i < 1$ (by (2d)). Therefore, it seems that a policy maker would set a higher tax rate, if he has stronger preference for public good. And, since tax rates are assumed to be strategic complements, increase in preference for public good of a policy maker would induce his rival to set higher tax rate too.

***Proposition 1****: In the case of simultaneous move tax competition, degree of preference for public good of a policy maker has positive impact on tax rate of both the regions:* $\frac{\partial t_i^S}{\partial \alpha_{p,i}} > 0$ *and* $\frac{\partial t_j^S}{\partial \alpha_{p,i}} > 0,\ i, j = 1, 2$*. Moreover, increases in tax rate of a region, due to increase in preference of the policy maker of that region, is more than the corresponding increase in rival region's tax rate:* $\frac{\partial t_1^S}{\partial \alpha_{p,1}} > \frac{\partial t_2^S}{\partial \alpha_{p,1}}$.

Proof: See Appendix A4.

Finally, we turn to analyze the equilibrium choice of policy makers in the two regions in Stage 1. In particular, we are interested to examine whether the median voter delegates the task of tax determination or not. Note that, in stage 1, the decisive median voter of a region selects the policy maker so that her own utility is maximized. In other words, in Stage 1, the median voters of the two regions decide whether to delegate the task of tax determination or not, simultaneously and independently.

In Stage 1, the problem of the median voter of region *i* can be written as follows.

$$\underset{\alpha_{p,i}}{Max} U^{\beta,i}(t_i^S, t_j^S) = \theta\, c_{\beta,i}(t_i^S, t_j^S) + \beta\, v(t_i^S, t_j^S) \tag{11}$$

$= \theta\left[f\left(x_i(t_i^S, t_j^S)\right) - x_i(t_i^S, t_j^S) f'\left(x_i(t_i^S, t_j^S)\right)\right] + \beta\, v\left(t_i^S\, x_i(t_i^S, t_j^S)\right)$, where $t_i^S$ and $t_j^S$ are given by (10a) and (10b), and $x_i(t_i^S, t_j^S)$ is obtained by substituting the expressions for $t_i^S$ and $t_j^S$ to solution of (1a) and (1b).

The first order condition of the above problem yields the following.

$$\frac{1}{v'(g_i)} = \frac{\beta[1-\eta_i\varphi]}{\theta[f''(x_i)\frac{\partial x_i}{\partial t_i}]\varphi}, \qquad i,j = 1,2, \tag{12}$$

where $\varphi = (\frac{\partial t_i^S}{\partial \alpha_{p,i}} - \frac{\partial t_j^S}{\partial \alpha_{p,i}}) / \frac{\partial t_i^S}{\partial \alpha_{p,i}}$. Clearly, $0 < \varphi < 1$, since $0 < \frac{\partial t_j^S}{\partial \alpha_{p,i}} < \frac{\partial t_i^S}{\partial \alpha_{p,i}}$ by Proposition 1. Note that both $\eta_i$ and $\varphi$ functions of $\alpha_{p,i}$ and $\alpha_{p,j}$.

We get the region *i*'s median voter's desired public good preference parameter ($\alpha_{p,i}$) from (12).[12] However, it appears to be cumbersome to express $\alpha_{p,i}$ in terms of $\beta$ (or $\beta$ in terms of $\alpha_{p,i}$), in order to gauge the relative magnitudes of $\beta$ and $\alpha_{p,i}$, directly from (12). Now, substituting (9b) in equation (12), we can check whether there is political delegation in the region or not:

$$\frac{\alpha_{p,i}[1-\eta_i]}{\theta[f''(x_i)\frac{\partial x_i}{\partial t_i}]} = \frac{\beta[1-\eta_i\varphi]}{\theta[f''(x_i)\frac{\partial x_i}{\partial t_i}]\varphi} \tag{13}$$

Clearly, in equilibrium, marginal rate of substitution between the public good and the private good remains the same in Stage 1 and Stage 2 of the game. From equation (13), it is straightforward to observe that $\alpha_{p,i} > \beta$, since $0 < \varphi < 1$, $i = 1,2$. That is, it is optimal for the median voter of region $i$ (=1, 2) to delegate the task to determine tax rate on her behalf to a policy maker, who has stronger preference for public good than the median voter. And, since two regions are symmetric and tax rates are chosen simultaneously, we can say that in equilibrium elected policy makers of both the regions will have the same preference for public good: $\alpha_{p,1}^* = \alpha_{p,2}^* > \beta$. We summarize this result in the following Proposition.

[12]Second order condition of the maximization problem (11) is satisfied.

***Proposition 2****: In equilibrium, political delegation takes place in both the regions, when there is simultaneous move tax competition for foreign owned mobile capital. The policy maker of each region has higher preference for public good than that of the median voter.*

The explanation for results in proposition 2 arises from the focus of the median voter on higher public good provision and further that median voter anticipates that tax competition will lead to race-to-the-bottom which can negatively affect the provision of public good. With this anticipation, the median voter in either regions delegates tax decision to the policy maker so that they are more conscious towards higher public good provision and race-to-the-bottom is restricted.

From Proposition 1 and Proposition 2, it is evident that the equilibrium tax rates of both the regions are higher than the case of no delegation. Therefore, through political delegation, competing regions can effectively restrict the harmful race-to-the-bottom in tax rates, in the case of simultaneous move tax competition. These results are in line with the findings of Persson and Tabellini (1992) and Ihori and Yang (2009).

## 4. SEQUENTIAL MOVE TAX COMPETITION

We now turn to examine the implications of the timing of move in tax competition and political delegation. We first characterize the equilibrium corresponding to sequential move tax competition between the two regions. The sequential choice games are motivated in two manners in the strategic competition literature. First is based on the first or second mover advantage of the regions by being the first in the market or making the decision before the other (due to historic, institutional or policy reasons). Second motivation comes from asymmetric information literature, where regions are considered to be simultaneous decision makers if they do not have any information about the decision taken or decision making process of the other regions. On the other hand, if one region has more information about decision making process of the other region and it is factored in its strategic choice process then this region is called leader and other region becomes the follower.

Since the two regions are symmetric, without any loss of generality we assume that region 1 is the leader and region 2 is the follower in tax competition[13]. The stages of the game involved are as follows:

Stage 1: Policy makers of the two regions are elected through political competition, guided by majority voting rule, in the two regions.

Stage 2: Policy maker of region 1 (the leader) decides its tax rate.

Stage 3: Policy maker of region 2 (the follower) decides its tax rate, observing the tax rate of region 1.

Stage 4: Owners of mobile capital decide the allocation of capital between the two regions.

We use backward induction method to solve this game, starting with stage 4. In Stage 4, the capital allocation is the same as was decided from equation $1(a)$ and $1(b)$, assuming the political delegation and the tax rates of the leader and the follower region as given.

Moving up to Stage 3, we consider the problem of region 2 (follower), assuming region 1's tax rate and public good preference parameters are given. The problem of region 2 is same as in equation (8),

[13] We do not model the endogenous nature of leadership in tax competition in this game, as this is not our main focus. This can be explored in future research.

$$\underset{t_2}{Max}U^{p,2}(t_2,t_1) = \theta\, c_{p,2}(t_2,t_1) + \alpha_{p,2}\, v(t_2,t_1), \tag{14}$$

The first order condition for region 2 (follower) is as follows:

$$\frac{\partial U^{p,2}(t_2,t_1)}{\partial t_2} = \theta\left[-x_2 f''(x_2)\frac{\partial x_2}{\partial t_2}\right] + \alpha_{p,2} v^{'}(g_2)\left[t_2\frac{\partial x_2}{\partial t_2} + x_2\right] = 0 \tag{15a}$$

On simplifying and rearranging the terms we get,

$$\frac{1}{v^{'}(g_2)} = \frac{\alpha_{p,2}[1-\eta_2]}{\theta[f''(x_2)\frac{\partial x_2}{\partial t_2}]} \tag{15b}$$

The second order condition is satisfied due to concave $U(.)$assumption. We get the tax reaction function of region 2 from $(15a)$.We can write the reaction function of region 2 as,

$$t_2 \ = t_2\left(t_1^L, \quad \alpha_{p,2}\right) \tag{16}$$

Region 2's tax rate is a function of the public good preference parameters and region 1's tax rate. Next, we consider the problem of region 1 in Stage 2. Region 1 decides its tax rate by taking into account the strategic effect on region 2's tax rate. In the leadership games, we assume that the leader knows the reaction function of the follower region and incorporates this information in his problem.

$$\underset{t_1}{Max}U^{p,1}(t_1,t_2) = \theta\, c_{p,1}(t_1,t_2) + \alpha_{p,1}\, v(t_1,t_2) \tag{17}$$

Subject to the constraint, $t_2 \ = t_2\left(t_1^L,\ \alpha_{p,2}\right)$, as in eq. (16).

The first order condition for region 1 is,

$$\frac{\partial U^{p,1}(t_1,t_2)}{\partial t_1} = \theta\left[-x_1 f''(x_2)\frac{\partial x_1}{\partial t_1}\left(1-\frac{\partial t_2}{\partial t_1}\right)\right] + \ \alpha_{p,1} v^{'}(g_1)\left[t_1\frac{\partial x_1}{\partial t_1}\left(1-\frac{\partial t_2}{\partial t_1}\right)+x_1\right]$$

$$= \ 0, \qquad (18a)$$

where $\frac{\partial t_2}{\partial t_1} < 1$, by Lemma 2. Now, rearranging the terms of (18a), we can write

$$\frac{1}{v^{'}(g_1)} = \frac{\alpha_{p,1}[1-\eta_1\left(1-\frac{\partial t_2}{\partial t_1}\right)]}{\theta[f''(x_1)\frac{\partial x_1}{\partial t_1}][1-\frac{\partial t_2}{\partial t_1}]}\,. \qquad (18b)$$

From (18b), we get the optimal tax rate of region 1's policy maker:

$$t_1^L = t_1^L\left(\alpha_{p,1}, \qquad \alpha_{p,2}\right) \qquad (19a)$$

Substituting equation (19), in (16), we also get the optimal tax rate chosen by region 2:

$$t_2^F = t_2^F\left(\alpha_{p,1}, \qquad \alpha_{p,2}\right) \qquad (19b)$$

The properties of the tax rates, as given by (19a) and (19b), are the same as in the case of simultaneous move tax competition, only the magnitude of the outcomes have changed. As in Proposition 1, it is easy to check that both the tax rates are increasing function of $\alpha_{p,1}$ and $\alpha_{p,2}$, i.e. public good preference parameters have tax increasing effect. Moreover, it can be checked that, if there is an increase in the region $i$'s policy maker's preference (value) for public good ($\alpha_{p,i}$), increment in region $i$'s tax rate would be higher than the increment of the region $j$'s tax rate, as in the case of simultaneous move tax competition.

Finally, we turn to Stage 1, i.e., the political competition in the regions. In this stage, the median voter decides such a policy maker to set tax rates, who maximizes the median voter's utility. Here, we are interested to examine whether the median voter delegates the policy making or not.

Now, in Stage 1, the problem of the median voter of region $i$ (leader) can be written as follows.

$$\underset{\alpha_{p,i}}{Max} U^{\beta,i}\left(t_i^L, t_j^F\right) = \theta\, c_{\beta,i}\left(t_i^L, t_j^F\right) + \beta\, v\left(t_i^L, t_j^F\right) \tag{20}$$

$$= \theta\left[f\left(x_i\left(t_i^L, t_j^F\right)\right) - x_i\left(t_i^L, t_j^F\right) f'\left(x_i\left(t_i^L, t_j^F\right)\right)\right] + \beta\, v\left(t_i^L\, x_i\left(t_i^L, t_j^F\right)\right)$$

The first order condition of this problem can be written as,

$$\frac{1}{v'(g_i)} = \frac{\beta[1-\eta_i\varphi]}{\theta[f''(x_i)\frac{\partial x_i}{\partial t_i}]\varphi}, \qquad i, j = 1, 2, \tag{21}$$

where $\varphi = (\frac{\partial t_i^L}{\partial \alpha_{p,i}} - \frac{\partial t_j^F}{\partial \alpha_{p,i}}) / \frac{\partial t_i^L}{\partial \alpha_{p,i}}$. Clearly, $0 < \varphi < 1$, since $0 < \frac{\partial t_j^F}{\partial \alpha_{p,i}} < \frac{\partial t_i^L}{\partial \alpha_{p,i}}$would hold true in the case of sequential move as well, as in Proposition 1. Note that both $\eta_i$ and $\varphi$ functions of $\alpha_{p,i}$and $\alpha_{p,j}$. Similarly, we can solve for the public good preference parameter of the follower region *j*. Since regions are symmetric, the first order condition for the region *j*'s median voter's maximization problem would be similar to that in (21), except that we need to interchange the subscripts *i* and *j*.

Note that, we are more concerned about the position of the policy maker in comparison to the median voter and not about the exact magnitude of the public good preference parameter. In sequential move tax competition, both the regions charge different tax rates. So we analyze their political equilibrium separately[14].

First, we consider region 2 (the follower). On comparing equation (15b) and (21) we get,

[14] Now, note that, in equilibrium, the marginal rate of substitution between public good and private good remains constant. We utilise this property to get the relation between the median voter's and the policy maker's public good preferences.

$$\frac{1}{v'(g_2)} = \frac{\alpha_{p,2}[1-\eta_2]}{\theta[f''(x_2)\frac{\partial x_2}{\partial t_2}]} = \frac{\beta[1-\eta_2\varphi]}{\theta[f''(x_2)\frac{\partial x_2}{\partial t_2}]\varphi} \tag{22}$$

The equation for region 2 (follower) is the same as in the simultaneous move tax competition game (13). For $0 < \varphi < 1$, we can easily observe that $\alpha_{p,2} > \beta$. This indicates that the policy maker in region 2 (follower) is on the right side of median voter. We can say that median voter of follower region delegates tax rate decision to the policy maker, who has higher preference for the public good compared to the median voter herself. So in the case of follower region, there is political delegation with a tax increasing effect.

Next, we analyze the scenario in region1 (leader). On comparing equation (18b) and (21), we obtain,

$$\frac{1}{v'(g_1)} = \frac{\alpha_{p,1}[1-\eta_1\left(1-\frac{\partial t_2}{\partial t_1}\right)]}{\theta[f''(x_1)\frac{\partial x_1}{\partial t_1}][1-\frac{\partial t_2}{\partial t_1}]} = \frac{\beta[1-\eta_1\varphi]}{\theta[f''(x_1)\frac{\partial x_1}{\partial t_1}]\varphi} \tag{24}$$

We can easily show that $\frac{\left(\frac{\partial t_2^F}{\partial \alpha_{p,1}}\right)}{\left(\frac{\partial t_1^L}{\partial \alpha_{p,1}}\right)} = \frac{\frac{|B|}{|H|}}{\frac{|A|}{|H|}} = \frac{|B|}{|A|} = \frac{\left(\frac{\partial^2 U^{p,2}}{\partial t_1 \partial t_2}\frac{\partial^2 U^{p,1}}{\partial \alpha_{p,1}\partial t_1}\right)^{15}}{-\left(\frac{\partial^2 U^{p,1}}{\partial \alpha_{p,1}\partial t_1}\frac{\partial^2 U^{p,2}}{\partial t_2{}^2}\right)} = -\left(\frac{\frac{\partial^2 U^{p,2}}{\partial t_1 \partial t_2}}{\frac{\partial^2 U^{p,2}}{\partial t_2{}^2}}\right) = \frac{\partial t_2}{\partial t_1}$.

So we can write, $\varphi = \frac{\frac{\partial t_1^L}{\partial \alpha_{p,1}} - \frac{\partial t_2^F}{\partial \alpha_{p,1}}}{\frac{\partial t_1^L}{\partial \alpha_{p,1}}} = \left(1 - \frac{\frac{\partial t_2^F}{\partial \alpha_{p,1}}}{\frac{\partial t_1^L}{\partial \alpha_{p,1}}}\right) = \left(1-\frac{\partial t_2}{\partial t_1}\right)$. Substituting in (24), we get,

$$\Rightarrow \frac{\alpha_{p,1}[1-\eta_1\varphi]}{\theta[f''(x_1)\frac{\partial x_1}{\partial t_1}]\varphi} = \frac{\beta[1-\eta_1\varphi]}{\theta[f''(x_1)\frac{\partial x_1}{\partial t_1}]\varphi} \tag{25}$$

[15] $\frac{\partial^2 U^{p,2}}{\partial \alpha_{p,1}\partial t_2}\frac{\partial^2 U^{p,1}}{\partial t_2 \partial t_1} = -\frac{\partial^2 U^{p,1}}{\partial t_1{}^2}\frac{\partial^2 U^{p,2}}{\partial \alpha_{p,1}\partial t_2} = 0$. In these two equations, the first component is the effect of political variable on marginal return to tax choice, whereas second component is the marginal effect of other region's tax on region's marginal utility returns.

From this simplified equation (25), we can easily deduce that $\alpha_{p,1} = \beta$. This indicates that in the political competition, median voter of region 1 (leader) does not delegate the tax rate decision. She decides to become the policy maker herself. This result is in contrast to the simultaneous tax competition game, where both the regions delegate the tax rate decision task. So we observe that, if the regions move sequentially, it is not necessary that a region delegates the tax rate decision. We can say that a region delegates the policy making task only if that region is the follower in sequential move tax competition; but does not delegate, if he chooses to be the leader. This brings us to our main result.

***Proposition 3:*** *In a sequential equilibrium, there is political delegation in the follower region only. There is no political delegation in the leader region, in equilibrium. In the follower region, the policy maker has higher preferences for public good compared to the median voter, while in the leader region the median voter herself decides to become the policy maker and the median voter's public good preference level is the optimum.*

The intuition behind this result is as follows. In a sequential move tax competition game, if a region is the follower, then due to strategic complement nature of tax rates, the follower region's tax rate is below the leader region's tax rate, provided no political competition is considered (see Kempf and Rota Graziosi (2010) for proof). At the first stage of the game, the median voter of the follower region anticipates that the policy maker will charge lower tax rate compared to the leader region, given other things constant, and the provision of public good will be lower than desired by her. We know that $\frac{\partial\,(t_i x_i)}{\partial t_i} = x_i(1-\eta_i) > 0$, i.e. higher tax rate leads to higher tax revenue. So there is a scope for tax rate increase without loss of tax revenue. Therefore in political competition, she delegates the tax rate decision to such a candidate who values the public good more than her. This puts an upward pressure on tax rates in the follower region $\frac{\partial t_2^F}{\partial \alpha_{p,2}} > 0$ leading to higher tax rate, compared to the no delegation situation, with increased public good provision. Conversely, in the leader region tax rates are higher and there is higher public good provision compared to the simultaneous move game (no political competition). So in stage 1, i.e. in the case of political competition, the median voter takes into consideration this result while deciding the political equilibrium. She does not delegate the tax rate decision making because the tax rate decided by her (median voter) is optimal to provide public good at the median voter's desired level. If she delegates the policy making to a candidate with higher public good preference, then the corresponding public good provision would have been too high compared to the median voter's desired level. These results point out that there is an optimal tax rate and corresponding public good provision desired by the representative median voter in each region. It is not always beneficial for a region to desire higher and higher tax rate to get more public good. In the case of the leader region, there is a possibility to charge a higher tax rate; still the median voter opts for no delegation to restrict the increase in the tax rate.

On the welfare implications, we extend the findings of Ihori and Yang (2009) by including a sequential choice in tax competition along with political competition. As is demonstrated in Ihori and Yang (2009) and Hoyt (1991) that tax competition leads to under provision of public good and political competition with heterogeneous individuals leads to over-provision of public good. A combination of these two aspects can lead to optimal provision of public good across the regions. We argue that a sequential choice in tax competition has two effects. First, based on Kempf and Rota-Graziosi (2010), only sequential tax competition has welfare improving effect on both regions as race-to-the-bottom" in tax rates in restricted. This causes increase in the provision of public goods in both regions. Second, the sequential tax competition also affects the political delegation in the presence of elected democracy. In our results, we show that in leader region median voter is the policy maker and follower region delegates the tax rate decision making to left leaning (higher tax rate) policy maker. Now a leader region will have higher tax rate than follower region (Kempf and Rota-Graziosi, 2010) and in turn higher public good provision, but the region with political delegation (i.e. leader) will have higher tax rate than region with no political delegation (i.e. follower). Thus there are two effects counterbalancing each other to reach toward optimal provision of public good[16]. To elaborate further, a leader region could have delegated to the policy maker who would then choose higher tax rate and higher level of public good but sequential tax competition acts as a strategic restriction for very high tax rate and over supply of public good. On the other hand, a follower region decides to delegate so that effect of sequential choice to choose lower tax rate is mitigated by political delegation leading to optimal tax rate and provision of public good. Thus we can say that Sequential tax competition combined with political delegation acts as an endogenous mechanism to ensure that race-to-the-bottom as well as race-to-the-top is restricted in tax rates and provision of public good.

Discussing the capital allocation across the regions, in the sequential tax competition, region with higher level of tax would attract lower capital and vice versa. So there would be asymmetry in capital allocation. But based on our capital market clearing conditions, the net return to capital would be same. These results highlight that when leadership and political competition mechanisms are considered jointly in tax competition, as expected there is restriction in 'race-to-the-bottom'. Further, we observe that sequential political delegation acts as a corrective

[16] Due to general nature (without functional forms) of objective function and model, we are not able to provide a optimal level closed form solution and just the conditions for the same.

mechanism to control for levying very high tax rate i.e. there is control on 'race-to-the-top' in public good provision (through tax rate restriction).

## 5. CONCLUSION

This paper investigates the impact of political competition and leadership in intraregional tax competition on equilibrium tax rates and local provision of public good to the citizens. We consider that there is heterogeneity in the preference for public good by the citizens (voters) in both the regions. The political equilibrium is decided by the median voter (through majority voting rule) and leadership in tax competition is decided randomly because of symmetric regions. We show that, political delegation of tax rate decisions in both the regions leads higher tax rates in simultaneous move tax competition.

However, if the regions choose tax rates sequentially (i.e. there is leadership in tax competition), it is not necessary that there is delegation of tax rate decision. We show that only in the follower region there is political delegation, whereas in the leader region, median voter becomes the policy maker and no political delegation is exercised in equilibrium. This result is in sharp contrast to the findings of the existing literature (Persson and Tabellini, 1992; Ihori and Yang, 2009; Brueckner, 2001).

The above result also indicates that political delegation acts as a corrective mechanism in sequential move tax competition, by restricting the upward spiral of tax rates. This restriction on tax rates indicate towards some optimal and desirable level of taxation for public good provision that is strategically and competitively viable.

Some of the possible extensions of this game that can enrich the literature on interaction between political economy and fiscal competition and can be considered for further research are as follows. First, in this paper, we consider the leadership decision being exogenous. A possible modification of this model with endogenous leadership can complement the findings from Kempf and Rota-Graziosi (2010), Eichner (2014) and others in particular and literature on endogenous leadership in supermodular games with incentive structure in general. Second, consideration of taxes being strategic substitute and their implications for the outcome of the game can enhance the understanding on interaction of political economy with leadership in taxation. Third, extension can be explored by including the public investment decision along with taxation in affecting the flow of capital in the regions. Lastly, another extension can be to consider the case where regions decide the political delegation sequentially[17]. In this case, we can understand the implication of joint sequential choice of political delegation and tax rates on equilibrium outcomes, flow of capital and provision of public goods.

[17] We are thankful to an anonymous reviewer for suggesting this extension.

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APPENDIX

## 1. Single peaked property and median voter theorem

In the present context, we define the single peaked property and the median voter theorem as follows:

*Definition 1*[18]*: Given any tax rate of region j,* $t_j$*, a tax rate* $t_i^*$ *is the most preferred tax rate of voter n in region i, iff* $U^{n,i}(t_i^*,\ t_j) > U^{n,i}(t_i,\ t_j)$ *for all* $t_i \neq t_i^*,\ i,j = 1{,}2$. *n=1, 2,…N.*

*Definition2*[19]*: Let* $t_i^{'}$ *and* $t_i^{''}$ *are any two tax rates among the possible tax rates for region i, such that either* $t_i^{'}, t_i^{''} \leq t_i^*$ *or* $t_i^{'}, t_i^{''} \geq t_i^*$*. Then voter's preferences are single peaked if and only if* $[U^{n,i}(t_i^{'},\ t_j) > U^{n,i}(t_i^{''},\ t_j)] \leftrightarrow [|t_i^{'} - t_i^*| < |t_i^{''} - t_i^*|];\ \ i,j = 1,2; n = 1,2,\ldots N.$

That is, given any two tax rates on the either side of the optimal (ideal) tax rate, a voter prefers one tax rate over the other only if the first tax rate is nearer to the her ideal tax rate compared to the second tax rate. Clearly, if the individuals' utility functions are concave in tax rate, their preferences are single peaked in terms of tax rate. Since, $U^{n,i}(t_i, t_j)$ is assumed to be concave in $(t_i, t_j)$, for all *i, j = 1,2* and *n=1,2,...N*, individual preferences are single peaked in terms of tax rate. Therefore, the median voter theorem, as stated below, holds true in the present context.

**A1. Proof of Lemma 1**

(a) $\frac{\partial[\alpha_{n,i}\, v(g_i)]}{\partial t_i} = \alpha_{n,i} v^{'}(g_i)\left(t_i \frac{\partial x_i}{\partial t_i} + x_i\right) = \alpha_{n,i}\, v^{'}(g_i)\, x_i(1-\eta_i) > 0$, since $\alpha_{n,i} > 0$ , $\eta_i < 1$ and $v^{'}(g_i) > 0$.

[18] Dennis Mueller (2003)
[19] Dennis Mueller (2003)

(b) $\frac{\partial^2[\alpha_{n,i}v(g_i)]}{\partial t_i^2} = \alpha_{n,i}\left(v^{'}(g_i)\left[t_i\frac{\partial^2 x_i}{\partial t_i{}^2} + 2\frac{\partial x_i}{\partial t_i}\right] + v^{''}(g_i)[t_i\frac{\partial x_i}{\partial t_i} + x_i]^2\right) = \alpha_{n,i}\left(v^{'}(g_i)2\frac{\partial x_i}{\partial t_i} + v^{''}(g_i)x_i^2[1-\eta_i]^2\right)$, since $\frac{\partial^2 x_i}{\partial t_i{}^2} = 0$. Clearly $\frac{\partial^2[\alpha_{n,i}v(g_i)]}{\partial t_i^2} < 0$, since $\alpha_{n,i} > 0$, $\frac{\partial x_i}{\partial t_i}$<0, $v^{'}(g_i) > 0$ and $v^{''}(g_i) < 0$.

(c) $\frac{\partial^2[\alpha_{n,i}\,v(g_i)]}{\partial t_j \partial t_i} = \alpha_{n,i}\left[v^{'}(g_i) + v^{''}(g_i)\left(t_i\frac{\partial x_i}{\partial t_i} + x_i\right)t_i\right]\frac{\partial x_i}{\partial t_j} = \alpha_{n,i}[v^{'}(g_i) + v^{''}(g_i)g_i(1-\eta_i)]\frac{\partial x_i}{\partial t_j}$. Now, since $[-\frac{g_i\,v^{''}(g_i)}{v^{'}(g_i)}] < 1$ and $0 < \eta_i < 1$, $\left[-\frac{g_i\,v^{''}(g_i)}{v^{'}(g_i)}(1-\eta_i)\right] < 1$. Therefore, $\alpha_{n,i}[v^{'}(g_i) + v^{''}(g_i)g_i(1-\eta_i)]\frac{\partial x_i}{\partial t_j} > 0$, since $\alpha_{n,i} > 0$, $v^{'}(g_i) > 0$and$\frac{\partial x_i}{\partial t_j} > 0$. QED.

## A2. Proof of Theorem

Suppose that, in region $i$, the median voter's most preferred tax rate is $t_i{}^{\beta}$. That is the median voter selects the tax rate $t_i{}^{\beta}$. Assume that$t_i^{'} \neq t_i{}^{m}$,say $t_i^{'} < t_i{}^{\beta}$. Let $R^{\beta}$ are the number of ideal tax rates to the right of$t_i{}^{\beta}$. By the definition of single peaked preferences all $R^{\beta}$voters prefer $t_i{}^{\beta}$ over $t_i^{'}$. As the median position is $t_i{}^{\beta}$, we have $R^{\beta} \geq n/2$. Thus, the voters preferring $t_i{}^{\beta}$over $t_i^{'}$ are at least $R^{\beta} \geq n/2$ and in the majority voting rule the median voter is selected as the decision maker or the tax rate selected by median voter is preferred by the majority.

## A3. Proof of Lemma 2

Note that, to prove Lemma 2, it is sufficient to show that the slope of the tax reaction function of the region 2's policy maker, in $t_1 - t_2$ plane, is less than one. Now note that the slope of the tax reaction function of the region 2's policy maker, in $t_1 - t_2$ plane, is given by $\left.\frac{\partial t_2}{\partial t_1}\right|_{p,2} = -\frac{\partial^2 U^{p,2}(t_1,t_2)}{\partial t_1 \partial t_2}\Big/\frac{\partial^2 U^{p,2}(t_1,t_2)}{\partial t_2^2}$, where $\frac{\partial^2 U^{p,2}(t_1,t_2)}{\partial t_1 \partial t_2}$and $\frac{\partial^2 U^{p,2}(t_1,t_2)}{\partial t_2^2}$are obtained by differentiating (9a), for *i=2*, with respect to $t_1$ and $t_2$, respectively. That is,

$\left.\frac{\partial t_2}{\partial t_1}\right|_{p,2} = -[\frac{\partial^2[\theta c_{p,2}\,(.)]}{\partial t_1 \partial t_2} + \frac{\partial^2[\alpha_{p,2}v(g_2)]}{\partial t_1 \partial t_2}]\Big/[\frac{\partial^2[\theta c_{p,2}\,(.)]}{\partial t_2^2} + \frac{\partial^2[\alpha_{p,2}v(g_2)]}{\partial t_2^2}] = -\frac{A+B}{C+D}$, where

$C = \frac{\partial^2[\theta c_{p,2}(.)]}{\partial t_2^2} = -\theta\left[x_j f^{'''}(x_j) + f^{''}(x_j)\right]\left(\frac{\partial x_j}{\partial t_j}\right)^2 = -\frac{\partial^2[\theta c_{p,2}(.)]}{\partial t_1\,\partial t_2} = -A$, $B = \frac{\partial^2[\alpha_{p,2}v(g_2)]}{\partial t_1\,\partial t_2}$ and $D = \frac{\partial^2[\alpha_{p,2}v(g_2)]}{\partial t_2^2}$. We have $(C+D) < 0$, since $U^{p,2}(.)$ is concave. Therefore, $\left.\frac{\partial t_2}{\partial t_1}\right|_{p,2} < 1 \Leftrightarrow A + B < -(C+D) \Leftrightarrow B + D < 0$, since $A + C = 0$.Now,

$$B + D = \alpha_{p,2}\left\{v^{'}(g_2)2\frac{\partial x_2}{\partial t_2} + v^{''}(g_2)x_2^2[1-\eta_2]^2 + [v^{'}(g_2) + v^{''}(g_2)g_2(1-\eta_2)]\frac{\partial x_2}{\partial t_1}\right\}$$

$$= \alpha_{p,2}\{v^{'}(g_2)2\frac{\partial x_2}{\partial t_2} + v^{''}(g_2)x_2^2[1-\eta_2]^2 - [v^{'}(g_2) + v^{''}(g_2)g_2(1-\eta_2)]\frac{\partial x_2}{\partial t_2}\}$$

$= \alpha_{p,2}\{v^{'}(g_2)\frac{\partial x_2}{\partial t_2} + v^{''}(g_2)x_2^2[1-\eta_2]^2 - v^{''}(g_2)g_2(1-\eta_2)\frac{\partial x_2}{\partial t_2}\} < 0$ , since $\frac{\partial x_2}{\partial t_2} < 0$, $\eta_2 < 1$, $v^{''}(g_2) < 0$ and $v^{'}(g_2) > 0$. Hence, $\left.\frac{\partial t_2}{\partial t_1}\right|_{p,2} < 1$. QED.

### A4. Proof of Proposition 1

Differentiating (9a) with respect to $\alpha_{p,1}$ , we get

$$\frac{\partial^2 U^{p,1}}{\partial {t_1}^2}\frac{\partial t_1^S}{\partial \alpha_{p,1}} + \frac{\partial^2 U^{p,1}}{\partial t_2 \partial t_1}\frac{\partial t_2^S}{\partial \alpha_{p,1}} + \frac{\partial^2 U^{p,1}}{\partial\, \alpha_{p,1}\partial t_1} = 0$$

$$\frac{\partial^2 U^{p,2}}{\partial t_1 \partial t_2}\frac{\partial t_1^S}{\partial \alpha_{p,1}} + \frac{\partial^2 U^{p,2}}{\partial {t_2}^2}\frac{\partial t_2^S}{\partial \alpha_{p,1}} + \frac{\partial^2 U^{p,2}}{\partial \alpha_{p,1}\partial t_2} = 0$$

From the above two equations, we can write $\frac{\partial t_1^S}{\partial \alpha_{p,1}} = \frac{|A|}{|H|}$ and $\frac{\partial t_2^S}{\partial \alpha_{p,1}} = \frac{|B|}{|H|}$ , where $|H| = \frac{\partial^2 U^{p,1}}{\partial {t_1}^2}\frac{\partial^2 U^{p,2}}{\partial {t_2}^2} - \frac{\partial^2 U^{p,2}}{\partial t_1 \partial t_2}\frac{\partial^2 U^{p,1}}{\partial t_2 \partial t_1}$, $|A| = -\frac{\partial^2 U^{p,1}}{\partial\, \alpha_{p,1}\partial t_1}\frac{\partial^2 U^{p,2}}{\partial {t_2}^2} + \frac{\partial^2 U^{p,2}}{\partial \alpha_{p,1}\partial t_2}\frac{\partial^2 U^{p,1}}{\partial t_2 \partial t_1}$ and $|B| = -\frac{\partial^2 U^{p,1}}{\partial {t_1}^2}\frac{\partial^2 U^{p,2}}{\partial \alpha_{p,1}\partial t_2} + \frac{\partial^2 U^{p,2}}{\partial t_1 \partial t_2}\frac{\partial^2 U^{p,1}}{\partial\, \alpha_{p,1}\partial t_1}$. Now, note that $|H| > 0$ (since the equilibrium is assumed to be stable), $\frac{\partial^2 U^{p,1}}{\partial \alpha_{p,1}\partial t_1} = v^{'}(g_1)x_1[1-\eta_1] > 0$ (since $\eta_1 < 1$) , $\frac{\partial^2 U^{p,2}}{\partial {t_2}^2} < 0$ (by second order condition of maximization), $\frac{\partial^2 U^{p,2}}{\partial \alpha_{p,1}\partial t_2} = 0$ (since $U^{p,2}(.)$ does not depend on $\alpha_{p,1}$), $\frac{\partial^2 U^{p,2}}{\partial t_1 \partial t_2} > 0$. Therefore, $|A| > 0$ and $|B| > 0$. So, we get, $\frac{\partial t_1^S}{\partial \alpha_{p,1}} > 0$ and $\frac{\partial t_2^S}{\partial \alpha_{p,1}} > 0$. Now, note that $\frac{\partial t_1^S}{\partial \alpha_{p,1}} - \frac{\partial t_2^S}{\partial \alpha_{p,1}} > 0 \Leftrightarrow -\frac{\partial^2 U^{p,2}}{\partial {t_2}^2} > \frac{\partial^2 U^{p,2}}{\partial t_1 \partial t_2}$. Since, $\left.\frac{\partial t_2}{\partial t_1}\right|_{p,2} = -\frac{\partial^2 U^{p,2}(t_1,t_2)}{\partial t_1 \partial t_2} / \frac{\partial^2 U^{p,2}(t_1,t_2)}{\partial t_2^2} < 1$ , by Lemma 2, and $\frac{\partial^2 U^{p,2}(t_1,t_2)}{\partial t_2^2} < 0$, we have $\Leftrightarrow -\frac{\partial^2 U^{p,2}}{\partial {t_2}^2} > \frac{\partial^2 U^{p,2}}{\partial t_1 \partial t_2}$. Therefore, $\frac{\partial t_1^S}{\partial \alpha_{p,1}} > \frac{\partial t_2^S}{\partial \alpha_{p,1}}$. QED.