Competition for Foreign Capital under Asymmetric Revenue-Orientation

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Abstract

This paper develops a model of inter-regional competition for mobile capital considering that regions may have different revenue-orientations. It shows that, if regions are asymmetric in terms of revenue-orientation, the less revenue-orientated region obtains higher tax-revenue and higher social welfare in the equilibrium than the more revenue-oriented region. However, if regions are symmetric, the equilibrium tax-revenue and social welfare are higher in the case of greater revenue-orientation of regions. Moreover, regions spend on public-investment and end up with Pareto-inferior equilibrium outcome, regardless of whether regions are symmetric or asymmetric. It also analyses implications of public-investment spill-over on equilibrium outcomes.

Key words: Asymmetric revenue orientation, Competition for foreign capital, Prisoners' Dilemma, Public investment, Spillover, Tax

JEL Classifications: H87, H40, R38, F21, C72

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Abstract

This paper develops a model of inter-regional competition for mobile capital considering that regions may have different revenue-orientations. It shows that, if regions are asymmetric in terms of revenue-orientation, the less revenue-orientated region obtains higher tax-revenue and higher social welfare in the equilibrium than the more revenue-oriented region. However, if regions are symmetric, the equilibrium tax-revenue and social welfare are higher in the case of greater revenue-orientation of regions. Moreover, regions spend on public-investment and end up with Pareto-inferior equilibrium outcome, regardless of whether regions are symmetric or asymmetric. It also analyses implications of public-investment spill-over on equilibrium outcomes.

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1 Introduction

It is observed that countries often engage themselves in multidimensional competition for foreign owned mobile capital. Bénassy-Quéré et al. (2007) and Bellak et al. (2009) document that the effect of public investment is as large as that of tax rate on capital flows in many European countries. It is also found that, in spite of setting high tax rates, countries can attract capital by spending more on productivity enhancing public investment.

Recently, a number of studies have attempted to analyze the tax-public investment interaction in the case of competition for mobile capital. It helps us to understand a variety of issues: effects of fiscal equalization schemes on the equilibrium tax and public investment (Keen and Marchand, 1997; Hindriks et al., 2008), implications of firm heterogeneity and tax harmonization (Zissimos and Wooders, 2008), effects of interregional-spillover of public investment (Dembour and Wauthy, 2009), role of country size (Pieretti and Zanaj, 2011), so on so forth. However, this set of studies assume that competing regions are symmetric in terms of their objective functions and their decisions to spend on productivity enhancing public investment are exogenously determined. Further, existing studies consider either net tax revenue (Zissimos and Wooders, 2008; Dembour and Wauthy, 2009; Pieretti and Zanaj, 2011) or social welfare (Keen and Marchand, 1997; Hindriks et al., 2008) as objective function. This paper analyses decisions to provide public investment by considering more general objective functions à la Pal and Sharma (2013), which encompasses social welfare and net tax revenue as special cases and allows us to analyze the implications of asymmetric objective functions of regions.[1]

Considering two regions competing for foreign owned mobile capital, this paper demonstrates that each region has unilateral incentive to spend on public investment, unless interregional-spillover of public investment is perfect. However, regions face a Prisoners'

[1]Unlike the present paper, Pal and Sharma (2013) focus on endogenous determination of regions' objective functions and, thus, bypass the issue of tax-public investment interaction in the presence of asymmetric objective functions.

Dilemma type situation while deciding on whether to spend on public investment or not. In the equilibrium, each region spends on public investment and ends up with Pareto inferior outcome. These results hold true in a number of plausible scenarios: (a) competing regions are concerned only about net tax revenue, (b) competing regions care for social welfare only, (c) competing regions care for both social welfare and net tax revenue but does not necessarily attach equal weights to social welfare and net tax revenue. These are new results.

It also examines effects of public-investment spillover and government's revenue orientation to equilibrium outcomes. Interestingly, tax rate and share of mobile capital in more (less) revenue oriented region are positively (negatively) related to the degree of spillover of public investment. This is because the negative effect of spillover on provision of public investment in the more revenue oriented region is smaller than that in the less revenue oriented region. Moreover, it shows that in the case of asymmetric revenue orientations of competing regions, more revenue oriented region sets higher tax rate, provides less public investment, attracts less mobile capital, earns lower net tax revenue and generates less social welfare compared to that of the less revenue oriented region. In contrast, if the two regions are symmetric, higher revenue orientation leads to higher tax rate, higher net tax revenue and higher social welfare in the equilibrium, as in Pal and Sharma (2013).

2 The Model

Suppose that there are two regions, region 1 and region 2, competing for foreign owned mobile investment capital of total amount one. Each region decides the tax rate t_i (≥ 0) on mobile capital x_i ($0 \leq x_i \leq 1$) and the level of public investment g_i (≥ 0), $i = 1, 2$. The cost to provide public investment g_i by region i is assumed to be $\frac{g_i^2}{2}$, $i = 1, 2$. So, the net tax revenue of region i is as follows.

$$NT_i = t_i x_i - \frac{g_i^2}{2},\ i = 1, 2. \tag{1}$$

Following Hindriks et al. (2008), we consider that the production function of a region i is as follows.

$$F_i(x_i, g_i) = (\gamma + g_i + \theta g_j)x_i - \frac{\delta x_i^2}{2},\ i,\ j = 1,\ 2,\ i \neq j, \tag{2}$$

where x_i is the amount of mobile capital invested in region i, γ (> 0) is the technology parameter, δ (> 0) denotes the rate of decline in the marginal productivity of mobile capital and θ ($0 \leq \theta \leq 1$) is the spillover effect of public investment in one region to the other region's productivity. Higher value of θ denotes higher spillover. We assume that $\gamma > \delta > 1$, which ensures that marginal productivity of capital is always positive and there exists stable interior solution in all the cases considered.

Assuming that the capital market is perfectly competitive and normalizing the price of output to be one, we can write the returns to immobile factors of region i as, $IR_i = [F_i(.) - x_i \frac{\partial F_i(.)}{\partial x_i}] = \frac{\delta}{2}x_i^2$. Therefore, following Kempf and Rota-Graziosi (2010), Hindriks et al. (2008) and Laussel and Le Breton (1998), we can express social welfare (SW) as follows.

$$SW_i = IR_i + NT_i = \frac{\delta}{2}x_i^2 + [t_i x_i - \frac{g_i^2}{2}],\ i = 1,\ 2. \tag{3}$$

We consider that the objective function of a region i is exogenously determined, which is given by a linear combination of its SW and NT:

$$\begin{aligned} O_i &= \alpha_i SW_i + (1 - \alpha_i)NT_i\,;\ 0 \leq \alpha_i \leq 1,\ i = 1,\ 2, \qquad (4)\\ &= \alpha_i[\frac{\delta x_i^2}{2}] + [t_i x_i - \frac{g_i^2}{2}]. \end{aligned}$$

where α_i and $(1 - \alpha_i)$ are the weights attached to SW_i and NT_i by region i. Note that, if $\alpha_i = 1$ ($\alpha_i = 0$), $O_i = SW_i$ ($O_i = NT_i$). Clearly, the above objective function encompasses SW_i and NT_i as special cases. Moreover, α_1 and α_2 need not necessarily be equal. If $\alpha_1 < \alpha_2$, region 1 is more revenue oriented than the region 2. That is, greater revenue orientation of a region corresponds to lower weight to social welfare and, thus, lower weight to returns to immobile factors in that region's objective function. The stages of the game involved are as follows.

Stage 1: Region 1 and region 2 simultaneously and independently decide whether to spend on public investment or not.

Stage 2: Regions decide their respective tax rates and level(s) of public investment, if decided to spend on public investment, simultaneously and independently.

Stage 3: Owners of mobile capital decide how much to invest in which region.

We solve this game by standard Backward Induction method. In stage 3, the arbitrage-proof equilibrium allocation of mobile capital between the two regions is given by

$$F'_{1,x_1}(x_1, g_1) - t_1 = F'_{2,x_2}(x_2, g_2) - t_2 > 0, \tag{5}$$

$$\text{and } \; x_1 + x_2 = 1. \tag{6}$$

Solving (5) and (6), we get

$$x_1 = \frac{1}{2} + \frac{1}{2\delta}[(t_2 - t_1) + (1-\theta)(g_1 - g_2)], \tag{7a}$$

$$\text{and } \; x_2 = \frac{1}{2} - \frac{1}{2\delta}[(t_2 - t_1) + (1-\theta)(g_1 - g_2)]. \tag{7b}$$

Clearly, increase in tax rate of one region negatively (positively) affects the flow of mobile capital in that (the other) region: $\frac{\partial x_i}{\partial t_i} < 0$ and $\frac{\partial x_j}{\partial t_i} > 0$; $i, \, j = 1, \, 2, \, i \neq j$. In contrast, increase in public investment in one region increases (decreases) capital flow in that (the other) region, unless there is perfect spillover of public investment: $\frac{\partial x_i}{\partial g_i} > 0$ and $\frac{\partial x_j}{\partial g_i} < 0$, unless $\theta = 1$; $i, \, j = 1, \, 2, \, i \neq j$.

From (7a), (7b) and (4), we get $O_1 = O_1(t_1, t_2, g_1, g_2, \alpha_1)$ and $O_2 = O_2(t_1, t_2, g_1, g_2, \alpha_2)$. It is easy to check that $\frac{\partial^2 O_1(.)}{\partial t_1 \partial t_2} = \frac{2-\alpha_1}{4\delta} > 0$ and $\frac{\partial^2 O_2(.)}{\partial t_2 \partial t_1} = \frac{2-\alpha_2}{4\delta} > 0, \forall \alpha_1, \, \alpha_2 \in [0, 1]$. It implies that the marginal effect of one region's tax rate on its own payoff increases with the increase in other region's tax rate. Therefore, tax rates $(t_1, \, t_2)$ are *strategic complements*. On the other hand, we can also check that $\frac{\partial^2 O_1(.)}{\partial g_1 \partial g_2} = -\frac{\alpha_1(1-\theta)^2}{4\delta} < 0$ and $\frac{\partial^2 O_2(.)}{\partial g_2 \partial g_1} = -\frac{\alpha_2(1-\theta)^2}{4\delta} < 0$, $\forall \alpha_1, \, \alpha_2 \in (0, 1]$ and $\theta \in [0, 1)$. Therefore, unlike tax rates, public investments $(g_1, \, g_2)$ are *strategic substitutes*.

We now turn to stage 2 of the game. The problem of region i in stage 2 can be written as follows.

$$\underset{t_i, g_i}{Max}\, O_i = \alpha_i \frac{\delta}{2} x_i^2 + [t_i x_i - \frac{g_i^2}{2}]$$

subject to

$$x_i = \frac{1}{2} + \frac{1}{2\delta}[(t_j - t_i) + (1-\theta)(g_i - g_j)]; i \neq j$$

Therefore, the outcomes of strategic interactions between the two regions in stage 2 are given by the following equations.[2]

$$\frac{\partial O_1}{\partial t_1} = 0 \Rightarrow t_1 = \frac{(2-\alpha_1)\,[\delta + (1-\theta)\ (g_1 - g_2) + t_2]}{4 - \alpha_1} \tag{8a}$$

$$\frac{\partial O_1}{\partial g_1} = 0 \Rightarrow g_1 = \frac{(1-\theta)\,[\alpha_1 \delta + (2-\alpha_1)\, t_1 + \alpha_1 t_2 - \alpha_1\,(1-\theta)\ g_2]}{4\delta - \alpha_1 (1-\theta)^2} \tag{8b}$$

$$\frac{\partial O_2}{\partial t_2} = 0 \Rightarrow t_2 = \frac{(2-\alpha_2)\,[\delta + (1-\theta)\ (g_2 - g_1) + t_1]}{4 - \alpha_2} \tag{9a}$$

$$\frac{\partial O_2}{\partial g_2} = 0 \Rightarrow g_2 = \frac{(1-\theta)\,[\alpha_2 \delta + (2-\alpha_2)\, t_2 + \alpha_2 t_1 - \alpha_2\,(1-\theta)\ g_1]}{4\delta - \alpha_2 (1-\theta)^2} \tag{9b}$$

For any g_1 and g_2, the tax reaction functions of region 1 (TRF_1) and region 2 (TRF_2) are given by (8a) and (9a), respectively. Clearly, for any given g_2, if g_1 increases, TRF_1 shifts out and TRF_2 shifts down, as depicted in Figure 1. As a result, the equilibrium tax rate of region 1 (region 2) increases (decreases): $\frac{\partial t_1(g_1,g_2)}{\partial g_1} > 0$ and $\frac{\partial t_2(g_1,g_2)}{\partial g_1} < 0$.[3] The intuition is as follows. If there is an increase in g_1 and tax rates are same across regions, region 1 becomes more attractive destination, which enables region 1 to set higher tax rate but induces region 2 to set lower tax rate.

On the other hand, for any t_2, if t_1 increases, both the regions' public investment reaction functions shift out as depicted in Figure 2. As a result, public investments in both

[2] The second order condition for maximization and the stability condition are satisfied, since $\delta > 1$ by assumption.

[3] For any g_1 and g_2, the equilibrium tax rates are as follows: $t_1(g_1, g_2) = \frac{(2-\alpha_1)[(3-\alpha_2)\,\delta + (1-\theta)\,(g_1 - g_2)]}{6-\alpha_1-\alpha_2}$ and $t_2(g_1, g_2) = \frac{(2-\alpha_2)[(3-\alpha_1)\,\delta - (1-\theta)\,(g_1 - g_2)]}{6-\alpha_1-\alpha_2}$.

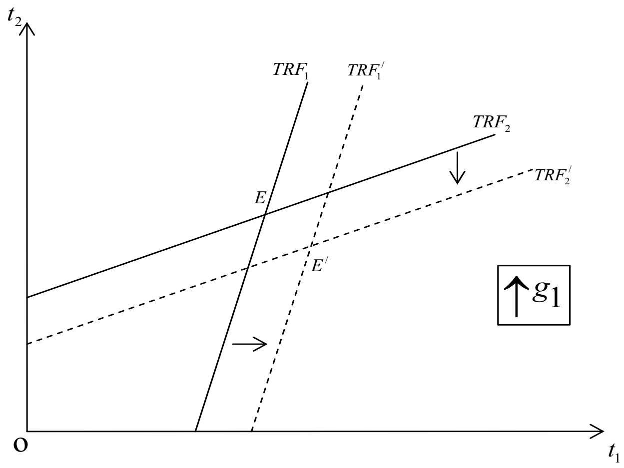

Figure 1: Change in public investment and tax reaction functions

the regions are higher in the new equilibrium $E^{/}$: $\frac{\partial g_1}{\partial t_1} > 0$ and $\frac{\partial g_2}{\partial t_1} > 0$, since $\delta > 1$.[4] The reason is, if there is an increase in t_1, region 1 becomes relatively less attractive destination of capital. As a result, (a) region 1 increases g_1 to counteract the negative effect of higher t_1 and (b) region 2 also increases g_2 as it can reap higher benefit by doing so if t_1 is higher.

Now, we turn to examine whether regions have unilateral incentive to spend on public investment or not. It is easy to check that allocation of capital in a region is increasing in public investment of that region: $\frac{\partial x_i}{\partial g_i} > 0$, for any g_j, provided that $0 \leq \theta < 1$; $i, j = 1, 2$, $i \neq j$. Therefore, for any given g_j, we have

$$\frac{\partial O_i}{\partial g_i} = \underbrace{\alpha_i \delta x_i \frac{\partial x_i}{\partial g_i}}_{+} + \underbrace{t_i \frac{\partial x_i}{\partial g_i}}_{+} + \underbrace{x_i \frac{\partial t_i}{\partial g_i}}_{+} - g_i \,.$$

It implies that, for any level of public investment in region j, returns to immobile factors as well as tax revenue of region i increases with increase in its own public investment. Clearly, $\frac{\partial O_i}{\partial g_i} \mid_{g_i=0} > 0$, $\forall \alpha_i, \alpha_j \in [0, 1]$ and $\theta \in [0, 1)$. Therefore, it is optimal for each region to spend on public investment.

[4]Public investment reaction functions of region 1 (IRF_1) and region 2 (IRF_2) are given by (8b) and (9b), respectively. Solving the (8b) and (9b) we get, $g_1 = \frac{(1-\theta)\,[\alpha_1\,\delta\{2\,\delta-\alpha_2\,(1-\theta)^2\}+\{2\,(2-\alpha_1)\delta-\alpha_2(1-\theta)^2\}t_1+\alpha_1\{2\,\delta-(1-\theta)^2\}t_2]}{2\delta\{4\delta-(\alpha_1+\alpha_2)(1-\theta)^2\}}$ and $g_2 = \frac{(1-\theta)\,[\alpha_2\,\delta\{2\,\delta-\alpha_1\,(1-\theta)^2\}+\{2\,(2-\alpha_1)\delta-\alpha_2(1-\theta)^2\}t_2+\alpha_2\{2\,\delta-(1-\theta)^2\}t_1]}{2\delta\{4\delta-(\alpha_1+\alpha_2)(1-\theta)^2\}}$.

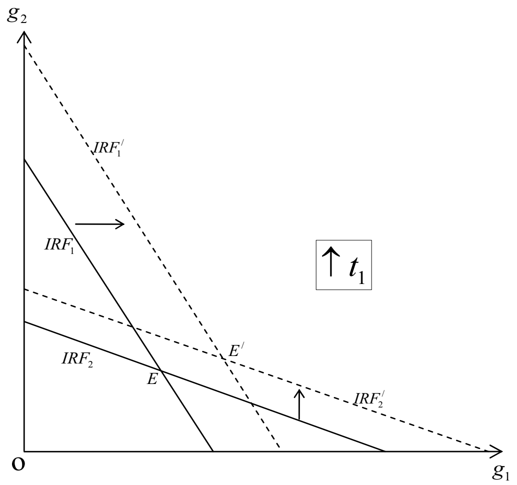

Figure 2: Change in tax rate and public investment reaction functions

Proposition 1: *Each region has unilateral incentive to spend on public investment, in the case of competition for foreign owned mobile capital, irrespective of whether the competing regions have symmetric objective functions or not.*

Solving (8a), (8b), (9a) and (9b), we get the equilibrium tax rates, public investments and allocation of mobile capital, given α_i and α_j ($\in [0,1]$), as follows:

$$\begin{aligned} t_i =& \frac{(2-\alpha_i)\ \delta\left[(3-\alpha_j)\ \delta-(1-\theta)^2\right]}{(6-\alpha_i-\alpha_j)\ \delta-2\,(1-\theta)^2} > 0, \\ g_i =& \frac{(1-\theta)\left[(3-\alpha_j)\ \delta-(1-\theta)^2\right]}{(6-\alpha_i-\alpha_j)\ \delta-2\,(1-\theta)^2} > 0 \text{ and} \\ x_i =& 1-x_j = \frac{\left[(3-\alpha_j)\ \delta-(1-\theta)^2\right]}{(6-\alpha_i-\alpha_j)\ \delta-2\,(1-\theta)^2} \ \in (0,1),\ \forall\theta\in[0,1);\ i,j=1,2. \end{aligned} \tag{10}$$

It is easy to check that $\frac{\partial g_i}{\partial \theta} < 0$. That is, each region spends less on public investment, if spillover is higher, irrespective of their objective functions. Also, if the extent of welfare orientation of region i is lower than that of its rival region j ($\alpha_i < \alpha_j$), higher spillover of public investment leads to higher tax rate in region i ($\frac{\partial t_i}{\partial \theta} > 0$) and lower tax rate in rival region j ($\frac{\partial t_j}{\partial \theta} < 0$), in the equilibrium. However, the negative effect of spillover on the equilibrium public investment is stronger in region j compared to that in region i, if region i

is less welfare oriented than region j: $0 > \frac{\partial g_i}{\partial \theta} > \frac{\partial g_j}{\partial \theta}$, if $\alpha_i < \alpha_j$. As a result, higher spillover leads to higher (lower) share of mobile capital of region i (in region j) in the equilibrium, if region i is more revenue oriented than that of its rival region j: $\frac{\partial x_j}{\partial \theta} < 0 < \frac{\partial x_i}{\partial \theta}$, if $\alpha_i < \alpha_j$.

Proposition 2: *In the case of asymmetric regions, (a) spillover of public investment positively (negatively) affects the tax rate of the relatively more (less) revenue oriented region, (b) negative effect of spillover on provision of public investment is stronger in the relatively less revenue oriented region and (c) spillover of public investment positively (negatively) affects the share of mobile capital of the relatively more (less) revenue oriented region.*

It is interesting to note that, if the two regions differ in terms of their objective functions (i.e., if $\alpha_i \neq \alpha_j$), in the equilibrium, relatively more revenue oriented region sets higher tax rate and provides less public investment compared to that of its rival region: $0 < t_j < t_i$ and $0 < g_i < g_j$, if $\alpha_i < \alpha_j$. This is because, greater revenue orientation of a region makes it less aggressive in tax competition, since it attaches less weight to returns to immobile factors. As a result, relatively more revenue oriented region attracts less mobile capital, earns less net tax revenue, earns less returns to its immobile factors and achieves lower social welfare than that of its rival region: $0 < x_i < x_j < 1$, $0 < NT_i < NT_j$, $0 < IR_i < IR_j$ and $0 < SW_i < SW_j$, if $\alpha_i < \alpha_j$.[5] However, if the two regions are symmetric in terms of their objective functions, i.e., if $\alpha_1 = \alpha_2 = \alpha$, higher welfare orientation (i.e., greater value of α) of the regions leads to lower tax rate, lower net tax revenue and lower social welfare in each of the two regions: $\frac{\partial t_i}{\partial \alpha} < 0$, $\frac{\partial NT_i}{\partial \alpha} < 0$ and $\frac{\partial SW_i}{\partial \alpha} < 0$, $i = 1, 2$. The intuition behind this result is as follows. Symmetric regions set the same tax rate and provide the same level of public investment in the equilibrium. Thus, each region gets half of the total mobile capital, no matter whether regions are more or less concerned about net tax revenue than social welfare. However, greater welfare orientation of the regions make them more aggressive players in tax competition and, thus, intensifies the race-to-the-bottom in tax

[5]Note that each region earns positive net tax revenue in the equilibrium, irrespective of their objective functions. In other words, governments' budget constraints are not binding in the present context.

rates. On the other hand, choice of public investment remains insensitive to the extent of welfare orientation of the regions, since the positive effect of greater welfare orientation of a region on its public invest gets exactly offset by the negative effect of the rival region's greater welfare orientation.

Proposition 3: *The equilibrium share of mobile capital, net tax revenue and welfare are less in the relatively more revenue oriented region than that in the relatively more welfare oriented region. However, if competing regions have the same level of revenue orientation, i.e. if the objective functions of the regions are same, greater revenue orientation of the regions leads to higher tax rate, higher net tax revenue and higher welfare.*

Now, substituting the expressions for t_i, g_i and x_i from (10) in the expression for O_i, we get $O_i = \frac{[(4-\alpha_i)\,\delta-(1-\theta)^2]\,[(3-\alpha_j)\,\delta-(1-\theta)^2]^2}{2\,[(6-\alpha_i-\alpha_j)\,\delta-2\,(1-\theta)^2]^2} = O_i^{g,g}$, where superscript '$g, g$' denotes that both the regions spend on public investment. Note that, if only region i spends on public investment, the stage 2 equilibrium public investments and capital allocation can be obtained by solving (8a), (8b), (9a) and $g_j = 0$, and the corresponding $O_i = \frac{(3-\alpha_j)^2\,\delta^2\,[(4-\alpha_i)\,\delta-(1-\theta)^2]}{2\,[(6-\alpha_i-\alpha_j)\,\delta-(1-\theta)^2]^2} = O_i^{g,0}$ and $O_j = \frac{(4-\alpha_j)\,\delta\,[(3-\alpha_i)\,\delta-(1-\theta)^2]^2}{2\,[(6-\alpha_i-\alpha_j)\,\delta-(1-\theta)^2]^2} = O_j^{g,0}$. Similarly, if only region j provides public investment, we get $O_i = \frac{(4-\alpha_i)\,\delta\,[(3-\alpha_j)\,\delta-(1-\theta)^2]^2}{2\,[(6-\alpha_i-\alpha_j)\,\delta-(1-\theta)^2]^2} = O_i^{0,g}$ and $O_j = \frac{(3-\alpha_i)^2\,\delta^2\,[(4-\alpha_j)\,\delta-(1-\theta)^2]}{2\,[(6-\alpha_i-\alpha_j)\,\delta-(1-\theta)^2]^2} = O_j^{0,g}$. If none of the regions spend on public investment, $O_i = \frac{(4-\alpha_i)\,(3-\alpha_j)^2\,\delta}{2\,(6-\alpha_i-\alpha_j)^2} = O_i^{0,0}$. We depict the normal form of the stage 1 game in Figure 3.

		Region 2	
		No public investment	Public investment
Region 1	No public investment	$O_1^{0,0}$, $O_2^{0,0}$	$O_1^{0,g}$, $O_2^{0,g}$
	Public investment	$O_1^{g,0}$, $O_2^{g,0}$	$O_1^{g,g}$, $O_2^{g,g}$

Figure 3: Decision to spend on public investment

From Figure 3, it is easy to observe that $O_1^{g,g} > O_1^{0,g}$ and $O_2^{g,g} > O_2^{g,0}$; $\forall \alpha_1, \alpha_2 \in [0, 1]$ and $0 \leq \theta < 1$. It implies that, if region 2 (region 1) spends on public investment, it is optimal for region 1 (region 2) also to spend on public investment. Moreover, we get

$O_1^{g,0} > O_1^{0,0}$ and $O_2^{0,g} > O_2^{0,0}$; $\forall \alpha_1, \alpha_2 \in [0,1]$ and $0 \leq \theta < 1$. Thus, in the equilibrium, both the regions spend on public investment irrespective of the weights attached to SW and NT by the regions. The intuition behind this result is as follows. If a region spends on public investment, the other region needs to counteract that by undercutting the tax and spending on public investment, since only tax under cutting is sub-optimum from both net tax revenue and social welfare point of view. On the other hand, if a region does not spend on public investment, by providing public investment the other region can increase the tax rate to some extent and still attracts more mobile capital, which in turn leads to higher net tax revenue as well as higher returns to immobile factors.

However, net tax revenue as well as social welfare of each region is lower when the regions spend on public investment compared to that in the case of no spending on public investment: $O_i^{g,g} < O_i^{0,0}$, $\forall \alpha_i \in [0,1]$ and $0 \leq \theta < 1$; $i = 1, 2$. It implies that the competing regions face a Prisoners' dilemma type of situation while deciding whether to spend on public investment or not and end up with Pareto inferior outcomes. Therefore, we have the following.

Proposition 4: *In the equilibrium, both the regions spend on public investment and end up with Pareto inferior outcomes.*

In this analysis, we have assumed that tax rates and levels of public investments are chosen by the regions simultaneously. However, there is no a priori reason for considering simultaneous choice of the two instruments. In fact, in the literature on tax competition, it is also considered that regions decide public investments before they set tax rates. Nonetheless, the results of this analysis are not sensitive to such alteration in sequence of events. The reason is, in the present context, public investment does not have any direct effect on returns to immobile factors, it acts only via the allocation of mobile capital. We are omitting the detailed calculations for the sequential choice game, which are quite straightforward, to economize on space.[6]

[6]These are available on request from the authors.

3 Conclusion

In this paper we have endogenized the governments' decisions to spend on productivity enhancing public investment in the case of competition for foreign owned mobile capital between two regions, by allowing for the possibility of asymmetric regions in terms of their objective functions. our set-up encompasses social welfare maximization and net tax revenue maximization by any region as two special cases. We have also examined the implication of interregional spillover of productivity enhancing public investment and revenue orientations of the regions on equilibrium outcomes.

We have demonstrated that, unless there is perfect spillover, each region has unilateral incentive to spend on public investment and, in the equilibrium, both the regions provide public investment. However, the equilibrium payoffs are Pareto dominated by the payoffs corresponding to no provision of public investment. These results hold true, irrespective of whether regions are symmetric or asymmetric.

We have also shown that spillover of public investment has differential impacts on equilibrium outcomes of the two regions, when regions are asymmetric. If one region is more revenue oriented than the other, higher spillover of public investments leads to higher tax rate as well as higher share of mobile capital in the relatively more revenue oriented region. Further, for any given degree of spillover, more revenue oriented region gets less mobile capital, less tax revenue and less social welfare than that of the more welfare oriented region. However, if the two regions are equally revenue oriented, greater revenue orientation leads to higher tax rate, higher net tax revenue as well as higher social welfare in the equilibrium, while levels of public investments and allocation of mobile capital remains unaltered.

In this paper, we have considered that regions' objective functions are exogenously determined. It seems to be interesting to extend the present analysis by allowing for endogenous determination of the weights given to social welfare and net tax revenue in the objective functions. It might also be interesting to examine the implications of sequential move by the regions (i.e., leader-follower game) and of other types of asymmetry between regions (e.g., different country size, mobility cost of capital, productivity, etc.) in the present context. We leave these for future research.

References

Bellak, C., Leibrecht, M., and Damijan, J. P. (2009). Infrastructure endowment and corporate income taxes as determinants of foreign direct investment in central and eastern european countries. *The World Economy*, 32(2):267–290.

Bénassy-Quéré, A., Gobalraja, N., and Trannoy, A. (2007). Tax and public input competition. *Economic Policy*, 22(50):385–430.

Dembour, C. and Wauthy, X. (2009). Investment in public infrastructure with spillovers and tax competition between contiguous regions. *Regional Science and Urban Economics*, 39(6):679–687.

Hindriks, J., Peralta, S., and Weber, S. (2008). Competing in taxes and investment under fiscal equalization. *Journal of Public Economics*, 92(12):2392–2402.

Keen, M. and Marchand, M. (1997). Fiscal competition and the pattern of public spending. *Journal of Public Economics*, 66(1):33–53.

Kempf, H. and Rota-Graziosi, G. (2010). Endogenizing leadership in tax competition. *Journal of Public Economics*, 94(9-10):768–776.

Laussel, D. and Le Breton, M. (1998). Existence of nash equilibria in fiscal competition models. *Regional Science and Urban Economics*, 28(3):283–296.

Pal, R. and Sharma, A. (2013). Endogenizing governments' objectives in tax competition. *Regional Science and Urban Economics*, 43(4):570 – 578.

Pieretti, P. and Zanaj, S. (2011). On tax competition, public goods provision and jurisdictions' size. *Journal of International Economics*, 84(1):124–130.

Zissimos, B. and Wooders, M. (2008). Public good differentiation and the intensity of tax competition. *Journal of Public Economics*, 92(5-6):1105–1121.