

Preferential Tax Regimes and Agglomeration Economies

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Preferential tax regimes have been criticized by policy makers as a source of harmful tax competition. It has been controversial among theorists, however, whether preferential tax regimes are harmful or not. The current paper introduces agglomeration economies and find that, while preferential regimes generate larger tax revenues, the difference of tax revenues between two regimes (preferential and non-preferential) may be larger or smaller than the case without agglomeration economies. It shows that the importance of the preferential regimes increase as the proportion of capital which generates external economy rises.

Keywords: preferential tax regimes; increasing returns to scale; tax competition

I. Introduction

While there is a large literature on tax competition, that on preferential tax regimes is relatively new and is now growing.¹ National or local governments have incentives to attract capital from abroad or other regions by setting lower tax rates on certain industries (in which mainly foreigners invest) than on other industries. For example, governments may set lower corporate tax rate for manufacturing and financial industries than for others. This is called tax discrimination or preferential tax regimes and has been criticized by organizations such as the European Commission and OECD as leading to harmful tax competition. Ireland, who used to adopt tax discrimination for the corporate tax, gave it up and unified the tax rate.

It has been controversial among theorists whether preferential tax regimes are desirable or not. Janeba and Peters (1999) assumed two tax bases (internationally mobile and not mobile at all) and showed that the Nash equilibrium of competing two countries under preferential tax regimes is the prisoners' dilemma, thereby argued that non-preferential regime is more desirable. Keen (2001), on the other hand, assumed two mobile tax bases

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and two identical countries, and argued that tax preference can limit the scope of tax competition and increase tax revenues. Janeba and Smart (2003) generalized the model of Keen (2001) and analyzed the cases where preferential treatment or the difference of tax rates is not prohibited but restricted. Then they showed that if a coordinated reduction in tax rates makes the tax bases grow and both types of capital are highly mobile, restrictions on preferential treatment is revenue-increasing, although a complete ban on tax preferences is undesirable. Haupt and Peters (2005) argued that with a home bias of investors, restrictions on preferential treatments increase tax revenues.

Bucovetsky and Haufler (2006) extended Keen's model assuming asymmetric countries in population and showed that Keen's conclusion holds. On the other hand, Oshima (2009) assumed the asymmetry in production technologies between two countries and showed that non-preferential regimes may be more desirable. Oshima (2010) considered the same model as Keen (2001) except that the two tax bases, or capital, are not separated but there exists only one type of capital invested in different industries as well as different countries, and showed that non-preferential regimes can be more desirable. Marceau et al. (2007) considered asymmetric countries in their amount of immobile capital, competing over mobile capital, where two types of capital are perfect substitutes in production functions. Then they showed that non-preferential regime generates larger global tax revenue, although the allocation of capital across countries is inefficient.

A possible extension to the model is to introduce agglomeration economies, which causes the concentration of economic activities in a number of places. Agglomeration economies were introduced to the models of tax competition by, for example, Andersson and Forslid (2003) and Baldwin and Krugman (2004). While these studies are based on the model of "new economic geography" with variety of manufactured goods and imperfect competition, a model with increasing returns to scale which is external to the firms has the advantage that they can easily be compared with the previous works of preferential tax regimes. Fernandez (2005) introduced this type of agglomeration economies based on Garcia-Mila and McGuire (2001). Then he showed that agglomeration economies make the usual inefficiency of tax competition (or underprovision of public goods) more severe.

The current paper analyzes whether preferential tax regimes are desirable when agglomeration economies exist. This situation is illustrated, for example, such that research and development (R&D) activities generate positive externalities and local governments have incentive to give preferential treatment to such sectors, as some governments actually do.

The rest of the paper is organized as follows. Section II sets up a model with two types of mobile capital one of which generates agglomeration economies. Then it shows that the tax revenue is larger under preferential regimes than under non-preferential regimes, as in Keen (2001) where agglomeration economies do not exist. Section III shows that under certain conditions the difference of tax revenues under two tax regimes is larger when agglomeration economies exist than when they do not. In addition, the preferential tax regimes will be more important as the proportion of capital which generates external economy rises. Section IV concludes.

II. Agglomeration economies

Suppose the economy consisting of many small and identical countries.² The governments aim at maximizing tax revenues. There are two types of capital, K and H , which are mobile across countries.

There are two sectors, or industries, whose products are represented by \tilde{F} and \tilde{G} . They employ capital K and H , and labor L^K and L^H respectively. Each worker supplies one unit of labor inelastically and is immobile across countries and sectors (L^K and L^H are fixed for each country). The production functions are expressed as follows:

$$\tilde{F} = F(K, L^K)E\left(\frac{H}{L^H}\right) \tag{1}$$

$$\tilde{G} = G(H, L^H)E\left(\frac{H}{L^H}\right) \tag{2}$$

where country-specific subscripts are suppressed. The function $E(H/L^H)$, which satisfies $E' > 0$, represents the external economy caused by the agglomeration. It is assumed that only the capital H (per worker) generates external economies. Because the externality is positive, we assume $E > 1$ throughout. Assuming that the functions F and G are

homogeneous of degree one, (1) and (2) can be rewritten as,

$$\tilde{f} = f(k)E(h) \quad (3)$$

$$\tilde{g} = g(h)E(h) \quad (4)$$

where k and h are capital per worker. We assume $f_k > 0$, $f_{kk} < 0$, $g_h > 0$ and $g_{hh} < 0$ where subscripts denote partial derivatives. Firms take the external economy $E(h)$ as given and determine k and h . Total amount of each capital in the economy is fixed, and the average per capita amounts are \bar{k} and \bar{h} .

Local governments levy taxes per unit of capital t^k and t^h on k and h . The net of tax returns are determined in the capital markets of k and h respectively. Denoting them as r^k and r^h , the profit maximization by the firms yields the following conditions:

$$f_k E = r^k + t^k \quad (5)$$

$$g_h E = r^h + t^h. \quad (6)$$

Since countries are assumed to be small enough, r^k and r^h are taken as given by the governments. Differentiating (5) and (6) with respect to t^k and t^h , respectively, and rearranging we have,

$$\frac{dk}{dt^k} = \frac{1}{f_{kk}E} \quad (7)$$

$$\frac{dh}{dt^h} = \frac{1}{g_{hh}E + g_h E_h} \quad (8)$$

which the governments take into account in determining the tax rates.

1. Preferential regime

Under preferential regimes governments determine the tax rates t^k and t^h . Note that $E(h)$ is not exogenous to the governments but they know that the external economy depends on the amount of h . Denoting the tax revenue under preferential regime as Rev^P , governments solve the following maximization problem:

$$\max_{t^k, t^h} Rev^P = t^k k + t^h h.$$

Using (7) and (8) we have the first order conditions,

$$t^k : k + \frac{t^k}{f_{kk}E} = 0$$

$$t^h : h + \frac{t^h}{g_{hh}E + g_h E_h} = 0.$$

Therefore the tax rates are expressed as follows:

$$t^k = -k f_{kk} E \tag{9}$$

$$t^h = -h(g_{hh}E + g_h E_h). \tag{10}$$

Tax revenue is obtained by substituting (9) and (10) into $Rev^P = t^k k + t^h h$. The second term in the parentheses of (10), $g_h E_h$, which would not appear without agglomeration economies, represents the reduction in tax rate (by multiplying h) to cope with the external economy. Because capital h generates positive externality, the government has incentive to set its tax rate lower than it would do without agglomeration economies to attract capital h in its jurisdiction. Because countries are symmetric, equilibrium capital amounts are \bar{k} and \bar{h} .

2. Non-preferential regime

Under the non-preferential regime governments cannot determine the tax rates on two tax bases separately but have to set a single tax rate t . Letting Rev^{NP} denote the tax revenue under non-preferential regime the maximization problem for the government is,

$$\max_t Rev^{NP} = t(k + h).$$

Solving this problem yields,

$$k + \frac{t}{f_{kk}E} + h + \frac{t}{g_{hh}E + g_h E_h} = 0.$$

Therefore the tax rate is expressed as follows:

$$t = -\frac{f_{kk}E(g_{hh}E + g_h E_h)}{f_{kk}E + g_{hh}E + g_h E_h}(k + h) \tag{11}$$

where tax revenue is obtained by substituting (11) into $Rev^{NP} = t(k + h)$.

3. Difference of revenues

We now compare tax revenues under preferential and non-preferential regimes. The difference of tax revenues Δ is,

$$\begin{aligned}
\Delta &= Rev^P - Rev^{NP} \\
&= -k^2 f_{kk}E - h^2(g_{hh}E + g_h E_h) + (k+h)^2 \frac{f_{kk}E(g_{hh}E + g_h E_h)}{f_{kk}E + g_{hh}E + g_h E_h} \\
&= \frac{-k^2(f_{kk}E)^2 - h^2(g_{hh}E + g_h E_h)^2 + 2khf_{kk}E(g_{hh}E + g_h E_h)}{f_{kk}E + g_{hh}E + g_h E_h} \\
&= -\frac{[kf_{kk}E - h(g_{hh}E + g_h E_h)]^2}{f_{kk}E + g_{hh}E + g_h E_h}. \tag{12}
\end{aligned}$$

The denominator of the RHS of (8), $g_{hh}E + g_h E_h$, should be negative as long as the use of h decreases as its price increases. Therefore the denominator of the RHS of (12) is negative and $\Delta \geq 0$. That is, the tax revenue is larger under preferential regimes than under non-preferential regimes, except when the numerator of the RHS of (12) equals zero, that is, from (9) and (10), when $t^k = t^h$ under the preferential regime.

III. Comparison with the non-agglomeration model

Let us consider a case without agglomeration economies which corresponds to the model of Keen (2001). Suppose that agglomeration economies do not exist, or alternatively, the government takes the positive externality as exogenous. External economy E is replaced with an exogenous parameter \bar{E} so that one can compare the result with that of the previous section. Then the production functions are expressed as follows:

$$\tilde{f} = f(k)\bar{E} \tag{13}$$

$$\tilde{g} = g(h)\bar{E} \tag{14}$$

in which case the profit maximization by the firms yields the following conditions:

$$f_k \bar{E} = r^k + t^k \tag{15}$$

$$g_h \bar{E} = r^h + t^h. \tag{16}$$

Differentiating (15) and (16) with respect to t^k and t^h , respectively, and rearranging we have,

$$\frac{dk}{dt^k} = \frac{1}{f_{kk}\bar{E}} \quad (17)$$

$$\frac{dh}{dt^h} = \frac{1}{g_{hh}\bar{E}}. \quad (18)$$

Solving the governments' problem of revenue maximization using (17) and (18) yields,

$$t^k : k + \frac{t^k}{f_{kk}\bar{E}} = 0$$

$$t^h : h + \frac{t^h}{g_{hh}\bar{E}} = 0.$$

Therefore the tax rates are expressed as follows:

$$t^k = -kf_{kk}\bar{E} \quad (19)$$

$$t^h = -hg_{hh}\bar{E}. \quad (20)$$

Similarly, under the non-preferential regime with a single tax rate t , solving the revenue maximization problem we have,

$$k + \frac{t}{f_{kk}\bar{E}} + h + \frac{t}{g_{hh}\bar{E}} = 0.$$

Therefore the tax rate is expressed as follows:

$$t = -\frac{f_{kk}g_{hh}\bar{E}}{f_{kk} + g_{hh}}(k + h). \quad (21)$$

Then the difference of tax revenues under the two tax regimes Δ is,

$$\Delta = Rev^P - Rev^{NP} = -\frac{(kf_{kk} - hg_{hh})^2}{f_{kk} + g_{hh}}\bar{E} \geq 0 \quad (22)$$

which again shows that the tax revenue is larger under preferential regimes than under non-preferential regimes, except when $t^k = t^h$. This is in line with Keen's (2001) conclusion.

In what follows, let variables with superscript "A" denote those when agglomeration economies exist (that is, variables in the previous section). If Δ^A is larger than Δ , it means that the preferential treatment is more important when agglomeration economies

exist than when they do not. Subtracting Δ from Δ^A and multiplying $(f_{kk}E + g_{hh}E + g_h E_h)(f_{kk}E + g_{hh}E) > 0$ and substituting $\bar{E} = E$ we have

$$\begin{aligned} & (\Delta^A - \Delta)(f_{kk}E + g_{hh}E + g_h E_h)(f_{kk}E + g_{hh}E) \\ &= [-(kf_{kk}E)^2 + 2kf_{kk}Eh(g_{hh}E + g_h E_h) - h^2(g_{hh}E + g_h E_h)^2](f_{kk}E + g_{hh}E) \\ &\quad + [(kf_{kk}E)^2 - 2kf_{kk}Ehg_{hh}E + (hg_{hh}E)^2](f_{kk}E + g_{hh}E + g_h E_h) \\ &= g_h E_h E^2(kf_{kk} - hg_{hh})^2 + hEg_h E_h(f_{kk} + g_{hh})[2E(kf_{kk} - hg_{hh}) - hg_h E_h]. \end{aligned}$$

The first term of the RHS is positive or zero. If the terms in square brackets of the second term, $\Phi \equiv 2E(kf_{kk} - hg_{hh}) - hg_h E_h$, are negative, the RHS is positive and $\Delta^A - \Delta > 0$ is satisfied.

To consider what this means let us define the elasticity of k with regard to the tax rate when agglomeration economies do not exist as ϵ^k :

$$\epsilon^k \equiv -\frac{t^k}{k} \frac{dk}{dt^k} = -\frac{t^k}{kf_{kk}E}$$

where (17) is used to have the second equality. Therefore,

$$kf_{kk}E = -\frac{t^k}{\epsilon^k}. \quad (23)$$

Similarly, denoting the elasticity of h as ϵ^h and using (18) we have,

$$hg_{hh}E = -\frac{t^h}{\epsilon^h}. \quad (24)$$

When agglomeration economies exist, the elasticities of k and h , ϵ^{kA} and ϵ^{hA} , respectively, are expressed as follows:

$$\epsilon^{kA} = -\frac{t^{kA}}{kf_{kk}E}, \quad \epsilon^{hA} = -\frac{t^{hA}}{hg_{hh}E + hg_h E_h}$$

where t^{kA} and t^{hA} are tax rates and (7) and (8) are used for derivation. Therefore we have,

$$kf_{kk}E = -\frac{t^{kA}}{\epsilon^{kA}}, \quad hg_{hh}E + hg_h E_h = -\frac{t^{hA}}{\epsilon^{hA}}. \quad (25)$$

Substituting (23) – (25) into $\Phi = 2E(kf_{kk} - hg_{hh}) - hg_h E_h$ yields,

$$\Phi = -\frac{t^k}{\epsilon^k} + \frac{t^h}{\epsilon^h} - \frac{t^{kA}}{\epsilon^{kA}} + \frac{t^{hA}}{\epsilon^{hA}}$$

and $\Phi < 0$ is equivalent to,

$$\frac{t^k}{\epsilon^k} + \frac{t^{kA}}{\epsilon^{kA}} > \frac{t^h}{\epsilon^h} + \frac{t^{hA}}{\epsilon^{hA}}$$

which means that the tax rates t^h and/or t^{hA} are low enough or the elasticities ϵ^h and/or ϵ^{hA} are large enough compared to those of k .

An example to satisfy the condition above is that $f(k) = ak^b$ and $g(h) = ah^b$ where $a > 0$, $b \in (0, 1)$ and equilibrium amounts of k and h are equal. That is, marginal private productivity of both types of capital are equal, but h has positive externality to the production as a whole. In this case $kf_{kk} - hg_{hh} = 0$ and from (12) and (22) we have $\Delta^A > \Delta = 0$.

If h is small enough compared to k , however, from (10) and (20) t^h and t^{hA} are high enough (because $|g_{hh}|$ is so large) such that $\Phi > 0$, and thereby we may have $\Delta^A < \Delta$. Suppose k is capital for traditional manufacturing industries and h is capital for high-tech or R&D-oriented industries. If k is large enough, the effect of external economy is canceled out and Δ^A can be smaller than Δ . In that case, the merit of preferential regimes may be less important than we would expect.

On the other hand, it is expected that the proportion of h will increase as the society goes more and more high-tech. In that case, Δ^A will be larger than Δ and the merit of preferential regimes will be larger.

IV. Conclusion

Researchers and practitioners have discussed whether preferential tax regimes are desirable or not. Practitioners and policy makers in organizations such as the European Commission and OECD have criticized preferential regimes as a source of harmful tax competition. In the academic world, while a number of papers supported non-preferential regimes, Keen's (2001) conclusion has also been forceful.

The current paper introduced agglomeration economies based on Keen's model and showed that agglomeration economies make preferential regimes more important under certain conditions, such that the amount of capital which generates external economy is large enough. For example, preferential regimes will be important in an advanced

economy with a large portion of high-tech industries which generate external economy. Otherwise, however, the difference of tax revenues between two regimes may be small and the merit of preferential regimes may be unimportant.

Notes

1. See Wilson (1999), Zodrow (2003) and Wilson (2006) for surveys on tax competition and preferential tax regimes.
2. The model of this section is partly based on Garcia-Mila and McGuire (2001) where the governments provide public inputs as in Oates and Schwab (1991). I do not assume public inputs and consider a model closer to the literature.

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