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Does technical assistance weaken tax competition?

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Abstract

This paper explores the relationship between technical assistance and tax competition between countries, and finds that technical assistance can be given voluntarily without altruism or moral obligation since technical assistance can weaken tax competition and improve the societal welfare. Technical assistance is provided by a country with high productivity to a country with low productivity to help in the production of public goods. This technical assistance would lower the marginal cost of public goods in the recipient country. This effect would lead to the recipient country raising its tax rate and the donor country too would then increase its tax rate in response to this change.

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1. Introduction

Technical assistance can weaken tax competition between countries while being provided voluntarily. The country with a high productivity in public goods can weaken tax competition, and increase its welfare, by giving technical assistance to a country with low productivity. Therefore, the country with high productivity could have an incentive to provide technical assistance. In other words, countries, which have high productivity, would be encouraged to provide technical assistance regardless of altruism, or moral obligation. This paper studies tax competition between two countries with a differential in productivity, and finds that there are conditions in which technical assistance is provided voluntarily from the country with high productivity. It shows that technical assistance is voluntarily given since there is tax competition. To my knowledge, interactions between fiscal externalities, such as tax competition and technical assistance or foreign aid, have not been argued.

In reality, tax competition and technical assistance can be seen simultaneously. For example, Japan has provided technical assistance to China while tax competition is present between these two countries. Moreover, in the case of the EU, Germany has provided environmental assistance to Poland.

In addition, even if we consider countries which have similar levels of development, their histories, experiments, and geographical nature are not exactly the same; this provides the opportunity for technical assistance to occur. Take the following situation as an example. Country i has suffered from air or water pollution, but country j has not. As time passes, changes in the climate or ocean currents could create similar problems for country j as they did for country i. In such a case, country i could teach country j an effective method to treat such problems. As such, there is still the opportunity for countries to provide technical assistance, even in the case of countries with similar levels of development.

In this globalized world, technical assistance is an important issue, and has been provided by many countries. Globalization makes relationships between countries stronger, causing countries to proffer technical assistance based on various factors. Alesina and Dollar (2000) have studied such factors empirically. They concluded that though there are differences between donor countries, the characteristics of recipient countries, such as poverty, democracy, economic openness, trade relations, and designation as former colonies of the donor, are the major factors determining foreign aid. In theoretical work, Svensson (2000) and Torsvik (2005) assume that the donor country has an altruistic motive towards providing foreign aid. The present paper shows, theoretically, that the donor country gives technical assistance voluntarily, without an altruistic motive, when there is a "welfare-improving" effect through weakened tax competition. This study does not intend to deny the existence of altruism, but insists that technical assistance can be given without an altruistic motive. In particular, factors considered in Alesina and Dollar (2000), such as the openness of an

economy and trade relations, may correspond to this present study, since capital mobility ensures tax competition. If there is no tax competition, that is, no relation between the donor country and the recipient country, technical assistance will not occur voluntarily without altruism or moral obligation.

Technical assistance, as considered in this paper, is such that the donor country takes care of the costs of teaching the recipient country an efficient method to produce public goods, giving new machine tools, and so on. Public goods considered here are roads, water and sewage, environmental pollution controls, legislative systems, and more.

Globalization also makes tax competition a large problem. Tax competition is thought to be harmful, as in the OECD report (1998), and it is a major issue among fiscal problems. A number of studies on tax competition exist, and there are several that consider the conditions or circumstances that weaken tax competition. Repeated game settings, coordination, and equalization schemes capture the major issues concerning tax competition's intensity and impact on societal welfare. Coates (1997), Cardarelli et al. (2002), and Itaya et al. (2008) represent the prominent research that uses repeated game settings. Studies about coordination have been done by Peralta and van Ypersele (2006), and Konrad and Schjelderup (1999). Equalization schemes are also well studied, for example, by Köthenbürger (2002) and Hindriks et al. (2008).

This present study belongs to this literature, since technical assistance could weaken the intensity of tax competition, and improve each country's welfare. However, in contrast to equalization schemes or tax coordination, once technical assistance is provided, its effects continue whether or not additional assistance is provided. Equalization schemes and coordination both need each country's consensus if they are to continue. Therefore, technical assistance may have an advantage from this viewpoint.

2. Model

A standard tax competition model is considered based on Bucovetsky (1991) and Wilson (1991). The model assumes there is a difference in the productivity of the public goods, and there are no other differences. A two-stage game is considered to analyze the relation between tax competition and technical assistance.

Consider a region consisting of two countries $(i = h, l)$ with heterogeneity in productivity. Country h has a higher productivity in producing public goods. Country h can provide technical assistance to country l funded by a capital tax in the first stage $(t = 1)$, consequently, the productivity of the public goods in country l rises at the end of this stage. In the second stage $(t = 2)$, there is no incentive to provide technical assistance at this stage since this is the last stage. At each stage, both countries provide public goods funded by

capital taxes. Capital endowments (k), and other factors, are symmetrical between these countries, and in each country there is one consumer.

To get clear-cut results, a specific functional form of a production function is considered. As in Bucobetsky (1991), Haufler (1997), Peralta and van Ypersele (2005), and Itaya et al. (2008), the production function is assumed to be quadratic:

$$y_t^i = f\left(k_t^i\right) \equiv Ak_t^i - \frac{B}{2}\left(k_t^i\right)^2.$$

y_t^i is a private good and capital is paid on its marginal product:

$$A - Bk_t^i = \rho_t + T_t^i,$$

then the return to fixed factors is

$$f\left(k_t^i\right) - k_t^i f'\left(k_t^i\right) = \frac{B}{2}\left(k_t^i\right)^2.$$

k_t^i is the capital employed in country i at stage t, T_t^i is the capital tax rate, and ρ_t is the after tax return of capital. Government i's budget constraint is

$$T_t^i k_t^i = P_t^i g_t^i + \theta a^i,$$

where $\theta = 1$ when $t = 1$ and $i = h$, otherwise $\theta = 0$. a^i is the level of technical assistance, g_t^i is a public good, and P_t^i is the productivity of the public good. A higher P_t^i means lower productivity. It is assumed that P_1^h=P_2^h=P^h and P_t^l>P^h. Technical assistance from country h raises country l's productivity of its public good. $P_2^l(a^h, P_1^l, P^h)$ has the following properties: $\partial P_2^l/\partial a^h \leq 0$, $\partial^2 P_2^l/\partial (a^h)^2 > 0$, $P_2^l\,|_{at\ a^h=0} = P_1^l$, $lim_{a^h\to\infty} P_2^l \to P^h$, $lim_{a^h\to 0}\partial P_2^l/\partial a^h \to -\infty$, and continuity. These properties are similar to the learning curve. A country with high productivity can teach and give technology to a country with low productivity because the former has more advanced technology than the latter. Therefore, the marginal increment of productivity of country l would disappear at $a^h \to \infty$. It is also plausible to assume that the marginal increment is infinite at $a^h \to 0$, since the country with low productivity would be taught new ways to produce public goods or be given new machine tools.

Capital is perfectly mobile and is allocated across the countries until the after tax returns on capital are equalized. The arbitrage condition is

$$f'\left(k_t^i\right) - T_t^i = \rho_t \Leftrightarrow A - Bk_t^i - T_t^i = \rho_t.$$

The clearing condition of the capital market in each stage is

$$2k = k_t^h + k_t^l.$$

We then get the following:

$$k_t^i = k + \frac{T_t^j - T_t^i}{2B},$$

$$\rho_t = A - Bk - \frac{T_t^j + T_t^i}{2},$$

$$\frac{\partial k_t^i}{\partial T_t^i} = -\frac{1}{2B} = -\frac{\partial k_t^j}{\partial T_t^i} < 0,$$
$$\frac{\partial \rho_t}{\partial T_t^i} = -\frac{1}{2} < 0.$$

When country i raises its tax rate, the capital will flow to another country and the returns are equalized.

To get equilibrium tax rates explicitly, the utility function is assumed to be linear:

$$U^i = c_1^i + \gamma g_1^i + \beta\left(c_2^i + \gamma g_2^i\right).$$

Cardarelli et al. (2002), Peralta and van Ypersele (2005, 2006), Hindriks et al. (2008), and Itaya et al. (2008) assume a linear utility function. $\beta \in [0,1]$ is the discount factor. γ is the parameter regarding a preference about the public goods. A consumer spends his/her total income on private consumption[1]:

$$c_t^i = f\left(k_t^i\right) - k_t^i f'\left(k_t^i\right) + k\rho_t.$$

3. Equilibrium

To identify the sub-game perfect equilibrium, the second stage is considered first.

3.1.Second stage

At this stage, both countries make decisions about their tax rates. Tax competition with productive asymmetry of public goods is considered at this stage. The problem of benevolent country i at this stage is:

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[1] Savings and government debt can be considered in the model. For simplicity and due to space constraints, each interest rate is assumed to be exogenous, government debts are assumed to be funded from abroad, and only country h is assumed to issue government debt, since it has the choice to provide technical assistance, which influences the next period. When savings are considered in the model, the budget constraints are:

$$c_1^i + s^i = f\left(k_1^i\right) - k_1^i f'\left(k_1^i\right) + k\rho_1, c_2^i = f\left(k_2^i\right) - k_2^i f'\left(k_2^i\right) + k\rho_2 + (1+r)s^i,$$

where r is the interest rate, and an interior solution is found when $\beta = 1/(1+r)$. However, although savings can be considered here, the savings decision does not have an impact on technical assistance and tax competition. In the first stage, the first-order condition concerning savings is $\partial U_1^i/\partial s^i = -1 + \beta(1+r) = 0$ and the rest of the first-order conditions of this stage are not affected by savings. That is, savings is the postponement of private consumption, and is independent from tax rates and technical assistance. In addition, when government debt is considered, the budget constraints are:

$$T_1^i k_1^i + b_1^i = P_1^i g_1^i + \theta a^i, T_2^i k_2^i = P_2^i g_2^i + (1+r)b_2^i,$$

where r is the interest rate, and an interior solution is found when $\beta = 1/(1+r)$. As in the abovementioned case, technical assistance and tax competition are not affected by debt. Debt is the front loading of public goods, and is independent from tax rates and technical assistance.

$$max_{T_2^i} U_2^i = f(k_2^i) - k_2^i f'(k_2^i) + k\rho_2 + \gamma \frac{T_2^i k_2^i}{P_2^i}.$$

The first order condition of country i is

$$\frac{\partial U_2^i}{\partial T_2^i} = -k - \frac{T_t^j - T_t^i}{4B} + \frac{\gamma}{P_2^i}\left(k + \frac{T_t^j - 2T_t^i}{2B}\right) = 0. \quad (1)$$

To satisfy the second order condition, $\gamma/P_2^i > 1/4$ is assumed. First and second terms are related to the marginal cost of raising the tax rate, and the third term is the marginal benefit of the public goods.

From (1), country i's tax rate is as follows:

$$T_2^i = Bk \frac{(\gamma - P_2^i)\left(\gamma - \frac{1}{4}P_2^j\right) + \frac{1}{2}(\gamma - P_2^j)(\gamma - \frac{1}{2}P_2^i)}{\left(\gamma - \frac{1}{4}P_2^i\right)\left(\gamma - \frac{1}{4}P_2^j\right) - \frac{1}{4}(\gamma - \frac{1}{2}P_2^i)(\gamma - \frac{1}{2}P_2^j)}. \quad (2)$$

From the assumption of $P_2^h < P_2^l$, it is easy to check $T_2^h > T_2^l$ and $k_2^h < k_2^l$. The country with the more advanced technology can loosen its attitude towards tax competition, since more advanced technology means a lower marginal cost of public goods.

The following is the proposition.

Proposition 1 *If* $\gamma/P_2^i > 1/2$, *then*

$$\frac{\partial T_2^l}{\partial P_2^l} < \frac{\partial T_2^h}{\partial P_2^l} < 0.$$

When the productivity of country l rises, country l faces smaller marginal costs in producing public goods and raises its tax rate to increase public goods. Country *h* responds to this change by raising its tax rate. $\gamma/P_2^i > 1/2$ assures that government tax rates strategically complement each other, that is, the existence of tax competition, since the slopes of the response functions are positive.

Proposition 2 *If* $\gamma/P_2^i > 1$, *the welfare level of each country in the second stage increases with the productivity of country* l.

This proposition is critical to country h's incentive to provide technical assistance voluntarily. $\gamma/P_2^i > 1$ means the marginal utility of the public funds is large compared to private consumption and therefore the tax rates are positive. Otherwise, public goods would not be needed, and tax rates could be negative. The reasons for this proposition are simple. If the productivity of country l grows, then the tax rates of both countries increase, tax revenue in both countries increase, and country l's marginal cost of public goods decreases in the second stage. Moreover, country l (capital importer) could get a benefit from decreased after tax returns. On the other hand, country h (capital exporter) loses benefits from a decrease in after tax returns. Therefore, these are all benefits for country l but not for country h. If the

effect of increased tax revenues is stronger than the effect of decreased after tax returns ($\gamma/P_2^h > 1$), country h could also benefit from the improved productivity of country l.

3.2.First stage

While country l decides the T_1^l only, country h decides the T_1^h and the level of technical assistance. The objective function of country i is

$$U^i = f(k_1^i) - k_1^i f'(k_1^i) + k\rho_1 + \gamma\frac{T_1^i k_1^i - \theta a^i}{P_1^i} + \beta\left\{f(k_2^i) - k_2^i f'(k_2^i) + k\rho_2 + \gamma\frac{T_2^i k_2^i}{P_2^i}\right\}.$$

From the Kuhn-Tucker condition and the first order condition, we get the following:

$$\begin{cases} -\frac{\gamma}{P^h} + \beta\left\{-\frac{1}{2}(k - k_2^h) + \frac{\gamma}{2BP^h}T_2^h\right\}\frac{1}{2B}\frac{\partial T_2^l}{\partial P_2^l}\frac{\partial P_2^l}{\partial a^h} = 0, if\ a^h > 0 \\ -\frac{\gamma}{P^h} + \beta\left\{-\frac{1}{2}(k - k_2^h) + \frac{\gamma}{2BP^h}T_2^h\right\}\frac{1}{2B}\frac{\partial T_2^l}{\partial P_2^l}\frac{\partial P_2^l}{\partial a^h} \le 0, if\ a^h = 0 \end{cases}, \quad (3)$$

$$-k - \frac{T_1^l - T_1^h}{4B} + \frac{\gamma}{P_1^h}\left(k + \frac{T_1^l - 2T_1^h}{2B}\right) = 0,$$

$$-k - \frac{T_1^h - T_1^l}{4B} + \frac{\gamma}{P_1^l}\left(k + \frac{T_1^h - 2T_1^l}{2B}\right) = 0.$$

The first term of (3) is the marginal cost of technical assistance and it is negative; the second term is the marginal benefit from technical assistance and can be positive based on proposition 2. Therefore, the property of P_2^l is crucial. Now, $lim_{a^h \to 0}\partial P_2^l/\partial a^h \to -\infty$ is assumed, and technical assistance is voluntarily offered.

Corollary *If $\gamma/P_2^i > 1$, the technical assistance occurs voluntarily.*

Although, the reason for this corollary is similar to the former propositions, this corollary is important because it concerns an objective of foreign aid such as technical assistance. Here, the objective of technical assistance is to increase the welfare of country h through weakened tax competition.

When $\gamma/P_2^i > 1$, the tax rate and its relations are as below:

$$T_1^i = Bk\frac{(\gamma - P_1^i)\left(\gamma - \frac{1}{4}P_1^j\right) + \frac{1}{2}(\gamma - P_1^j)\left(\gamma - \frac{1}{2}P_1^i\right)}{\left(\gamma - \frac{1}{4}P_1^i\right)\left(\gamma - \frac{1}{4}P_1^j\right) - \frac{1}{4}\left(\gamma - \frac{1}{2}P_1^i\right)\left(\gamma - \frac{1}{2}P_1^j\right)},$$

$$T_1^l < T_1^h, T_2^l < T_2^h,\ T_2^h > T_1^h\ and\ T_2^l > T_1^l.$$

4. Discussion and conclusion

If public goods are desired (tax rates are positive), technical assistance can be offered voluntarily, without any supposed altruism, thereby weakening tax competition and,

ultimately, improving each country's welfare. Moreover, technical assistance is different from equalization schemes and coordination, as it directly changes the productivity of public goods. For instance, the low productivity of country l causes it to abandon the production of public goods and concentrate on gathering capital. Therefore, tax competition is intense. However, technical assistance can modify this mechanism by raising the productivity of country l.

The function of productivity is not specified in this paper, since the objective here is to explore the possibility of a country volunteering technical assistance. However, if the extent of the technical assistance is of concern, the form of the function must be specified. As such, a study with specified forms for this function should be the focus of future work.

Further, investments should be considered, as savings cause the capital supply to increase in the second period. Yet, even when investments are included, the incentive to provide technical assistance can still exist, since this assistance can lead to higher tax rates and increased welfare in each country. Therefore, technical assistance would still be effective. However, investments can lead to differences in accumulated capital, which could be the source of differences in tax rates and change in the size of technical assistance. Thus, a study that considers investments should be conducted in the future.

Appendix

A1. Proof of Proposition 1

Differentiating (2) with respect to P_2^j, we get the following equations.

$$\frac{\partial T_2^i}{\partial P_2^j} = -\gamma Bk \frac{6\gamma^2 - 5\gamma P_2^i + (P_2^i)^2}{16\left\{\left(\gamma - \frac{1}{4}P_2^i\right)\left(\gamma - \frac{1}{4}P_2^j\right) - (\gamma - \frac{1}{2}P_2^i)(\gamma - \frac{1}{2}P_2^j)\right\}^2}$$

$$\frac{\partial T_2^j}{\partial P_2^j} = -\gamma Bk \frac{12\gamma^2 - 7\gamma P_2^i + (P_2^i)^2}{16\left\{\left(\gamma - \frac{1}{4}P_2^i\right)\left(\gamma - \frac{1}{4}P_2^j\right) - \frac{1}{4}(\gamma - \frac{1}{2}P_2^i)(\gamma - \frac{1}{2}P_2^j)\right\}^2}$$

From $\gamma/P_2^l > 1/2$ and $P_2^l > P^h$, we get the following:

$$\frac{\partial T_2^l}{\partial P_2^l} < \frac{\partial T_2^h}{\partial P_2^l} < 0.$$

A2. Proof of Proposition 2

Differentiating each country's welfare in the second stage with P_2^l, we get the following:

$$\frac{\partial U_2^h}{\partial P_2^l} = \left\{T_2^h\left(\frac{\gamma}{P^h} - \frac{1}{2}\right) + \frac{T_2^l}{2}\right\}\frac{1}{2B}\frac{\partial T_2^l}{\partial P_2^l}$$

$$\frac{\partial U_2^l}{\partial P_2^l} = \left\{T_2^l\left(\frac{\gamma}{P_2^l} - \frac{1}{2}\right) + \frac{T_2^h}{2}\right\}\frac{1}{2B}\frac{\partial T_2^l}{\partial P_2^l} - \frac{\gamma T_2^l k_2^l}{(P_2^l)^2}$$

If $\gamma/P_2^l > 1$, tax rates are positive and these are negative.

References

Alesina, A., Dollar, D., 2000. Who Gives Foreign Aid to Whom and Why? Journal of Economic Growth 5, 33-63.

Bucovetsky, S., 1991. Asymmetric tax competition. Journal of Urban Economics 30, 167-181.

Cardarelli, R., Taugourdeau, E., Vidal, J.-P., 2002. A repeated interactions model of tax competition. Journal of Public Economic Theory 4, 19-38.

Coates, D., 1993. Property tax competition in a repeated game. Regional Science and Urban Economics 23, 111-119.

Haufler, A., 1997. Factor taxation, income distribution, and capital market integration. Scandinavian Journal of Economics 99, 425-446.

Hindriks, J., Peralta, S., Weber, S., 2008. Competing in taxes and investment under fiscal equalization. Journal of Public Economics 92, 2392-2402.

Itaya, J., Okamura, M., Yamaguchi, C., 2008. Are regional asymmetries detrimental to tax coordination in a repeated game setting? Journal of Public Economics 92, 2403-2411.

Konrad, Kai A., Schjelderup, G., 1999. Fortress building in global tax competition, Journal of Urban Economics 46(1), 156-167.

Köthenbürger, M., 2002. Tax competition and fiscal equalization. International Tax Journal 9(4), 391-408.

OECD, 1998. Harmful Tax Competition, An Emerging Global Issue, Paris.

Peralta, S., van Ypersele, T., 2005. Factor endowments and welfare levels in an asymmetric tax competition game. Journal of Urban Economics 57, 258-274.

Peralta, S., van Ypersele, T., 2006. Coordination of capital taxation among asymmetric countries. Regional Science and Urban Economics 36, 708-726.

Svensson, J., 2000. When is foreign aid policy credible? Aid dependence and conditionality. Journal of Development Economics 61, 61-84.

Torsvik, G., 2005. Foreign economic aid; should donors cooperate? Journal of Development Economics 77, 503-515.

Wilson, J.D., 1991. Tax competition with interregional differences in factor endowments. Regional Science and Urban Economics 21, 423-451.