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Geographical Size, Population Density, and Cross-Border Shopping

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Based on earlier studies we consider commodity tax competition, or cross-border shopping between two countries (or regions) with different geographical extent and population density. We focus on the effects of changes in population densities, and show that parts of the reaction curbs of the two countries shift and the tax rates of both countries increase until they are equal. Eventually, the tax rates jump and the direction of cross-border shopping is reversed.

Keywords: tax competition; commodity tax; cross-border shopping

1 Introduction

Tax competition among countries and regions has been a major issue in international public policies and there is a large literature of theoretical and empirical studies on this issue.[1)] While tax competition for capital has become increasingly important as the economic globalization advances, commodity tax competition has also been discussed intensively, especially in Europe, since the difference in commodity tax rates encourages shoppers to cross borders, which affects the tax revenues of countries. Many practitioners of EC (and later, EU) considered that the tax rates should be harmonized across member states.

Commodity tax competition and cross-border shopping between two countries with different population have been analyzed theoretically by Kanbur and Keen (1993), Haufler (1996), Nielsen (2001, 2002) and others.[2)] They showed, for example, that setting a minimum tax rate tends to be more desirable than a harmonization of tax rates. A harmonized, or common, tax rate necessarily reduces the tax revenue of the small country which would otherwise set lower tax rate, because it discourages shoppers in the large country to cross the border. On the other hand, a minimum tax rate constrains only the small country to raise the tax rate. The large country responds to it according to the reaction function and also raises the tax rate, then tax revenues of both countries increase. Among those models Kanbur and Keen (1993) assumed two

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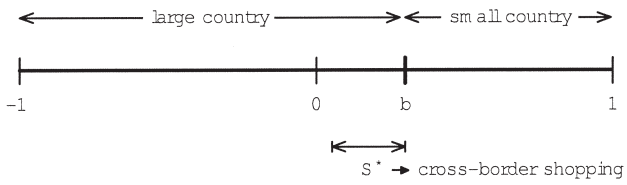

Figure 1: cross-border shopping when $T > t$

countries with the same geographical extent and different population density. Nielsen (2001), on the other hand, considered the model of two countries with different geographical extent and equal population density. The present paper generalizes the model so that both can be different, and investigates what will happen if the population density of one country (or both) changes. We show that the tax rates can jump, unlike earlier studies, when the direction of cross-border shopping is reversed.

2 The Model

Suppose there are two countries (or regions), together represented by the interval $[-1, 1]$. The large country extends from -1 to $b \in (0, 1)$, while the small country extends from b to 1 as depicted in Figure 1.[3] The population is distributed uniformly within each country, but the population densities can be different across countries.

There is one composite good. Each individual purchases one unit of good if her reservation price is higher than the price of the good. Reservation prices in the large and small countries are denoted by V and v, respectively, and we assume they are high enough so that all individuals wish to purchase the good.

The large and small countries levy commodity taxes, in unit form, at the rates T and t, respectively. Following earlier studies we assume that marginal production cost equals zero and hence the prices of goods are simply the tax rates. We also assume that shops are distributed uniformly across the countries and consumers can purchase the good just in front of their houses. If an individual chooses to purchase the good in the neighboring country, she travels to the border spending δ per unit distance. An individual in the large country will do so if $V - t - \delta S \geq V - T$ is satisfied, where S denotes the distance from the border. Therefore, residents with a distance $S \leq S^* = (T - t)/\delta$ choose cross-border shopping if $T > t$. Similarly, residents in the small country whose distance from the border s satisfies $s \leq s^* = (t - T)/\delta$ choose to cross the border

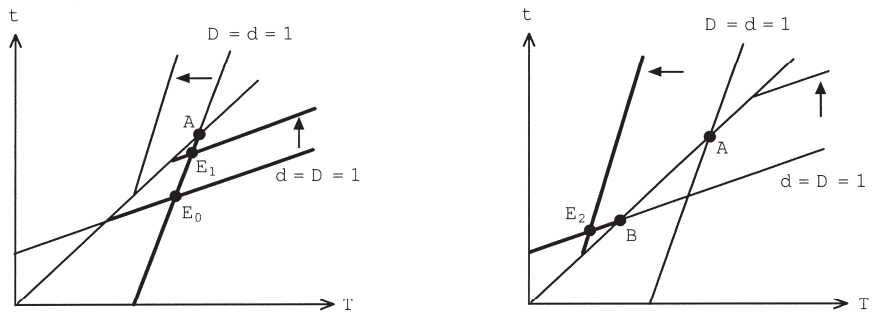

Figure 2: population densities and reaction curbs

and shop in the large country if $t > T$.

Now suppose that D and d denote the population densities of the large and small countries, respectively.[4] Therefore, the population to choose cross-border shopping from the large country to the small one is $S^*D = (T-t)D/\delta$ if $T > t$. Similarly, the population in the small country who opts for cross-border shopping is $s^*d = (t-T)d/\delta$ if $t > T$. Therefore the tax revenues of the large and small countries are, respectively,

$$R(T,t) = \begin{cases} T[(1+b)D - \dfrac{T-t}{\delta}D] & \text{if } T \geq t \\ T[(1+b)D - \dfrac{T-t}{\delta}d] & \text{if } T < t \end{cases} \tag{1}$$

$$r(t,T) = \begin{cases} t[(1-b)d + \dfrac{T-t}{\delta}D] & \text{if } T \geq t \\ t[(1-b)d + \dfrac{T-t}{\delta}d] & \text{if } T < t. \end{cases} \tag{2}$$

The governments try to maximize their tax revenues.[5] From the first-order conditions we have the reaction functions as follows:

$$T = \frac{1+b}{2}\delta + \frac{t}{2}, \quad t = \frac{(1-b)d}{2D}\delta + \frac{T}{2} \qquad \text{if } T \geq t \tag{3}$$

$$T = \frac{(1+b)D}{2d}\delta + \frac{t}{2}, \quad t = \frac{1-b}{2}\delta + \frac{T}{2} \qquad \text{if } T < t. \tag{4}$$

These can be depicted as in Figure 2. One can see that the reaction curb shifts upward as the own relative population density (e.g., d/D for the small country) increases if the own tax rate is lower (e.g., the area below the forty-five degree line in Figure 2 for the small country). On the other hand, the reaction function is not affected by population densities if the own tax rate is higher. This is because only the host country of cross-border shoppers (with lower tax rate) faces different population density and must cope with it.

3 Changes in Population Density

Solving (3) and (4), respectively, we have the Nash equilibrium tax rates of the two countries as below:

$$T^N = \frac{2(1+b)D + (1-b)d}{3D}\delta, \quad t^N = \frac{2(1-b)d + (1+b)D}{3D}\delta \qquad \text{if } T \geq t \tag{5}$$

$$T^N = \frac{2(1+b)D + (1-b)d}{3d}\delta, \quad t^N = \frac{2(1-b)d + (1+b)D}{3d}\delta \qquad \text{if } T < t. \tag{6}$$

As in Figure 2, if $D = d = 1$ the equilibrium is shown by E_0 and the tax rate of the large country is higher than that of the small country, as in Nielsen (2001). If d increases and/or D decreases, equilibrium tax rates increase as the small country's reaction curb in $T \geq t$ area moves upward (e.g., to the equilibrium E_1). Although large country's reaction curb in $T < t$ area also moves leftward, it has no effect on the equilibrium. Finally, two reaction curbs intersect on the forty-five degree line (point A) and the tax rates of the two countries are equal. Substituting (5) into $T = t$ yields,

$$(1+b)D = (1-b)d,$$

that is, at this point the populations of the two countries are equal.

If d further increases (or D decreases), the equilibrium jumps from A to B in Figure 2, which does not occur in earlier theoretical studies on cross-border shopping. This jump occurs from the following reason. When the equilibrium falls on $T < t$ area and the direction of cross-border shopping reverses, the population density of those shoppers suddenly increases. This is reflected in the reaction curbs in $T < t$ area whose intersection exhibits lower tax rates than at point A. Afterwards the equilibrium moves along the small country's reaction curb (e.g., E_2) and both tax rates decrease. If, in the beginning, the (geographically) large country has smaller population and its population (or its population density) increases, the equilibrium starts from a point such as E_2 and moves in the reverse direction.

4 Conclusion

We have considered a two-country model where both geographical extent and population density can be different between the two countries, and analyzed the effects of changes in population densities on commodity tax rates. It was shown that starting from the equilibrium where the large country's tax rate is higher, parts of reaction curbs shift and the tax rates of the two coun-

tries increase until they are equal. Further changes in population densities make the tax rates jump down and the direction of cross-border shopping is reversed. In reality, however, commodity tax rates are also influenced by other factors such as revenues from other tax sources. In many countries corporate tax rates have decreased and tax rates on consumption have increased. Nevertheless, the jump in tax rates is notable as a theoretical possibility. Sharp rises or declines in commodity tax and VAT rates observed in reality may be caused by demographic changes. Empirical analyses on this issue remain a topic for future research.

Notes

1) See Wilson (1999), Zodrow (2003) and Wilson (2006) for surveys on tax competition.

2) See Leal et al. (2010) for a survey on cross-border shopping.

3) Throughout the model we say "large" or "small" in geographical sense.

4) If $D = d = 1$, we obtain the same results as in Nielsen (2001).

5) This is either because governments are Leviathans, or because governments are welfarists and the (implicit) marginal utilities for public goods are high enough.

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