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Abstract

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Competition for Talent as a Solution to Free Riding in the Presence of Local Public Goods

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Abstract: It is well known that free riding when offering public goods hinges on the true revelation of households' preference for public goods. In contrast to the requirement of a large number of communities in Tiebout (1956), this paper shows that when high-skill workers have a stronger preference for cultural amenities than low-skill workers and when few jurisdictions compete for multi-type mobile talent using cultural amenities, with housing markets the equilibrium can be almost-complete-sorting. That is, except for the workers in one jurisdiction, all workers' types are revealed by their residential choices. Therefore, jurisdictional competition for multi-type mobile talent can be a solution to Samuelson's free-rider problem in offering public goods. (*JEL Classifications*: D51; D82; R13)

Keywords: Agglomeration; Local Public Goods; Asymmetric Information; Fiscal Competition

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1 Introduction

The revelation of private information about preferences plays a crucial role in offering public goods. As expounded in Samuelson (1954, 1969), with public goods, people have every reason not to reveal their true demand functions. That is, the information requirement to achieve a Lindahl equilibrium is formidable. Tiebout (1956) is relatively optimistic about free-rider problems: Since most public goods are not completely pure, a competition of local public goods leads people to "vote by their feet" and "this problem does have a conceptual solution. If consumer-voters are fully mobile, the appropriate local governments, whose revenue-expenditure patterns are set, are adopted by the consumer-voters [p. 424]." That is, Tiebout claims that competition in local public goods yields an approximately complete sorting equilibrium where households' preference for public goods is revealed by their residential choices.[1] Since there is no private information hidden in equilibrium, the complete sorting equilibrium generates the first best allocation even when public goods are considered.

Tiebout's argument, however, does not completely clear economists' doubts about efficiency of the provision of local public goods. Bewley (1981) shows that Tiebout's result is correct only under very restrictive assumptions. One of the trickiest assumptions Tiebout made is that there are a large number of jurisdictions offering *various* public expenditure-tax patterns.[2] Though it is natural to view different jurisdictions as being "adopted by" households in the same way that they choose private consumption bundles, it is rather

[1] Buchanan (1965) has the same result in club theory.

[2] Or, in other words, forming new communities is costless. It may be reasonable to say that the cost of forming new clubs is small though there are coordination problems among members. Since the formation of a jurisdiction needs land and a huge relevant installation cost (for paving roads and building city halls, etc) and jurisdiction formation is exogenously limited by geographical and political causes, it is rather clear that the cost of forming a new jurisdiction is far from small.

far afield from reality saying that all varieties of local public projects are offered. Especially when jurisdictions care about their growth and development, which is common for modern metropolises, rather than maximizing their fiscal surplus as assumed in Wildasin (1988), it is not reasonable that every type of households are wooed by at least one jurisdiction. Therefore, we ask: When there are few jurisdictions competing for one or few specific mobile factors, will households reveal their preference by their equilibrium locations? We are the same as Scotchmer and Shnnon (2010) in that jurisdictional poll tax rates (prices for memberships) caonnot be depend on unverifiable characteristics. In this case, is a large number of jurisdictions necessary for an efficient provision of local public goods?

As emphasized in Romer (1990), "what is important for growth is integration not into an economy with a large number of people, but rather into one with a large amount of human capital [p. 98]." Lucas (1988) and Berry and Glaeser (2005) suggest that regional growth is strongly correlated with regional human capital. Abel and Gabe's (2010) estimation shows that one-percentage increase in the proportion of households with a college degree raises metropolitan area GDP per capita by 2 percentage. Moreover, Florida (2002) verifies a positive relationship between the agglomeration of Bohemian and human capital. City managers can leverage culcural amenities to increase local human capital and raise jurisdictional growth rates. Falck and Fritsch (2009) show that the concentration of high skilled people today is explained by the proximity to exogenous concentrations of bohemians prior to the Industrial Revolution in Germany. We ask: Can cultural amenities actually improve jurisdictional growth rates when people are also taxed for them? Does the competition for talent yield a symmetric equilibrium or does just one jurisdiction win all the talent? Whether the existence of housing markets help or hinder jurisdictions to grab all types of workers who can

contribute to jurisdictional growth? Whether an initial large population an advantage or disadvantage in the competition for talent?

Public goods are goods with externalities achieved through the intentional production of jurisdictional governments whose output is technologically restricted to variables representing externalities. Without crowding externality, one person's consumption in local public goods, as defined in Tiebout (1956), leads to no subtraction from any other people's consumption in the same jurisdiction. Since we follow Shell (1966) in regarding technical knowledge as a public good in production, i.e., "technical knowledge can be used by many workers without altering its character." In fact, *there are two dimensions of local public goods in our model.* We ask: *Whether jurisdictional competition in one dimension yeilds a much better result than what Tiebout had in mind in that it solves the problem of collective provision of public goods in more than one dimensions*? Whether Jocab's (1969) spillover can be internalized by jurisdictional competition? In contrast to Conley and Wooders (1997), the spillover (crowding benefit) is not shared by all workers within a jurisdiction, but enjoyed only by a subset of jurisdictional citizens (high-skill workers).[3]

On the other hand, Tiebout's model is essentially an adoption-viewpoint-based model, so the adaption of local public object projects, especially in pursuing one specific mobile factor, is rarely discussed in literature. Tiebout (1956) admits that "in this model there is no attempt on the part of local governments to adapt to the preferences of consuemr-voters [p. 420]."[4] We consider an adaption process that not all households are allowed to migrate to one jurisdiction immediately and jurisdictional managers offer local public

[3]In contrast to distance-dependent production externalities modeled in Berliant, Peng, and Wang (2002), we consider jurisdiction-dependent spillover effects. One result of this paper different from Berliant, Peng, and Wang (2002) is that a jurisdictional configuration with multiple and hierarchical centers can be formed in equilibrium.

[4]Moreover, Samuelson (1969) points out that "what is much needed are serious analytical studies of cases where public good situations can be solved by algorithms immune to bilateral-monopoly or game-theoretic objections [p. 110]."

goods under their current budget constraints. With this process, there is no foresighted fiscal externality and no commitment on local public good capacities if they are unavailable for jurisdictional current budgets. We then examine: How do the distribution of local public goods and the distribution of workers shape each other? And how does this interaction lead to an equilibrium?

Though complete sorting is sufficient for a complete revelation of households' types (private information), we do not know whether an efficient provision of local public goods is achieved when there is no complete sorting in equilibrium. Moreover, t is not realistic to claim that workers of every type enjoy the same public good capacity and pay the same tax rate through the whole country. Berglas (1976) examines the conditions for the formation of mixed communities under the assumption that forming new communities is costless. We ask: Whether a mixed jurisdiction can co-exist with a pure-type jurisdiction in equilibrium? Whether the workers of the same type can enjoy different local public goods in different jurisdictions? Most importantly, is the complete-sorting configuration necessary for a Pareto-optimal allocation of local public goods?

As claimed in McGuire (1974), it is intriguing to appreciate the power of people's concern with the economic reasons that isolate them from others. In addition to asymmetric information and signaling effects, what else can explain agglomeration with sorting? How about the competition for one or few specific mobile factors? When housing markets are considered, whether one specific type of workers can bid up housing prices so that other types of workers cannot afford? Moreover, we assume neither a capacity corresponding to cost minimization nor a locally-fixed resource in the production of public services. The equilibrium distribution of workers is sorely determined by the pulling and draging of competitive jurisdictions and, if any element

should be considered, housing markets. In literature, tax competition usually yields underprovision of public goods. We ask: Whether a competition for one or few mobile factors results in an underprovision or overprovision of local amenities?

In what follows, a jurisdictional competition model with two types of workers without housing markets is introduced in Section 2. In Section 3, we consider a jurisdictional competition model with multiple types of workers. The equilibrium with and without housing markets are compared. Conclusions are in Section 4.

2 Jurisdictional Competition for Talent without Housing Markets

We present a model to capture the idea that jurisdictional culture amenity attracts high-skill workers, and thus, the metropolitan GDP growth rate is raised in the jurisdiction with a higher level of culture amenity. We also examine whether jurisdictional competition for one specific mobile factor alone (by local public goods) can yield a complete sorting equilibrium. With no housing market and capacity constraint, households play passive roles and the distribution of workers is completely determined by the competition on jurisdictional amenities.

There are two jurisdictions, denoted by $k \in K \equiv \{x, y\}$. The jurisdictional local public good, $g_k \in \mathbb{R}_+$, $k \in K$, is financed by levying taxes on residents while the poll tax rate at each jurisdiction is determined by a jurisdiction manager. The objective of each manager is to maximize the growth rate in his/her jurisdiction. There are two types of mobile workers, high-skill workers and low-skill workers ($i \in N \equiv \{H, L\}$) with population $n^H, n^L \in \mathbb{R}_{++}$, respectively. Workers' type is indexed by a superscript and

the location of any variable is indexed by a subscript.

The (endogenous) population of i-type workers living in k is denoted by n_k^i, $i \in N$, $k \in K$, while the (exogenous) aggregate population in the model is $n = n^H + n^L$. Letting g_k and z_k^i denote the capacity of local public goods and the consumption of composite good for each i-type workers in k, respectively. The utility function for individual i-type worker living in k is

$$U_k^i(g_k, z_k^i),\ i \in N, k \in K. \tag{1}$$

Assume that individual worker's preference satisfies strict (differentiable) monotonicity, strict (differentiable) concavity, and smooth boundary condition which implies that both goods are necessary to workers. For every $(g_k, z_k^i) \in \mathbb{R}^2_{++}$, assume that $MRS_{gz}^H(g_k, z_k^i) > MRS_{gz}^L(g_k, z_k^i)$ which ensures single crossing property with respect to public good preference. This assumption is supported by the positive relationship between the agglomeration of Bohemian and human capital as presented in Florida (2002) and consistent with the claims of consumers' cities in Glaeser et al (2001).

Assume that both types of workers are endowed with one unit of labor which is inelastically supplied to firms in producing composite good. The income for each i-type worker in k is Y_k^i, $i \in N$, where $Y_k^H > Y_k^L > 0$, $k \in K$. Each local government levies a poll tax on workers in her jurisdiction and turns the tax (in the unit of composite good) collected into local public good. The budget constraint for every i-type worker is $z_k^i \leq Y_k^i - T_k$ where $T_k \in [0, Y_k^i)$ denotes the poll tax charged in k, $k \in K$. It is notice that $\tau_k \equiv T_k/g_k$ indicates the shadow price of each unit of local public good for households in k, $k \in K$.

For a given $g_k \in \mathbb{R}_{++}$, $k \in K$, the valuation of each unit of local public good for every i-type worker is $MRS_{gz}^i(g_k, z_k^i)$, $i \in N$, $k \in K$. The local government cannot recognize any worker's type and cannot levy tax discriminatively on workers; however, the (equilibrium) distribution of workers'

type over two regions is a common knowledge. Denote ρ^H (ρ^L) as the ratio of high-type (low-type) workers in the world living in x, and then $1-\rho^H$ ($1-\rho^L$) is the ratio of all high-type (low-type) workers living in y. Letting $n_x \equiv \rho^H n^H + \rho^L n^L$ and $n_y \equiv (1-\rho^H)n^H + (1-\rho^L)n^L$ denote the population in x and y, respectively. Each worker lives in one and only one jurisdiction. Since workers' utility functions satisfy the smooth boundary condition, their voluntary participation constraints are always satisfied.

Each local governmental manager's objective is to maximize jurisdictional GDP growth rate in his/her region. To capture our idea of jurisdictional competition for talent, it is assumed that there exists spillover only among high-skill workers in the same jurisdiction but no spillover to low-skill workers. Therefore, for individual worker, assume that $Y_k^H = A_k(n_k^H)$ and $Y_k^L = 1/n_k^L$, $k \in K$. For simplicity, assume $A_k(n_k^H) = B \cdot n_k^H$, $k \in K$, where $B > 0$ denotes the strength of spillover effects. Under these settings, jurisdictional output is $Y_k = B \cdot (n_k^H)^2 + 1$. It can be noticed that L-type workers contribute nothing good to jurisdictional growth rates, so jurisdictional managers want to attract only H-type workers into their jurisdictions. This assumption is reasonable especially when a city full of low-skill labor is considered. The optimization problem for the manager in k, $k \in K$, is

$$\max_{(g_k, T_k)} \begin{cases} \dot{Y}_k = 2\,\dot{n}_k^H, & \text{when } n_k^H \cdot n_k^L > 0, \\ U_k^i(g_k, z_k^i), & \text{when } n_k^{i'} = 0, \forall i' \neq i,\ i', i \in N. \end{cases} \tag{2}$$

The second optimization condition is to have a termination condition for the jurisdictional competition for talent. In what follows, a nondegenerate initial distribution of both types of workers is always considered.

Consider local public service cases, following Bewley (1981), the local government's budget constraint is $T_k \cdot n_k = c \cdot g_k$, where $c > 0$ denotes the production cost for one unit of local public good. To attract high-skill migrants as many as possible, jurisdiction manager in k can offer a public project (g_k, T_k) according to the first best condition for H-type workers, $\tau_k =$

$c/n_k = MRS_k^H(g_k, T_k)$. Furthermore, the intersection point of a vertical line of $g_k \in \mathbb{R}_{++}$ and any i-type worker's budget constraint, (g_k, z_k^i), represents a local public object $(g_k, T_k = Y_k^i - z_k^i)$ offered to each i-type worker in jurisdiction k, $i \in N$, $k \in K$.[5] As shown in Figure 1, without loss of generality consider $n_x > n_y$ and the tangency point of H-type workers' indifference curve $\bar{U}^{H'}$ and their budget line in jurisdiction x, denoted by A, is in the upper contour set of their indifference curve $\bar{U}^H$ which passes through the tangency point with their budget line in y, denoted by B. Two cases need to be discussed.

In case 1, when $Y_x^H \geq Y_y^H$ or $Y_x^H < Y_y^H$ but $|Y_x^H - Y_y^H|$ is small, since jurisdiction x has a cost-sharing advantage, given jurisdiction y's best offer for H-type workers g^B, x does not need to offer the local public project according to A, instead jurisdiction x can choose g^C so that H-type workers in y want to migrate into x but L-type workers in y do not have incentive to move. Given $(\rho^H, \rho^L) \in (0,1)^2$ such that $\bar{U}^{H'} > \bar{U}^H$, in the short-run $(g_x^*, T_x^*, g_y^*, T_y^*) = (g^C, c \cdot g^C/(\rho^H n^H + \rho^L n^L), g^B, c \cdot g^B/((1-\rho^H)n^H + (1-\rho^L)n^L))$ constitutes a Nash equilibrium for the jurisdictional competition for H-type workers. Each H-type and L-type worker in x (y) is given the consumption bundle at E and C (B and D) respectively in the short-run equilibrium. It is noticed that, given these equilibrium offers, workers have no way to fake their preference.

In the long-run, we care only about stable equilibria. Since H-type workers continuously migrates to x while L-type workers are kept with the initial distribution, eventually $n_y^H = 0$ which implies y is occupied completely by L-type workers. From (2), this implies that for an initial distribution $(\rho_0^H, \rho_0^L) \in (0,1)^2$, $(g_x^{**}, T_x^{**}, g_y^{**}, T_y^{**}) = (g^G, c \cdot g^G/(n^H + \rho_0^L n^L), g^B, c \cdot g^B/((1-\rho_0^L)n^L))$ constitutes a long run Nash equilibrium. As shown in Figure 2, in the long-

[5]For the story of attracting high-skill workers by culture amenities, the model is essentially a competition on the capacity of local public goods under fiscal balance constrsints rather than a tax competition.

run equilibrium, H-type and L-type workers in x (y) are offered consumption bundles at H and G (I and F), respectively. It is noticed that since there is no competition for talent in the long run, the equilibrium local public capacity in each jurisdiction in the long run is smaller than the capacity in the short run. Furthermore, the long-run equilibrium is partially segregated: Only the type of workers in jurisdiction y is completely revealed though all H-type workers are agglomerated in jurisdiction x. However, the provision of local public goods reaches a Pareto optimum. That is, spillover benefit is internalized by jurisdictional competition for high-skill workers. It is implied that *a complete-sorting distribution of workers is not necessary for the first best allocation.*

In case 2, as shown in Figure 3, when $Y_x^H < Y_y^H$ and $|Y_x^H - Y_y^H|$ is so large that the utility level for a H-type worker at the consumption bundle B is larger than the utility for a H-type worker at point E. In this case, it is impossible to attract H-type workers but prevent L-type workers from migrating into x. In the long run, only pooling equilibrium with one jurisdiction exists.

From both cases, it is shown that *without housing markets, for all parameters equilibrium is either partially segregated or pooling, jurisdictional competition for one specific mobile talent yields no complete sorting equilibrium.* In the partially segregated equilibrium, one pure-type jurisdiction co-exists with one mixed-type jurisdiction. Whether this claim is ture when housing markets are considered is examined in the next section.

3 Jurisdictional Competition for Multiple Talent with Housing Markets

In this section, a set of m types of workers and m jurisdictions are considered, $m \geq 3$, each of which is endowed with the same land endowment $\bar{s} \in \mathbb{R}_{++}$. With housing markets, high-skill workers can bid up housing prices where they live so that other types of workers may or may not afford. We examine whether there exists an equilibrium distribution of workers approximately close to complete sorting.

Let the types of workers be ordered by the strength of spillover effects and their preference for local public goods while m-type workers produce no spillover, that is, $Y_k^1 = B^1 \cdot n_k^1$, $Y_k^2 = B^2 \cdot n_k^2$, ..., $Y_k^m = 1/n_k^m$, $k \in K$, where $B^1 > B^2 > ... > B^{m-1} > 0$ and $n^1 < n^2 < ... < n^m$. Without loss of generality, jurisdictions are ordered by their population, $n_1 > n_2 > ... > n_m$,[6] so the manager of jurisdiction 1 has the greatest cost-sharing advantage and has an incentive to attracts *all* workers except type-m workers to jurisdiction 1.

Given the above settings, we first analyze whether the manager of jurisdiction 2 can offer a local public project to attract type 2 workers into her place. To eliminate the influence of initial income inquality, assume that type-1 workers are evenly distributed among jurisdictions 1 and 2, i.e., $\rho^1 = 1/2$, and there are initially only type-1 and type-2 workers in these two jurisdictions. When there is no housing market, as shown in Figure 4, when the tangency point of type 2 workers' indifference curve with their budget line in x, point I, is in the upper contour set of type 2's indifference curve passing through tangency point J, the manager of jurisdiction 2 has no offer to attract type 2 workers. In this case, jurisdiction 1 can eventually get both

[6]Notice that n^i denotes the total number of type i workers in the country while n_k denotes the total population in jurisdiction k, $i \in N$, $k \in K$.

type 1 and type 2 workers.

However, when there are housing markets in both jurisdictions, the intercept of each budget lines now becomes $Y_k^i - p_k\, s_k^i$, where p_k and s_k^i denotes housing price and each i-type worker's housing consumption in k, respectively. Furthermore, since $n_1 > n_2$ implies $p_1 > p_2$, the budget line with a flatter slope has a lower intercept when housing markets are considered. Therefore, as shown in Figure 5, since both segments $\overline{PQ}$ and $\overline{RS}$ are shortened, with housing markets when jurisdiction 1 cannot get type 2 workers while keep type 1 workers at the same time.

More specifically, for example, when $U_k^i(g_k, T_k, s_k^i) = (s_k^i)^{\beta^i} + (g_k)^{\beta^i} + z_k^i$, $i, k \in M$, it can be checked that $s_k^{i*} = (\beta^i/p_k)^{\frac{1}{1-\beta^i}}$ and from housing market clearing conditions, $\sum_{j=1,..,m} n_k^j\, s_k^{i*} = \bar{s}$, we can solve equilibrium p_k^*, $k \in K$. Given $\beta^1 = 1/2$, $\beta^2 = 1/4$, $n^1 = 1$, $n^2 = 1$, $c = 1$, $B^1 = 15$, $B^2 = 10$, $\bar{s} = 10$, when $\rho^1 = 1/2$ is controled, it can be checked that without housing markets (mathematically, fix $s_k^i = 0$, $\forall i \in N$, $k \in K$), it can be checked that jurisdiction 1 can grab all workers of type 1 and type 2, for all initial $\rho^2 \in (1/2, 1)$. However, when housing markets are included (mathematically, $s_k^{i*} = (\beta^i/p_k)^{\frac{1}{1-\beta^i}}$, $i \in N$, $k \in K$), when jurisdiction 1 chooses any local public good capacity to attact type 2 workers, type 1 workers in jurisdiction 1 always have incentive to migrate to jurisdiction 2—they are crowded out since the housing price is increased and the amenity capacity is not their ideal when the manager of jurisdiction 1 wants to take over both types.

When there are m types of workers and m jurisdictions, with housing markets, jurisdiction 1 can get only type 1 workers, and jurisdiction 2 can get only type 2 workers, and so on. Following this process, each type is assigned to one jurisdiction until there are only two types left, $m-1$ and m, which is the same as the case that we discuss in Section 2. Therefore, it can be checked that jurisdiction $m-1$ is mixed with types $m-1$ and m workers

while jurisdiction m is occupied completely by type m workers. Since the equilibrium distribution pattern of types is as shown in Figure 6, we have the following proposition.

Theorem 1 *When there are m types of workers and jurisdictions, $m \geq 3$, the existence of housing markets helps to yield an almost-complete-sorting equilibrium where all workers' types are revealed by their residential choices except workers in one jurisdiction (jurisdiction $m-1$).*

Proposition 1 implies that jurisdictional competition for multiple mobile human capital, together with proper housing markets, can almost be a solution to Samuelson's free-rider problem in offering public goods.

Since there is spillover only among the same type of workers, the first best distribution of workers should be complete sorting and local public goods are offered according to each pure type in that jurisdition. Therefore, we have the following proposition.

Theorem 2 *With housing markets, when there are m types of workers and jurisdictions, $m \geq 3$, the competition for high-skill workers generates an almost-first-best allocation.*

It can be noticed that, centered with a set of parameters which yields an almost-complete-sorting equilibrium, we can perturb the indifference curves and budget lines a little bit such that the equilibrium pattern is maintained. This shows that we can always find an open subset of economies, each of which possesses an unique almost-complete-sorting equilibrium. That is, in contrast with Berglas' (1976) finding that only mixed communities exist when the distribution of tasts and skills is independent, our result shows that generically jurisdictions cannot be all mixed under a structure of fiscal competition for multiple types of wanted mobile factors with housing markets. It is also noticed that in contrast to the finding in Berliant, Peng, and Wang (2002) that a multicentric urban configuration cannot appear in equilibrium,

as shown in Figure 7, our model shows that a jurisdictional configuration with multiple and hierarchical centers can be formed in equilibrium when the number of types (i.e., $n = 4$) is strictly smaller than the number of jurisdictions (i.e., $m = 5 > n$).

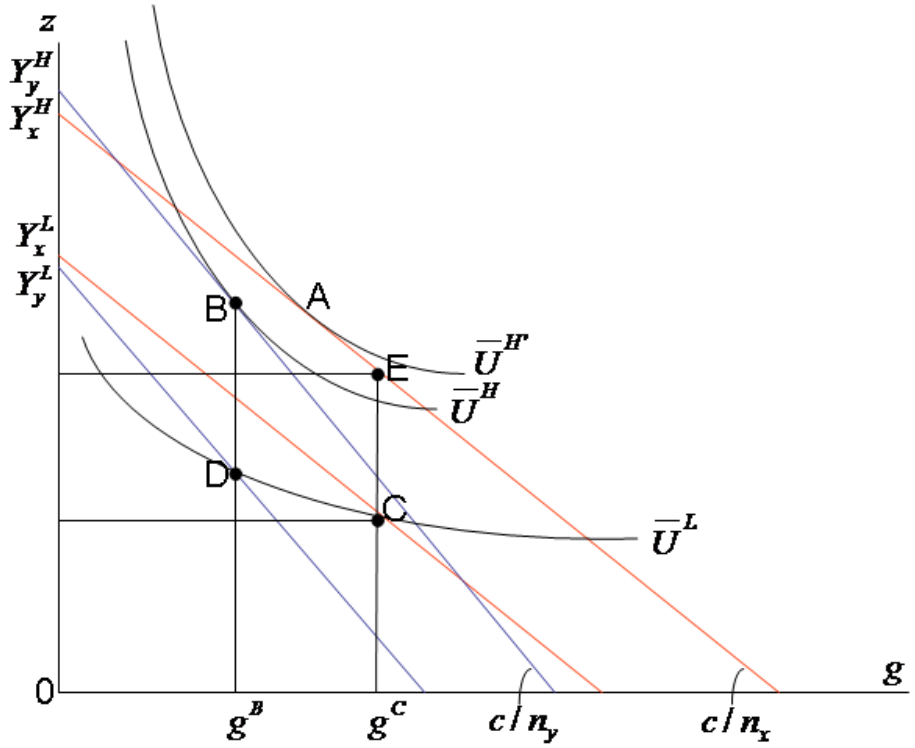

Figure 1: The local public projects in a short-run equilibrium in Case 1.

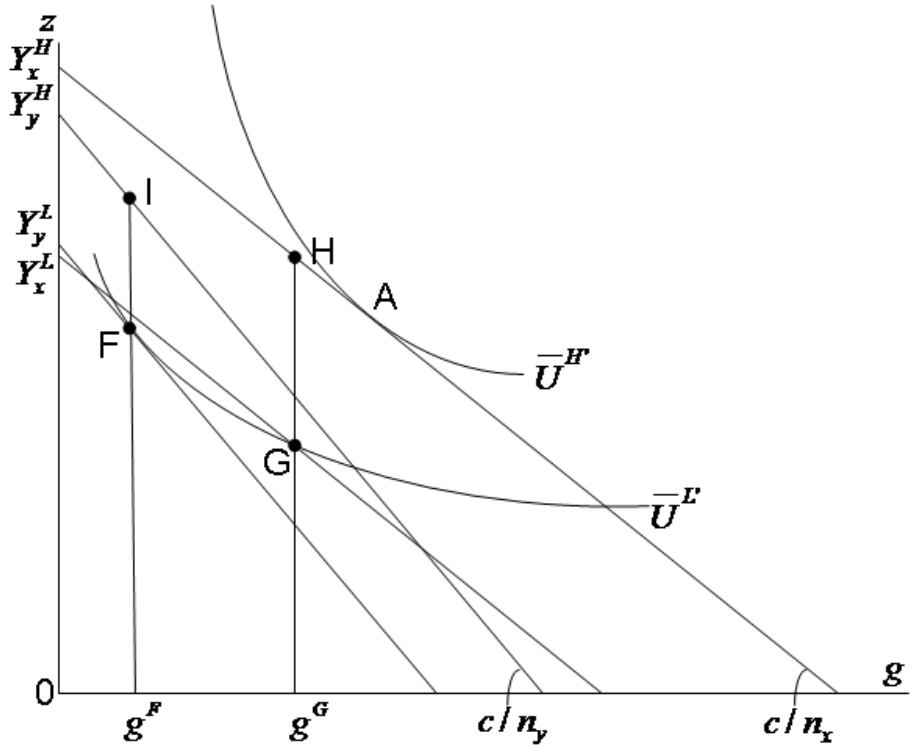

Figure 2: The local public projects in a long-run equilibrium in Case 1.

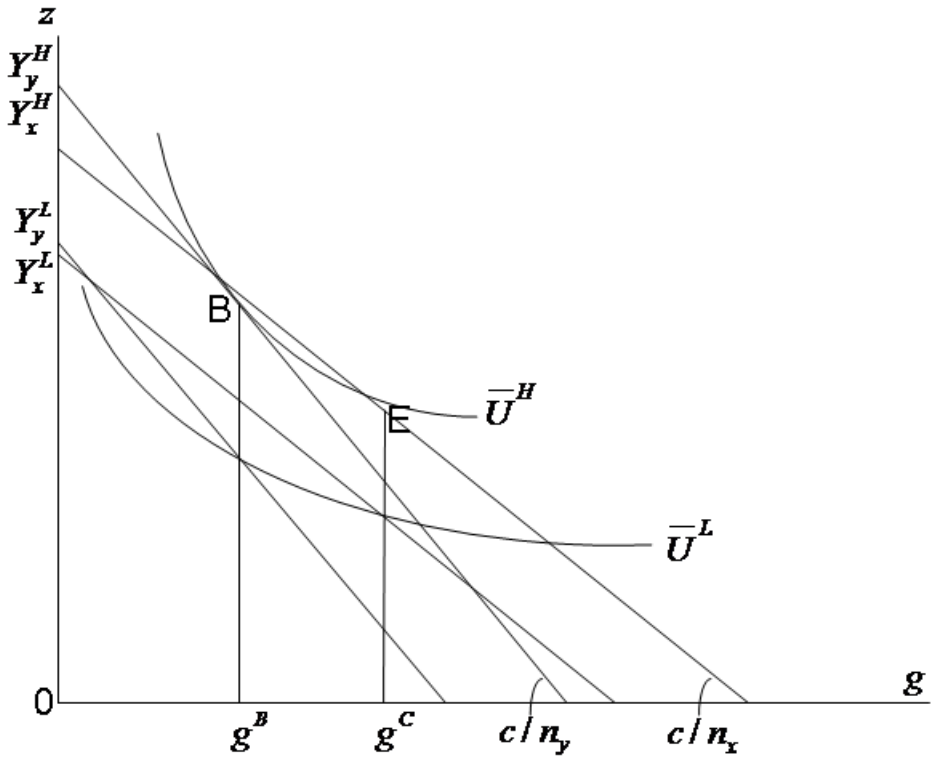

Figure 3: The local public projects in a short-run equilibrium in Case 2.

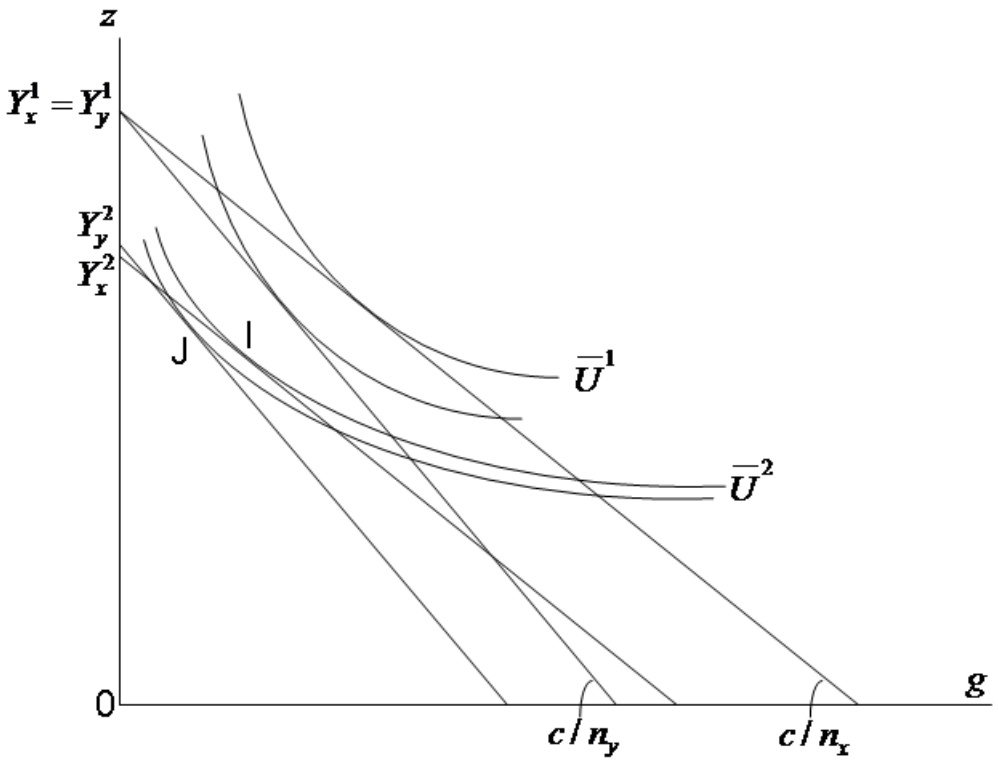

Figure 4: Without housing market, jurisdiction 1 grabs both types of workers when both of them contribute to jurisdictional growth.

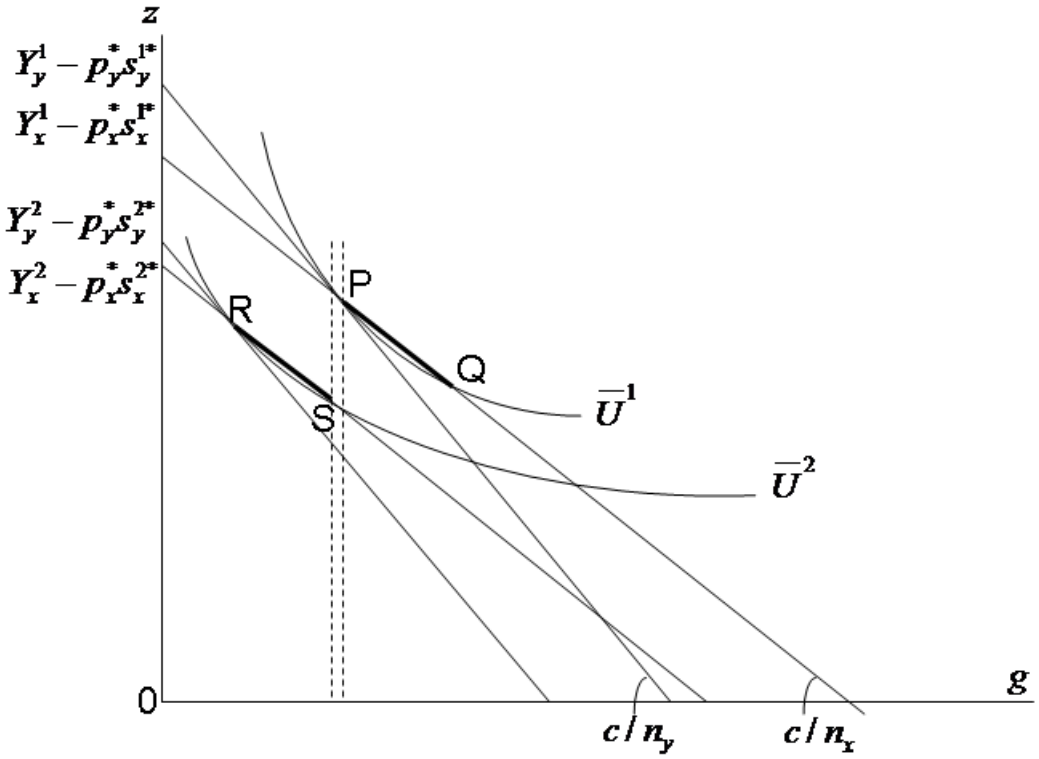

Figure 5: With housing market, jurisdiction 1 cannot grab both types of workers when they all contribute to jurisdictional growth rates.

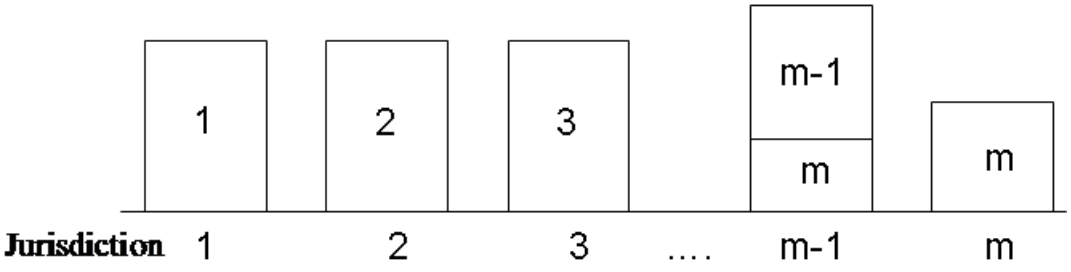

Figure 6: There exist an open subset of economies, each of which possesses an almost-complete-sorting equilibrium.

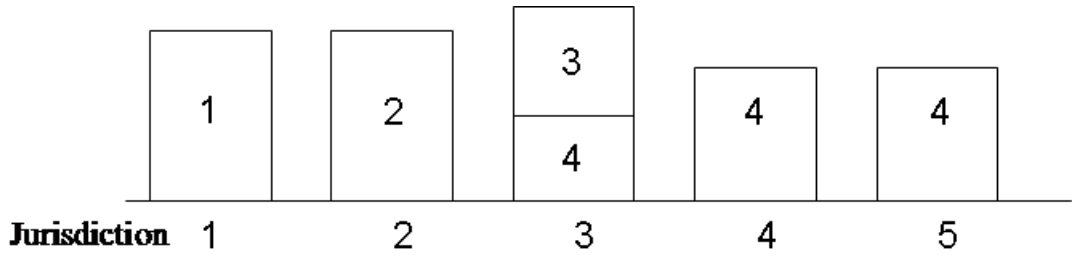

Figure 7: A jurisdictional configuration with multiple and hierarchical centers.