The Annals of Regional Science
https://doi.org/10.1007/s00168-023-01229-y

SPECIAL ISSUE PAPER

Tiebout jurisdictions and clubs

Todd Sandler[1]

Received: 20 January 2023 / Accepted: 24 May 2023

Abstract
In celebration of the centennial of the birth of Charles M. Tiebout, the current essay establishes the Tiebout hypothesis regarding jurisdictional composition as an origin of club theory and the study of local public goods. The Tiebout hypothesis and club theory constitute two of many foundational contributions to public choice. Tiebout's voting-with-the-feet analysis exerts a lasting influence on empirical investigations in urban and regional economics regarding city size, regional composition, housing price capitalization, and migration patterns. The current paper displays three fundamental club models to establish an unmistakable linkage between the Tiebout hypothesis and club theory. Given that linkage, the paper also identifies essential differences between the two analyses. Myriad applications of club theory to virtually all fields of economics highlight Tiebout's far-reaching legacy.

JEL classification H41 · H72 · R23

1 Introduction

In a relatively short, but influential article, Tiebout (1956) sketches a model where consumer-voters' mobility can circumvent the Samuelson (1954) free-rider problem associated with pure public goods. The so-called Tiebout hypothesis indicates that consumer-voters join local jurisdictions, whose tax-public good package best fits their tastes and income. By so doing, individuals effectively reveal their preferences among alternative jurisdictions, which offer diverse sets of tax-expenditure options. Tiebout (1956) draws a sharp distinction between Samuelson's (1954) central government and Tiebout's local jurisdictional governments, namely central governments try to adjust their public goods to the preferences of consumers, while local governments fix their tax-public goods options and allow consumers to vote with their feet. Because central governments really have no way to gauge consumers'

✉ Todd Sandler
tsandler@utdallas.edu

[1] School of Economic, Political and Policy Sciences, University of Texas at Dallas, 800 W. Campbell Road, Richardson, TX 75080, USA

demand for pure public goods,[1] central governments face an insurmountable task, compounded by the presence of multiple public goods with wide ranging benefit spillover domains.[2]

The model underlying the Tiebout hypothesis hinges on seven assumptions. First, consumer-voters are fully mobile and choose their ideal jurisdictional residency to satisfy their tax-public good preferences. Second, consumer-voters are completely informed about alternative tax-public good packages of *all* alternative jurisdictions. Third, there exists a sufficiently rich set of jurisdictional tax-expenditure choices to accommodate the diverse tastes of the relevant population. Fourth, consumer-voters subsist on dividend income so that job prospects are unimportant in their jurisdictional choice. Subsequent extensions to the Tiebout model allow for wages and housing considerations (Batina and Ihori 2005; McGuire 1991; Oates 1969, 1973). Fifth, there are no interjurisdictional positive or negative externalities, so that there are no taxes or public good spillovers to outside residents. Sixth, there exists an optimal jurisdictional size where average cost to serve a resident is minimized so that marginal cost equals average cost. Implicitly, a U-shaped average cost per resident is assumed to define a unique membership-size equilibrium. Seventh, communities below the optimal membership will actively attract residents, while communities above the optimal membership will repel residents.

The set of Tiebout's assumptions is somewhat similar to the model of perfect competition given full knowledge, complete mobility, no frictions, sufficient firms, and no externalities. The strictness of Tiebout's assumptions may result in some existence concerns, such as a nonconvexity problem caused by a discontinuity of tax-expenditure choices, so that some desired choices of the population are not available. Another issue involves the partitioning of the population into jurisdictions with no leftover individuals, i.e., the so-called integer problem, discussed at various places in the paper (see, e.g., Pauly 1967; Sandler and Tschirhart 1980). With leftover individuals, the membership configuration of the population is not stable as some excluded individuals are motivated to join jurisdictions owing to the absence of a *core*, where residents (or nonresidents) cannot improve their welfare by leaving (or joining) the jurisdiction. An analogous population partitioning issue concerns leftover population members among replicable clubs. When the population is accommodated among replicable clubs (jurisdictions), the core determines the optimal number of clubs (jurisdictions) (McGuire 1974; Pauly 1967).

[1] Given nonexcludable benefits, consumers have no motivation to reveal their true preferences for a public good, thereby taking a free ride. Additionally, nonrival benefits of a pure public good mean that practicing exclusion is not optimal because there is zero marginal cost of extended consumption to another person (Cornes and Sandler 1996).

[2] The matching of public good benefit and political jurisdictional domains results in the notion of fiscal equivalence (Olson 1969), which is independent of the Tiebout hypothesis and determines the different levels of government.

The Tiebout (1956) jurisdiction model may be seen as the theoretical precursor of club theory, later formulated by Buchanan (1965).[3] For Buchanan clubs, members join to share an excludable, congestible public good, financed by congestion-internalized tolls (Berglas 1976, 1984; Sandler 2013; Sandler and Tschirhart 1980, 1997). For Tiebout jurisdictions, residents join to share local public goods, financed by taxes (Berglas 1984; Scotchmer 1994, 2002; Scotchmer and Wooders 1987). The Tiebout (1956) and Buchanan (1965) articles are two of the most influential contributions in the field of public choice.[4] The Tiebout (1956) article earns its status by showing how jurisdictional residential choice can escape the free-riding problem and promote allocative efficiency. In addition, Tiebout (1956) is credited with introducing the concept of local public goods that constitutes an important foundation to urban and regional economics (Stanford Encyclopedia of Philosophy 2021). The Buchanan (1965) article earns its importance by indicating how private member-owned clubs can circumvent the need for government provision and achieve allocative efficiency. As shown later, both articles put forward clever preference-revelation schemes.

Tiebout's (1956) exalted status stems, in part, from its influence on empirical regional and urban studies on a wide range of topics (Dowding et al. 1994). In particular, alternative local tax-and-services configurations affect residential migration patterns both positively and negatively (Oates 1969; Tullock 1971). The Tiebout model can help explain city size as consumer-voters' residential choices react to tax-expenditure options and city amenities. The latter is part of the city's public good package. With mobile populations, fiscal decentralization serves as a potential and testable constraint on public sector growth. The presence of competing jurisdictions can affect community composition and, in particular, residents' homogeneity. In addition, the Tiebout hypothesis may determine the relationship between tax-expenditure differentials and property capitalization, influenced by property taxes and jurisdictional public goods and amenities (Dowding et al. 1994; Oates 1969).

Inspired by the Tiebout hypothesis, Oates (1969) argues that utility-maximizing consumers choose their resident jurisdiction to achieve the greatest surplus of benefits from local public services over the associated tax liability. In so doing, the residents' tax liability (i.e., property tax rate times the house value) represents the price of residential entry. The capitalized property value of houses in the jurisdiction captures not only the value of public services and housing characteristics but also the property taxes from residency. As such, the estimated property value of houses should rise with greater public services and environmental amenities (e.g., nearness to parks and beaches, crime rates, and closeness to city center) and fall with

[3] In an interesting article, Boettke and Marciano (2017) argue that Buchanan did not consider the Tiebout analysis as a forerunner of club theory because Buchanan viewed jurisdictional mobility as having negative welfare consequences, namely residents of poor jurisdictions will move to rich ones, resulting in mixed-taste jurisdictions with the original rich residents paying for the poor entrants. This view ignores the tax-internalizing entrant fee.

[4] Public choice includes the study of committees, political competition among parties, the theory of voting, the study of lobbying, economic theory of democracy, and other applications of economics methods to political science.

greater taxes. Moreover, housing characteristics (e.g., number of bathrooms, square footage, lot size, house vintage, and earthquake risk) also affects property values. Such house-value regressions are often called hedonic regressions and represent a key tool in urban economics and local public finance (Yinger 2015). Oates (1969) views house-value regressions as validation of the Tiebout hypothesis that people choose their jurisdiction, while accounting for jurisdictional taxes and public good packages.

Oates' innovative analysis spawned a huge literature, starting with Pollakowski (1973) and Oates (1973), to refine the empirical study of the determinants of property-value capitalization. Such refinements allowed for more public services and housing characteristics, while accounting for reverse causality. As econometrics improved the identification process, tests of property-value capitalization and related indirect tests of the Tiebout hypothesis improved and grew in number.

The rest of the paper has six additional sections. In Sect. 2, club theory is presented with special attention paid to its origin assumptions, optimality conditions, financing, and optimal club configuration. To provide an elegant foundation for the Tiebout hypothesis, the McGuire (1974) club representation is displayed in Sect. 3. Section 4 distinguishes between fixed and variable utilization rates with two variants of the Berglas (1976) club models. In Sect. 5, differences between club theory and Tiebout jurisdictions are drawn, followed by applications of club theory in Sect. 6. Concluding remarks are contained in Sect. 7.

2 Club theory

"A club is a voluntary group of individuals who derive mutual benefits from sharing one or more of the following: production costs, the members' characteristics, or a good characterized by excludable benefits" (Sandler 2013; Sandler and Tschirhart 1980). Tiebout (1956) foreshadows Buchanan's (1965) theory of clubs by permitting individuals to voluntarily choose their jurisdiction to share the local public good, thereby determining jurisdictional membership size. Another forerunner of club theory is Wiseman's (1957) club principle for sharing cost among customers of a public utility so as to reduce average cost per user by spreading fixed cost over more users. Simultaneous to the publication of Buchanan (1965), the Olson (1965) book indicates the notion of *exclusive groups* for jointly utilizing a congestible public good.[5] For exclusive collectives, the members determine the size of the collective or club by joining to share and finance the club good.[6] Another precursor to club theory involves the study of highway provision, congestion, and tolls, where user fees fix membership in terms of toll-paying drivers (Mohring and Harwitz 1962).

In the broad definition of clubs, the sharing of production costs is accomplished through congestion-internalizing tolls. If, however, members consume

[5] An inclusive group involves the joint consumption of a pure public good for which the absence of benefit rivalry or crowding means that the group can include everyone (Olson 1965).

[6] Olson (1965) never uses the term, club.

the characteristics of other members (e.g., their status, knowledge, or skills, then crowding is *nonanonymous* among members). For nonanonymous congestion, so-called discriminatory clubs allow members' favorable traits to offset some crowding (DeSerpa 1977; Scotchmer 1997). Unfavorable traits add to the toll, which must now account for such traits and crowding. For the rest of the paper, the analysis focuses on anonymous crowding, where each unit of utilization of the club good adds the same marginal crowding regardless of the user.

2.1 Buchanan clubs

Buchanan clubs concern the sharing of an impure public good, whose benefits are subject to congestion or degradation beyond some level of users, denoted by $\bar{s}$. Prior to that level, the shared good's benefits may actually rise at the margin owing to camaraderie, such as the heightened excitement generated by larger crowds at a rock concert or sporting event. However, with sufficient crowds, negative externalities (e.g., traffic, long queues, and crowded toilets) eventually overwhelm camaraderie. Buchanan clubs abide by a host of assumptions. First, members are assumed to be homogenous with identical tastes and endowments. Second, club utilization rates, x^i, are fixed with each member utilizing the entire amount, X, of the club good provided, so that $x^i = X$ for every i. Third, there is no discrimination among members, whose crowding is anonymous. Fourth, nonmembers are costlessly excluded by the club's exclusion mechanism. Fifth, club cost is equally shared among members. Sixth, Buchanan clubs are replicable with no integer problem so that the entire population is partitioned among the clubs with no leftover individuals.

Next, I turn to the formal model in which each member divides income between a club good, X, and a private numéraire good, y. Member i's strictly quasi-concave utility function is

$$U^i = U^i\left(y^i, X, s\right), \tag{1}$$

where s denotes the number of club members in the club containing individual i. For the utility function, the following is assumed: $\partial U^i \big/ \partial y^i = U^i_y > 0$; $\partial U^i \big/ \partial X = U^i_X > 0$; and $\partial U^i \big/ \partial s = U^i_s < 0$ for $s > \bar{s}$. Utility increases with the consumption of private and club goods but decreases with membership once the camaraderie threshold is surpassed.[7]

The other key ingredient of the Buchanan model is member i's strictly convex resource constraint:

$$F^i\left(y^i, X, s\right) = 0 \tag{2}$$

with $\partial F^i \big/ \partial y^i = F^i_y > 0$, $\partial F^i \big/ \partial X = F^i_X > 0$, and $\partial F^i \big/ \partial s < 0$, so that a member expends more resources, at the margin, for increases in the private and club goods

[7] See Sandler (2013) on the workings of the Buchanan clubs models. The absence of a camaraderie threshold does not have an essential effect on club theory.

and for decreases in membership, s. Given club cost sharing, a member saves on resources for the club as membership increases.

Each member chooses y^i, X, and s to maximize utility in (1) subject to the resource constraint in (2). The resulting first-order conditions (FOCs) can be rearranged to yield[8]:

$$MRS^i_{Xy} = MRT^i_{Xy} \Rightarrow MB^i_X = MC^i_X, i = 1, \ldots, s \text{ (provision)}, \tag{3}$$

$$MRS^i_{sy} = MRT^i_{sy},\ i = 1, \ldots, s \text{ (membership)}, \tag{4}$$

where MRS^i_{Xy} is the ith member's marginal rate of substitution between the club good and the numéraire, and MRT^i_{Xy} is the ith member's marginal rate of transformation between the club good and the numéraire. For simplicity of interpretation, I normalize the marginal value and the marginal cost of the private good to equal one so that I can replace the *MRS* and *MRT* in the provision condition with i's marginal benefit (MB^i_X) and marginal cost (MC^i_X) of the club good, respectively. The *MRS* and *MRT* for the trade-off between club membership and the numéraire have similar interpretations in the membership condition, except that each term is negative as larger membership lowers marginal utility due to crowding, while larger membership reduces club cost to a member due to cost sharing.

At this juncture, there are a number of things to highlight about Buchanan clubs' provision and membership requirements. For provision, each member equates the marginal benefit of another unit of the club good to the associated marginal cost from greater provision. For an optimal membership, members equate marginal crowding cost for admitting an additional member (namely $MRS^i_{sy} < 0$) to the marginal cost savings of having another member (namely $MRT^i_{sy} < 0$). To ascertain optimal membership size, s^*, and optimal club good provision, X^*, conditions (3) and (4) must be simultaneously satisfied for all i members (Buchanan 1965; Sandler and Tschirhart 1997). By examining a representative member's choice, Buchanan (1965) takes a "within-club" viewpoint (Sandler and Tschirhart 1980). In the member's utility function, Buchanan envisions a simple crowding relationship corresponding to crowding, c, assuming the identity function, i.e., $c(s) = s$. More elaborate crowding functions are introduced by Berglas and Pines (1981), McGuire (1974), Mohring and Harwitz (1962), Sandler (1984), and many others to investigate full financing, variable utilization rates, and transportation clubs as discussed subsequently.

For the representative member, the Buchanan club model contains a rudimentary utility function and resource constraint; hence, more detail must be added to ascertain the prospects for club financing and Pareto optimality. If, at the margin, the club is breaking even, then the sum of the members' marginal cost of provision or utilization,

[8] The FOCs for an interior solution consist of four equations: $U^i_y - \lambda F^i_y = 0$; $U^i_X - \lambda F^i_X = 0$; $U^i_s - \lambda F^i_s = 0$; and $F^i(y^i, X, s) = 0$ with λ as the Lagrange multiplier associated with the resource constraint. Taking the two appropriate ratios of the first three FOCs yields conditions (3) and (4).

$\sum_{i=1}^{s} MC_X^i$, must equal the club's marginal provision cost, $MRT_{Xy} = MC_X$. By the condition in Eq. (3), the Samuelson's (1954) public good provision condition,

$$\left(\sum_{i=1}^{s} MRS_{Xy}^i \right) = \sum_{i=1}^{s} MB_X^i = MC_X = \left(MRT_{Xy} \right) \tag{5}$$

holds, thus implying that Buchanan clubs are Pareto optimal when marginal-cost financing applies. Because each member utilizes the entire shared good, the latter takes on the character of a public good for the club. If constant returns to scale hold at optimal provision, X^*, then $MC_X = AC_X$ and members' utilization charges or user fees self-finance the club good. Given homogeneous members, everyone is charged $X^* \times AC_X$ divided by s^*.

2.2 Partitioning population and the optimal number of replicable clubs

A fixed homogeneous population, N, can accommodate N/s^* replicable Buchanan clubs. If those replicable clubs divide evenly into the population with no one leftover, then the replicable clubs partition of the population is in the *core* and is Pareto optimal (McGuire 1974; Pauly 1967; Sandler 2013; Sandler and Tschirhart 1980, 1997; Scotchmer and Wooders 1987). For the partitioned population, memberships are stable with no member of any club desiring to shift among clubs. When, however, $0 < s^* < N$ but N/s^* is not an integer, the extended Buchanan model must determine s^* by accounting for members and nonmembers (Helpman and Hillman 1977). The resulting solution is not in the core with some nonmembers wanting to exchange places with members.

Finally, consider a heterogeneous population of n types of individuals. Further suppose that the number of each type consists of $N^j, j = 1, \ldots, n$, individuals. If s^{j*} denotes the optimum membership for a homogeneous club of type j members, then N^j / s^{j*} indicates the number of replicable clubs for type j persons. When each population type can be partitioned into its own clubs, the resulting configuration of segregated clubs is in the core (McGuire 1974; Pauly 1967). Given that members, regardless of type, must use the entire club good, X, McGuire (1974) proves that mixed clubs with two or more member types are less optimal than segregated clubs. With different members' tastes, club utilization rates among members must differ, which is not possible when $x^j = X$ for different types of members (see, e.g., Sandler 1984; Sandler and Tschirhart 1984). Once fixed utilization is replaced with variable utilization—see Sect. 4—mixed clubs may be optimal. Taste differences are revealed through visits, where members desiring more visits pay more in total user fees.

3 A rudimentary club foundation for Tiebout jurisdictions

McGuire (1974) formulates a club model that offers a foundation for Tiebout jurisdictions where homogeneous residents consume a local public good. In particular, individual i's utility, $U^i\left(y^i, X\right)$, is maximized subject to an income constraint, $I^i = y^i + \left[C(X, s)/s\right]$, where I^i is i's income, C is the club's cost function, and the private good's price is set at 1. In the budget constraint, each member shares the club's cost so that each member covers C/s so that the club is fully financed. McGuire's cost function captures marginal provision cost, $C_X > 0$, and marginal crowding cost, $C_s > 0$.

A representative member chooses X and s to

$$\max U^i\left\{I^i - \left[C(X,s)/s\right], X\right\}, \tag{6}$$

where the resource constraint is substituted for y^i in the member's utility function. The two key FOCs are rearranged to give:

$$sMRS^i_{Xy} = C_X \equiv MC_X \text{ (provision)}, \tag{7}$$

$$C_s = C/s \text{ (membership)}. \tag{8}$$

The provision requirement is the famed Samuelson provision condition where the sum of MRSs between the club good and the numéraire equals marginal provision cost, MC_X. Optimal membership, $s*$, requires the equality between marginal crowding cost and average cost, so that the minimum cost per member is achieved, consistent with the Tiebout hypothesis for jurisdictional "clubs." The McGuire (1974) representation assumes either a single shared good or else a package of shared goods. In the latter instance, the package is treated as a single entity in regard to crowding and provision. For the membership requirement, the crowding toll of C_s equals shared membership cost per person, C/s.

McGuire (1974) goes on and establishes that the core corresponds to the number of replicable clubs (or jurisdictions) equal to $N/s*$ when no one is left out to challenge the stability of the partition of the homogeneous population. To accommodate a heterogeneous population, which is more germane to Tiebout's jurisdictional sorting, each subpopulation of j-type individuals must be assigned to the N^j/s^{j*} replicable jurisdictions. The latter is a tall order of convenience. Mixed clubs or jurisdictions may be replicable and optimal under more structured assumptions (Berglas and Pines 1981; Sandler and Tschirhart 1984, 1997; Scotchmer 2002).

4 Fixed versus variable utilization clubs and jurisdictions

To distinguish between fixed and variable utilization clubs, researchers must embellish the McGuire club model and introduce a club crowding, c, and cost function, C. For fixed utilization, each member chooses y^i, X, and s to satisfy:

$$\max U^i\left[y^i, c(X,s)\right] \text{ subject to } I^i = y^i + \left[C(X,s)/s\right], \tag{9}$$

where $c_X < 0$ and $c_s > 0$, so that crowding falls with greater provision but rises with larger membership, respectively (Berglas 1976). For the budget constraint, $C_X > 0$ and $C_s > 0$ indicate that marginal provision cost and marginal maintenance cost both increase with greater provision and larger membership, respectively. The FOCs associated with optimizing club members' constrained utility result in:

$$sc_X MRS^i_{cy} = MC_X \text{ (provision)}, \tag{10}$$

$$C_s - sc_s MRS^i_{cy} = C/s, \text{(membership)}, \tag{11}$$

where $MRS^i_{cy} = \left(\partial U^i / \partial c\right) / \left(\partial U^i / y^i\right) < 0$ is the MRS between congestion (or crowding) and the numéraire.

The provision condition again corresponds to the Samuelson provision requirement for the shared public good for which marginal crowding decreases with provision. Reduced crowding is a pure public good among members. In (11), the membership condition equates the marginal maintenance cost $\left(C_s\right)$ plus marginal crowding cost $\left(-sc_s MRS^i_{cy}\right)$ to the shared club cost per member (C/s). Generally, club provision and membership conditions internalize various costs that a member imposes on other members, thereby constituting Pigouvian pricing. An optimal club requires the satisfaction of both the provision and membership requirements to identify $X*$ and $s*$, respectively. For those optimal choices, the population must be partitioned as before to identify the number of clubs in the core.

To come nearer to reality, Berglas (1976) allows for variable utilization or visitation, v, rates, where sv denotes members' total visits in the club. The extended model now requires the choice of y^i, X, v, and s to fulfill,

$$\max U^i\left[y^i, v, c(X, sv)\right] \text{ subject to } sI^i = sy^i - C(X, sv). \tag{12}$$

The five FOCs yield a provision condition that is identical to Eq. (10) and a visitation or toll condition equal to

$$C_{sv} - sc_{sv} MRS^i_{cy} = MRS^i_{vy} \equiv MB_v. \text{ (visitation or toll)} \tag{13}$$

For visits, MRS^i_{vy} is the marginal rate of substitution between visits and the numéraire, representing the marginal benefit from a visit, MB_v. By the visitation condition (13), the marginal visitation gain is set equal to the sum of marginal maintenance cost $\left(C_{sv}\right)$ and marginal crowding cost of a visit. The associated membership choice, $s*$, satisfies:

$$vC_{sv} - svc_{sv} MRS^i_{cy} = C/s \text{ (membership)}, \tag{14}$$

which is essentially the visitation condition multiplied by visits. Hence, by Eqs. (13)–(14), each visit costs C/sv, so that average cost per visit equals the marginal cost per visit. Again, a minimum average cost is implied, consistent with the Tiebout hypothesis, but now the average cost *per visit* is minimized. Further extensions, not pursued here, allow for a heterogeneous population being partitioned into mixed replicable clubs or jurisdictions (Sandler 1984; Scotchmer and Wooders 1987).

The innovation of variable visits sets the stage for heterogeneous members, whose revealed utilization rates differ. Those members with a greater preference for the club good visit more often (e.g., more rounds of golf, more visits to the movies, more time on a phone or network plan, or more trips per week over a toll bridge) and, thus, pay more in total tolls. However, every member pays the same toll per visit. Visitation rates reveal members' preferences in a clever way. Member ownership of clubs eliminates the need for government provision of club goods. Berglas (1976) shows that replicable clubs can be operated by firms in a competitive industry (e.g., movie theaters) that maximizes profits, which equals $P_v sv - C(X, sv)$, where P_v is the toll per visit, subject to an incentive compatibility constraint, $U^i\left[I^i - vP_v, v, c(X, sv)\right] \geq U^{i*}$. The latter constraint requires members' utility in firm-operated clubs to equal or exceed their utility in the member-owned alternative club, U^{i*} (Cornes and Sandler , 1996).

Once variable visits are permitted, the application of fine versus coarse exclusion becomes relevant (Helsley and Strange 1991). With fine exclusion, visits are monitored, and a pre-visit toll is charged; with coarse exclusion, visits are not tracked, and the annual membership charge is levied. In the absence of exclusion cost, charging per-visit tolls are more efficient than an annual membership fee since the tolls internalize the crowding externality to a fuller extent. Membership charges result in overutilization as members drive their marginal benefit of a visit to zero, namely $MRS^i_{vy} = 0$. If, however, per-visit charges are more costly than membership fees to implement, monitor, and collect, then the latter fees may become more desirable than per-visit charges (Helsley and Strange 1991).

5 Contrasts between clubs and Tiebout jurisdictions

Even though club theory in a stylized form serves as a foundation for Tiebout jurisdictions, there are some crucial differences between clubs and the latter that must be recognized. In clubs, the shared good's provision level and the corresponding membership must be simultaneously chosen; in a Tiebout jurisdiction, the provision package of public goods is predetermined, and membership responds to consumer-voters' mobility. Also, jurisdictional amenities (e.g., nearness to the sea or neighborhood crime), unlike clubs, are an integral part of the jurisdictional package of goods.

As mentioned in the preceding section, clubs can institute fine or coarse fee charges; however, jurisdictions generally use land or property taxes to charge residents an annual membership fee (Batina and Ihori 2005; Scotchmer 1994, 2002). When property-values reflect residents' use of the public good package, such taxes can proxy visits, e.g., richer residents taking greater advantage of good schools or better police protection of property. Nevertheless, Tiebout jurisdictions have much less flexibility than clubs in internalizing crowding externalities through visit tolls.

In an extended Tiebout analysis, occupational choice and wages play a role in consumer-voters mobility among jurisdictions (McGuire 1991). Clubs are focused on the provision of the shared good and internalizing crowding, while ignoring occupational choice. The latter affects members' income but not necessarily their choice of clubs per se. Thus, jurisdictional choices may involve a more complex choice than associated with clubs.

Perhaps, the most substantial difference between clubs and Tiebout jurisdictions concerns the multiproduct package of local public goods associated with jurisdictions. Clubs may, but need not, contain multiple shared club goods. In fact, many clubs share a single congestible good such as a park or swimming pool. The presence of multiproduct jurisdictions favors the implementation of a membership fee in the form of a tax rather than visit-based charges to the many local public goods. Visit-based fees imply high transaction costs (Helsley and Strange 1991). With multiproduct jurisdictions, the notion of an optimal jurisdictional composition must involve economies of *scope* of the product package instead of a minimum average cost per user tied to economies of scale (Brueckner and Lee 1991; Sandler and Tschirhart 1993). The so-called integer problem for replicable jurisdictions now must hinge on membership *and product* partitioning of the population. For clubs, the integer problem and economies of scope are ignored by Berglas (1984) by assuming separable cost among products, which then eliminates fixed-cost sharing among products, giving rise to economies of scope. As such, the most important gain from a multiproduct club is ignored for theoretical "convenience." Multiproduct clubs cloud the notion of optimal membership size because each component product may have its own ideal membership size. Hence, by choosing out of necessity a single membership size for the multiproduct club, the club trades off gains from economies of scope against losses from compromising on a single membership size.

Another difference between clubs and jurisdictions concerns nonanonymous crowding where users' characteristics along with crowding affect the appropriate toll (DeSerpa 1977; Scotchmer 1997). Clubs may account for nonanonymous crowding, for instance, a learned society may give free honorary memberships to accomplished scholars because their presence makes the society more attractive to the average member. Open access journals (a club) may waive fees for authors whose citation rates are high in order to increase the journal's impact factor, which entices the average author to pay the article processing fee (apc). By contrast, local government jurisdictions cannot practice such discriminatory taxes among residential taxpayers though jurisdictions may give tax breaks to industries or large employers. Such tax breaks are used to attract some industries from other jurisdictions but are not necessarily efficient.

Finally, there are some key existence difficulties associated with Tiebout jurisdictions, not necessarily associated with clubs. For instance, an insufficient number of jurisdictions may exist so that not all tastes of population members can be accommodated, resulting in an integer problem and nonconvexity (namely missing choices). Additionally, multiple products introduce a further integer concern for jurisdictions that hampers the existence of the core.

6 Club applications

As the forerunner of club analysis, partial testimony to the lasting contribution of Tiebout (1956) is tied to the broad-ranging applications of club theory to every field of economics. In Olson (1965), labor unions are viewed as sharing an excludable public good among their members, whose collectives can bargain with employers for higher wages and better working conditions. Larger membership can crowd out benefits by being spread over more recipients, so that enhanced union membership must contend with opposing benefits and costs at the margin as individual wage demands are reduced. The equality of the opposing gains and losses fixes optimum union membership.

Early on, club theory is applied to urban economics in terms of the determinants of city size regarding residents (Sandler and Tschirhart 1980). Moreover, the provision of highways, financed by congestion-internalizing tolls, represents a direct application of club theory, where tolls impacts the number of drivers. Drivers deriving marginal benefits below the congestion toll are shunted (by choice) onto more congested or inferior roads with no toll. A key issue of highway provision in a club framework concerns the ability of collected tolls to self-finance optimal provision. In a celebrated work, Mohring and Harwitz (1962) establish the role of the form of the congestion function in achieving self-financing. If the congestion function is homogeneous of degree zero in total utilization, $\sum_{i=1}^{s} x^i$ or sv, and club provision, then self-financing ensues. The congestion function $c(sv/X)$ satisfies the homogeneity requirement, where the independent variable is the average utilization per unit provided.

In the field of defense economics, the theory of military alliances hinges, in part, on club theory (Olson and Zeckhauser 1966; Sandler and Hartley 2001). For a defense alliance sharing conventional weapons designed to protect borders or fronts, the club good consists of this protection, which is subject to force thinning (Sandler 1977; Sandler and Forbes 1980). As more troops and weapons are allocated to one part of the perimeter, the density of protection elsewhere on the border is reduced or thinned. Border force thinning is the alliance-related notion of congestion. Sandler (1977) indicates how club principles can be applied to determine optimal alliance size and allies' user fees even in light of joint products, where military spending yields country-specific benefits (e.g., national guard and disaster relief), protective or defensive (club) benefits, and pure public deterrence of an enemy attack. Membership and tolls are only germane for allies' shared protection.

Club theory is applicable to a host of environmental goods and issues. The sharing of wilderness areas by enthusiasts constitutes a club arrangement for which the equality between marginal cost and marginal benefit from utilization fixes the optimal membership (Fisher and Krutilla 1972). Enhanced utilization creates crowding cost from heightened noise and fewer animal encounters. The sharing of water and air sheds are other environmental club goods whose provision and utilization rates must adhere to club theory. Forest and recreation areas are other instances of environmental club goods.

Nordhaus (2015, 2020) views clubs as providing a possible mechanism for addressing climate change. A coalition or club of countries can agree on "harmonizing" reductions in carbon emissions to meet a desired target with the use of a carbon price on emissions, where the decarbonized atmosphere is the shared "club" good. An issue with this club good is that it is nonexcludable, thus allowing for nonmembers' free riding. To address nonmembers who do not cut emissions (i.e., free ride on members' efforts), Nordhaus proposes the use of a tariff punishment based on nonmembers' carbon emissions. The analogy with club theory is not perfect because addressing climate change is a pure global public good whose benefits are nonexcludable. The proposed tariff violates the voluntary nature of clubs and presents a distortion that is ignored by Nordhaus. Also, the tariff raises an enforcement problem, left unaddressed.

In a recent article, Larson (2018) indicates how various collectives of global governance—e.g., the G7 or G20 memberships—constitute transnational clubs. Actually, international clubs abound and include, among others, the World Health Organization, the United Nations, International Monetary Fund, and the World Bank. At the regional level, the Asian Development Bank, the Inter-American Development Bank, African Development Bank, and regional trading blocs constitute other club examples. Development banks share investment, loan funds, and congestible regional infrastructure (i.e., bridges, roadways, and waterways), while trading blocs and common markets share trading arrangements. In recent years, the Asian Development and the Inter-American Development Banks are undertaking massive funding initiatives for providing regional infrastructure to support commerce and regional economic growth. As such, development banks are providing regional and subregional club goods that can, in some instances, be self-financed over time by congestion-internalizing tolls (Susantono and Park 2020).

The International Telecommunications Satellite Organization (INTELSAT), a private company joining most of the world in an external communication satellite-based network, is a novel club, whose user charges finances existing and ever-expanding provision (Sandler and Schulze 1981). The INTELSAT system consists of geostationary satellites in orbit at 22,300 miles over the equator at an altitude where each satellite remains, except for a drift of 100 miles, fixed over a point on the earth. This high altitude allows three satellites to provide point-to-point global coverage except at the poles. Additional INTELSAT satellites are needed to carry the ever-increasing amount of communications and to serve as backups when network satellites fail. The backups augment the reliability of the network in light of satellite failures. Sandler and Schulze (1981) identify two complementary club goods: geosynchronous orbital slots and the electromagnetic bandwidth, both of which are subject to crowding. A club arrangement addresses, in practice, the two crowding concerns: signal interference from transmissions and satellite collision owing to drift. User charges based on transmission time internalize noise externalities, while fees for orbital slots internalize collision worries. In the latter case, higher orbital fees may motivate better position-keeping devices onboard satellites to limit drift.

Sandler and Tschirhart (1997) identify many other club goods including phone networks, the internet, transatlantic air corridors, air-traffic control systems, universities, cathedrals, and knowledge pools. Even cartels in the study of industrial organizations can be modeled as clubs. An important set of clubs involves intergenerational clubs for which multiple generations of members share a good that is subject to atemporal crowding and intergenerational depreciation due to consumption (Sandler 1982). Consider antibiotics that we all share to treat bacterial infections. Contemporaneous crowding involves the use of available limited supply, while depreciation occurs when use today limits the antibiotic effectiveness tomorrow as bacteria build up immunities. The latter represents an intertemporal crowding that affects current and future generations. Congestion pricing must account for both types of externalities and be applied to self-finance new supplies and novel antibiotics. Intergenerational clubs also correspond to universities, cathedrals, and culture. On a more physical level, the Amazon jungle with its teeming biodiversity constitutes an intergenerational club shared by humans today and hopefully tomorrow.

7 Concluding remarks

The Tiebout (1956) article has garnered well over 24,000 google cites by the start of 2023. His seminal piece is not only a theoretical forerunner of club theory and the notion of local public goods but is also influential in empirical studies in urban and regional economics involving city size, interregional migration, property-value capitalization, and taxation as individuals choose their ideal tax-public good option to satisfy their income-constrained tastes. The Tiebout (1956) article illustrates how simple, but insightful, ideas can generate a significant and lasting body of work. Complex theoretic constructs are not necessary to capture the attention of political economists or policy makers as is also true for Olson's (1965) *The Logic of Collective Action*, which is another precursor of club theory. As econometric tools advance, researchers continue to reconsider some Tiebout-inspired empirical tests in urban and regional economics, where past tests are inconclusive (Dowding et al. 1994). The Tiebout hypothesis continues to remain relevant some 67 years later.

Acknowledgements The author profited from helpful comments by two anonymous reviewers, Steven Craig, and Eric John Heikkila on an earlier draft.

References

Batina RG, Ihori T (2005) Public goods: theories and evidence. Springer, Berlin
Berglas E (1976) On the theory of clubs. AER Papers Proc 66(2):116–121
Berglas E (1984) Quantities, qualities and multiple public services in the Tiebout model. J Public Econ 25(3):299–321
Berglas E, Pines D (1981) Clubs, local public goods and transportation models: a synthesis. J Public Econ 15(2):141–162
Boettke PJ, Marciano A (2017) The distance between "An economic theory of clubs" and Tiebout's "a pure theory of local public expenditures." New insights based on an unpublished manuscript. Eur J Hist Econ Thought 24:205–237
Brueckner JK, Lee K (1991) Economies of scope and multiproduct clubs. Public Financ Quart 19(2):193–208
Buchanan JM (1965) An economic theory of clubs. Economica 32(1):1–14
Cornes R, Sandler T (1996) The theory of externalities, public goods and club goods. Cambridge University Press, New York
DeSerpa AC (1977) A theory of discriminatory clubs. Scott J Polit Econ 24(1):33–41

Dowding K, John P, Biggs S (1994) Tiebout: a survey of the empirical literature. Urban Stud 31(4–5):767–797
Fisher AC, Krutilla JV (1972) Determination of optimal capacity of resource-based recreational facilities. Nat Res J 12(3):417–444
Helpman E, Hillman AL (1977) Two remarks on optimal club size. Economica 44(3):293–296
Helsley RW, Strange WC (1991) Exclusion and the theory of clubs. Can J Econ 24(4):888–899
Larson DW (2018) New perspectives on rising powers and global governance: status and clubs. Int Stud Rev 20(2):247–254
McGuire MC (1974) Group segregation and optimal jurisdictions. J Polit Econ 82(1):112–132
McGuire MC (1991) Group composition, collective consumption, and collaborative production. Am Econ Rev 81(5):1391–1407
Mohring HD, Harwitz M (1962) Highway benefits: an analytical review. Northwestern University Press, Evanston
Nordhaus W (2015) Climate clubs: overcoming free-riding in international climate policy. Am Econ Rev 105(4):1339–1370
Nordhaus W (2020) The climate club: how to fix a failing global effort. Foreign Aff 99(3):10–17
Oates WE (1969) The effect of property taxes and local public spending on property values: an empirical study of tax capitalization and the Tiebout hypothesis. J Polit Econ 77(6):957–971
Oates WE (1973) The effects of property taxes and local public spending on property values: a reply and yet further results. J Polit Econ 81(4):1004–1009
Olson M (1965) The logic of collective action. Harvard University Press, Cambridge
Olson M (1969) The principle of "fiscal equivalence:' the division of responsibilities among different levels of government. AER Papers Proc 59(2):479–487
Olson M, Zeckhauser R (1966) An economic theory of alliances. Rev Econ Stat 48(3):266–279
Pauly MV (1967) Clubs, commonality, and the core: an integration of game theory and the theory of public goods. Economica 34(3):314–324
Pollakowski HO (1973) The effects of property taxes and local public spending on property values: a comment and further results. J Polit Econ 81(4):994–1003
Samuelson PA (1954) The pure theory of public expenditure. Rev Econ Stat 36(4):387–389
Sandler T (1977) Impurity of defense: an application to the economics of alliances. Kyklos 30(3):443–460
Sandler T (1982) A theory of intergenerational clubs. Econ Inquiry 20(2):191–208
Sandler T (1984) Club optimality: further clarifications. Econ Lett 14(1):61–65
Sandler T (2013) Buchanan clubs. Const Polit Econ 24(4):265–285
Sandler T, Forbes JF (1980) Burden sharing, strategy, and the design of NATO. Econ Inquiry 18(3):425–444
Sandler T, Hartley K (2001) Economics of alliances: the lessons for collective action. J Econ Lit 39(3):869–896
Sandler T, Schulze W (1981) The economics of outer space. Nat Res J 21(2):371–393
Sandler T, Tschirhart JT (1980) The economic theory of clubs: an evaluative survey. J Econ Lit 18(4):1481–1521
Sandler T, Tschirhart JT (1984) Mixed clubs: further observations. J Public Econ 23(3):381–389
Sandler T, Tschirhart JT (1993) Multiproduct clubs: membership and sustainability. Public Financ 48(2):153–170
Sandler T, Tschirhart JT (1997) Club theory: thirty years later. Public Choice 93(3–4):335–355
Scotchmer S (1994) Public goods and the invisible hand. In: Quigley J, Smolensky E (eds) Modern public finance. Harvard University Press, Cambridge, pp 93–119
Scotchmer S (1997) On price-taking equilibrium in club economies with nonanonymous crowding. J Public Econ 65(1):75–88
Scotchmer S (2002) Local public goods and clubs. In: Auerbach A, Feldstein M (eds) Handbook of public economics. North-Holland, Amsterdam, pp 1998–2042
Scotchmer S, Wooders MH (1987) Competitive equilibrium and the core in club economies with anonymous crowding. J Public Econ 34(2):159–173
Stanford Encyclopedia of Philosophy (2021) Public goods. https://plato.stanford.edu/entries/public-goods/ Accessed April 20, 2023
Susantono B, Park C-Y (2020) Future of regional cooperation in Asia and the Pacific. Asian Development Bank, Manila, The Philippines
Tiebout CM (1956) A pure theory of local expenditures. J Polit Econ 64(5):416–424

Tullock G (1971) Public decisions as public goods. J Polit Econ 79(4):913–919
Wiseman J (1957) The theory of public utility price – an empty box. Oxf Econ Pap 9(1):56–74
Yinger J (2015) Hedonic markets and sorting equilibria: bid-function envelopes for public services and neighborhood amenities. J Urban Econ 86(1):9–25