This article develops a model that extends the theory of clubs to the case in which a local congestible public good requires a capital facility for its provision in a community facing population growth. The trade-offs facing officials planning the capital facility are examined. The model offers an explanation as to why formerly progrowth communities may now vigorously oppose growth. Many communities imposing growth controls cite inadequate public facilities. An implication of the model is that this inadequacy may be planned. The article examines other implications of the model and gives some indication of its explanatory and predictive powers.

FISCAL EXTERNALITIES AND RESIDENTIAL GROWTH CONTROLS: A THEORY-OF-CLUBS PERSPECTIVE

ROBERT A. BLEWETT
Western Illinois University

Starting in the late 1960s and continuing to the present, an increasing number of suburban communities have attempted to limit or control their residential growth. Today there are hundreds of localities in all parts of the United States with institutions whose explicit purpose is to limit or manage the number of entering residents. Many communities that vigorously promoted growth in the 1950s and 1960s are now employing various growth-control measures. To date, the usual explanation for this relatively sudden reversal is that there has been a change in attitudes. People have, it is claimed, rejected the "growth is good" ideology that was prevalent in the past (Finkler and Popper, 1976: 7).

AUTHOR'S NOTE: I gratefully acknowledge the suggestions and comments of Paul B. Downing, T. Nicolaus Tideman, Roger Congleton, Norman Walzer, and anonymous referees.
This article develops a model offering an alternative explanation for the imposition of growth controls, which is not dependent upon changes in ideology or sudden changes in tastes. This model is an extension of the theory of clubs (Buchanan, 1965) to the case in which a local congestible public good requires a capital facility for its provision in a community facing population growth. The "growth theory of clubs" that is developed will examine the trade-offs facing decision makers planning such a capital facility and the way in which growth restrictions become rational in time. The model will examine the essential fiscal costs and benefits of residential growth and how they relate to the above-mentioned decisions in a "competitive" community. The conclusion reached through this analysis is that the imposition of suburban residential growth controls can be the result of an imbalance between population and planned capacity of public capital goods.

The model will explain why formerly progrowth communities may suddenly oppose growth. Many communities cite inadequate public facilities as a rationale for growth controls. An implication of the model to be developed is that this inadequacy may be planned. A number of other interesting implications and explanations are obtained from the model, as well.

Section II offers additional explanation of certain elements of the model. The model itself and the various trade-offs are examined in Section III, while Section IV analyzes the implications of the model. Possible solutions to efficiency problems are examined in Section V, and the final section offers some concluding remarks and observations.

ASSUMPTIONS

The problem at hand is to examine the collective provision of a congestible public good in a "competitive" community. A competitive community is one among many alternative communities in an urban area where residents could choose to locate. A congestible public good, also known as a "club good," is an intermediate case between two extremes of a pure private and
pure public good. One person can enjoy the benefits of a unit of a club good without totally eliminating the benefits another person can derive from that same unit. However, this sharing of a unit diminishes the satisfaction derived from it. That is to say, a club good has some “publicness,” but it is subject to congestion.

The goods and services provided by local government have the characteristics of neither pure public nor pure private goods. For the most part, local government services have the characteristics of club goods. For example, a local public swimming pool, public library, fire and police protection, and a sewer system are all club goods. A swimming pool may be shared between users. The addition of another user increases congestion and does decrease the pleasure derived by each user. Therefore, it is not a pure public good. However, the decrease in benefits is not complete, so it is not a pure private good. In fact, any good subject to declining costs can be considered a club good.

The provision of club goods often requires the construction or purchase of capital facilities. For example, a local public swimming pool or public library involves capital facilities that provide a stream of services for many years. Local governments often build fire and police stations, school buildings, playgrounds, and sewer and water systems, which generate (or facilitate generation of) a stream of club goods and services.

The satisfaction or fiscal surplus one obtains from a local public service is a function not only of the size of a public facility (i.e., the quantity of the club good generated) but also of the number of people sharing the service. Additional residents lower resource cost shares, but they also increase congestion costs. Previous work (Buchanan, 1965) has shown an individual's optimal combination of residents (club membership) and club good quantity. However, this work has not considered how an expected future growth in residents would affect the decision calculus. That is to say, an area may be growing, and current residents may want to build larger public facilities in anticipation of a future increase in residents.

Often the scale of public capital improvements cannot be altered without substantial cost. For example, once a sewer line is
installed, the cost of enlarging this line is more than double the expense of installing a larger line in the first place. Many capital facilities have this characteristic. Given that some service facilities cannot be increased incrementally through time, local governments find it in the interest of citizens to build capacity not only for today's demands but also for the demands of the future. The task before us is to outline a model to explain the trade-offs facing a community or club planning for the future, given certain information. A "growth theory of clubs" will be developed to model the trade-offs concerning the scale of public improvements.

It is assumed that all residents and potential residents are identical in every respect except as to when they enter the community. The per period benefits of the public good that each resident will receive, $B(K)$, is determined by the scale of public facilities. It is assumed that $B'(K) > 0$ and $B''(K) < 0$. Congestion costs per period, $h[n(t)]$, are a function of population and $h[n(t)] > 0$.

The capital facility has a lifetime of $T$ time periods. Productivity of the capital asset does not decline until time period $T$, when its productivity is zero. The resource cost of the public facility is dependent on the scale of plant. We will assume that the community is able to finance this resource cost over the life of the asset with uniform payments of $C(K)$, with $C'(K) > 0$. This uniform per-period payment is shared or divided equally among all current residents of the community in any particular time period. That is to say, the resource cost share of an individual in period $t$ would be $C(K)n(t)^{-1}$.

The increase in potential population per period will be positive and there is some positive population level in the initial time period. That is to say: $n(0) \geq 1, n'(t) > 0$. This potential population level per time period is determined exogenously.

THE TRADE-OFFS

The residents in the initial time period, or their representatives, will decide what scale of plant is to be built. They will make this
decision so as to maximize their discounted stream of net benefits or fiscal surpluses. Their decision will be made given certain information concerning the benefits, costs, and potential population levels. Also, they are fully aware that population growth will be limited in some future time period \((t^*)\) if residents present in that period so desire.

The discounted stream of fiscal surpluses of initial residents is given by:

\[
S = \int_0^T B(K)e^{-rt} \, dt - \int_0^{t^*} C(K)n(t)^{-1}e^{-rt} \, dt - \int_{t^*}^{T} C(K)n(t^*)^{-1}e^{-rt} \, dt - \int_0^{t^*} h[n(i)]e^{-rt} \, dt \tag{1}
\]

The first term in equation 1 is the discounted stream of benefits an initial resident derives over the life of the public facility. The second term is the stream of resource cost shares paid before population is limited in time period \(t^*\), and the next term is the stream of these shares after this period. The fourth and fifth terms, respectively, refer to the stream of congestion costs per period before and after the number of residents is limited. The initial residents will select a scale of plant, \(K\), given a particular population limitation period \(t^*\), so as to maximize their stream of surpluses, \(S\).

A first order condition for maximization is:

\[
\frac{\partial S}{\partial K} = B'(K)(1-e^{-rT})/r - C'(K) \left[ \int_0^{t^*} n(t)^{-1}e^{-rt} \, dt \right] + t^* \int_{t^*}^{T} n(t^*)^{-1}e^{-rt} \, dt = 0 \tag{2}
\]

In words, an initial resident should choose the scale of plant so that the sum of the stream of discounted marginal benefits derived from that scale equals the discounted stream of marginal costs of that scale. Referring to quadrant I in Figure 1, curve MB represents the discounted marginal benefits curve while MC;\(t^*\) represents the discounted cost shares given a population cut-off period of \(t^*\). Given this cut-off period, initial residents will desire
a scale of plant $K_s$. Note that the cost share curve, $MC; t^*_1$, can be decreasing. Many local capital facilities, (e.g., sewer treatment plants) have this characteristic. Maximization requires that the following second-order condition also hold:

$$\frac{\partial^2 S}{\partial K^2} = B''(K)(1-e^{-rT})/r - C''(K) \left[ \int_0^{t^*_1} n(t)^{-1} e^{-rt} dt \right] < 0$$

If a longer period of uncontrolled growth is allowed, then the discounted stream of individual cost shares decreases. Graph-
ically, this means that MC;\(t_2^*\) is below MC;\(t_1^*\), if \(t_2^*\) is greater than \(t_1^*\). This implies a larger desired scale of plant \(K_s\). This conclusion can be derived mathematically from equations 2 and 3 above:

\[
dK/dt^* = -(\partial^2 S/\partial K \partial t^*) / (\partial^2 S/\partial K^2) > 0 \quad \text{given} \quad \partial S/\partial K = 0
\]

since

\[
\partial^2 S/\partial K \partial t^* = C'(K) n'(t^*) n(t^*)^{-2} (e^{-rt^*} - e^{-rT})/r > 0
\]

If population growth is allowed for more time periods, then the individual cost shares in later time periods will be less than they would be otherwise, since more people would be sharing a given per-period cost. The total discounted stream of the cost shares will be a smaller amount for any given scale of plant. Thus, if the cost of the scale of plant to individuals goes down, they would be expected to desire a larger scale of plant. A schedule of optimal plant sizes given any population limitation period can be derived graphically, such as curve \(K;\(t^*\) in quadrant IV of Figure 1. Given this curve, one can determine the optimal scale of plant if one knows the time period in which population growth will be limited.

In order to maximize their discounted stream of benefits, the initial residents would desire a cut-off period, \(t^*\), so as to satisfy the following first- and second-order conditions:

\[
\partial S/\partial t^* = C(K) n'(t^*) n(t^*)^{-2} (e^{-rt^*} - e^{-rT})/r
- h'[n(t^*)] n'(t^*) (e^{-rt^*} - e^{-rT})/r = 0
\]

\[
\partial^2 S/\partial t^*^2 = C(K) [n''(t^*) n(t^*)^{-3} (e^{-rt^*} - e^{-rT})/r
- 2 n'(t^*)^2 n(t^*)^{-3} (e^{-rt^*} - e^{-rT})/r - n'(t^*) n(t^*)^{-2} re^{-rt^*}]
- h''[n(t^*)] n'(t^*)^2 (e^{-rT})/r
- h'[n(t^*)] n''(t^*) (e^{-rt^*} - e^{-rT})/r + h'[n(t^*)] n'(t^*) re^{-rt^*} < 0
\]

The following can be derived from 6

\[
C'(K) n'(t^*) n(t^*)^{-2} = h'[n(t^*)] n'(t^*)
\]
In words, growth will be stopped in the period when the cost share savings of another period of uncontrolled population is equal to the marginal congestion costs accompanying this growth. It should be apparent that the residents in this particular time period will indeed stop growth as the initial residents desire. In any time period all residents, regardless of when they entered the community, have the same future costs and benefits. The fiscal surpluses of previous periods can be thought of as "inframarginal benefits," and they will not affect the trade-offs.

The cost-share savings decline as periods of uncontrolled growth increase, since in the future there will be more people to share the cost of a given facility. Larger facilities also imply higher costs, and thus, higher cost shares. These relationships are illustrated in quadrant II of Figure 1 by curves MS;K₁, MS;K₂, and MS;K₃, where K₁ < K₂ < K₃.

The marginal congestion costs of additional growth are represented by curve MH. Given the marginal conditions, it is shown that larger facilities imply more periods of uncontrolled growth. This implication can be derived from equations 5, 6, and 7 above:

\[ \frac{dt^*}{dK} = -\frac{\partial^2 S/\partial t^*^2}{\partial^2 S/\partial K} > 0; \text{ given } \partial S/\partial t^* = 0 \quad [9] \]

A locus of points, such as curve t*;K in quadrant IV of Figure 1, can be plotted, showing the optimal desired limitation period (t*), given any scale of plant K.

When the initial residents of the community or their representatives determine the scale of plant for the public facility, they are also implicitly determining when population growth will be stopped. If the initial residents are aware of this and if the residents of some future period can indeed stop growth, initial residents can take into account the trade-offs depicted in Figure 1. Initial residents will choose a scale of plant, K, so as to determine their optimal combination of K and t*. Such a combination is found in quadrant IV of Figure 1 by the intersection of t*;K and K;t*. That is to say, initial residents will choose K⁸ for their public capital facility, knowing that future residents will then choose to limit growth in time period t⁸.
The total fiscal surplus of the community can be stated in terms of the surplus obtained by an initial resident:

\[ V = A \cdot S \]  \hspace{2cm} [10]

where

\[ A = n(0) + \int_{t_1}^{T} n'(t) \left[ \frac{B(K) - \int B(K) \left\{ C(K)n(\tau) - \frac{h[n(\tau)]}{S(t^*, K)} \right\} e^{-\tau dt}}{S(t^*, K)} \right] dt \]  \hspace{2cm} [11]

\[ \frac{\partial A}{\partial K}, \frac{\partial A}{\partial t^*} > 0 \]  \hspace{2cm} [12]

The term within the outer parentheses is the fraction of an initial resident's surplus that a resident entering the community in period \( t \) obtains. \( A \) is the total number of residents in the community, with the number of new residents in each time period \( t \) reduced by the fraction in parentheses.

Maximization of total surplus requires the following first-order conditions:

\[ \frac{\partial V}{\partial K} = (\frac{\partial A}{\partial K})S + A (\frac{\partial S}{\partial K}) = 0 \]  \hspace{2cm} [13]

\[ \frac{\partial V}{\partial t^*} = (\frac{\partial A}{\partial V})S + A (\frac{\partial S}{\partial t^*}) = 0 \]  \hspace{2cm} [14]

The above conditions imply that the initial residents will build a smaller-than-socially-efficient scale of plant, and thus cause growth limitations to be imposed sooner than if total surplus was maximized. This can be shown in Figure 2, where functions \( S \) and \( V \) are graphed. If \( S \) is maximized, then \( K = K^* \) and \( \frac{\partial S}{\partial K} = 0 \). From equation 13 above, this implies that \( (\frac{\partial A}{\partial K}) > 0 \). However, if total surplus, \( V \), is maximized, \( K = K^v \), which implies (based on equation 13) that \( (\frac{\partial A}{\partial K})S = A(\frac{\partial S}{\partial K}) \), which means \( (\frac{\partial S}{\partial K}) > 0 \). Since we know that \( (\frac{\partial^2 S}{\partial K^2}) < 0 \), this implies that \( K^* < K^v \).

The absence of growth controls will not necessarily lead to efficient growth. If there were not growth controls, population growth would continue until period \( T \) or until the additional fiscal surplus available to a new resident was driven to zero. Referring to quadrant I of Figure 1, this means that the sum of the
discounted marginal cost shares facing the initial residents would be MC; T. This implies a larger scale of plant KT. Thus, the absence of controls would indeed cause a larger scale of plant to be built, but this scale would be larger than the efficient scale. The community's population would be larger than that which would maximize the social value of the community. The inability to exclude new residents leads to something analogous to a commons problem. However, Downing (1977) maintains that a properly designed system of user charges may solve this problem.

**IMPLICATIONS**

The growth theory of clubs indicates that communities face certain trade-offs that may cause them to build public facilities at a smaller-than-socially-efficient scale if growth controls can be imposed in the future. This model will not be descriptive of some
communities for several reasons. First, many communities do not have to contend with significant residential growth. Also, the planning authorities of some communities may be controlled by prodevelopment interest groups. Third, the model assumes that public authorities look to the future effects of their actions. Casual empiricism may find that many local governments just "muddle along."

However, there are many examples of growth-conscious communities that appear to take into account the trade-offs of the model. For example, a fiscal rationale is offered for the implementation of growth controls. A survey of planning officials in communities with experience with growth-control measures found that the measures were often imposed to ensure adequate public facilities (Brower et al., 1976: 104). That is to say, the purpose of controls was to limit overcrowding or excessive congestion of public capital facilities.

An implication of the model is that the overcrowding of public facilities may not be the result of inadequate municipal finances or mistaken housing forecasts; this overcrowding may be planned. The relatively sudden reversal in attitudes toward growth can be explained, since a municipality's residents may desire growth until the planned inadequacy of public facilities presents itself.

There is evidence that some municipalities deliberately alter the size or extent of capital facilities in order to restrict future population growth. In 1972, new members of the Board of Supervisors in Fairfax County, Virginia, desired to control residential growth. Included among the actions they took were (1) designing smaller sewer treatment plants than had been originally planned by officials, (2) undersizing pipe collection systems leading to treatment plants, and (3) renegotiating earlier allocation agreements with other jurisdictions to reduce Fairfax County's share of sewer plant capacity (Hirst and Hirst, 1975).

Another famous growth-controlling community is Petaluma, California. Officials were found to have deliberately limited the city's public facilities so as to "serve a population lower than the market and demographic rates would produce" (U.S. District Court, 1975: 136-138). Officials did this by limiting water and sewer treatment capacity.
The environmental, political, and social externalities of residential growth may also affect the desire for growth limitations. These externalities can be easily incorporated into the model. For example, air and water pollution can be viewed as congestion of the environment. Since this pollution also tends to increase as population increases, the marginal environmental congestion cost is positive. By merely adding this marginal congestion cost to curve MH in Figure 1, environmental quality can be incorporated into the model. An increased environmental sensitivity or awareness would be represented as an increase in MH and would imply that growth controls would be implemented sooner. Of course, the implications derived earlier are not changed by this extension of the model.

Another implication derived from the model is the effect of an unexpected increase in the population growth, n'(t), after the public facility is built. Increased growth would mean that congestion costs are increasing faster. Referring back to quadrant II of Figure 1, this would mean that the MH curve would shift up. On the other hand, there would be more people in intermediate time periods to share the expense of the previously built facility—thus, the marginal savings curve, MS (given the particular scale of plant) would shift down. These two shifts imply that growth-control measures would be imposed sooner. Thus, the model can explain the high incidence of residential growth controls in the 1970s. During this period there was a sudden increase in the demand for housing. This was due to the fact that the babies of the baby boom had now grown up and were buying their first houses. Also, it may not be coincidental that the imposition of growth controls in Fairfax County, Virginia, Montgomery County, Maryland, and other Washington SMSA localities, accompanied the expansion of federal employment in neighboring District of Columbia in the 1960s.

The model also indicates that efficient development may not always be popular. For example, Irvine Ranch in Orange County, California, is a privately planned and developed community. The residents of Irvine Ranch have, in the past, complained vehemently concerning the overdevelopment of the community.
Referring to Figure 2, we can see that the residents may be complaining because additional residents are causing the average surplus to decline. However, the developer may be taking total benefits into account in order to maximize profits. Of course, this maximization may actually be more efficient than stopping the development when current residents desire to do so.

POSSIBLE SOLUTIONS

An implication of the growth-theory-of-clubs model is that communities may build public facilities at a smaller-than-socially-efficient scale. There is a period when an additional resident lowers the fiscal surplus of others already residing in the community. These residents will desire growth controls, even though their total loss is outweighed by the additional resident's gain. Therefore, there are possible net gains to growth that may be realized.

Exclusionary or "snob" zoning is one method—albeit an indirect one—that communities may use to maintain their fiscal surplus. One way in which new residents can compensate established residents is with property tax payments. In order to increase this compensation, higher-value housing may be required. This is an inefficient method of compensation, in that the municipality requires a home that is higher in value than that which would benefit the dweller, only to justify payment of higher taxes.

Tax limitations, such as Proposition 13 in California, should result in more residential growth control. If property tax rates are lowered, then additional development will add even less to the local fisc. Experience in California following passage of Proposition 13 supports this conclusion (Sansweet, 1979).

It should be noted that financial feasibility of building larger facilities is not an issue. The issue concerns the trade-offs and incentives facing planning authorities. For example, the community may levy a land value tax or property tax in order to finance public service capacity to be built in one period for use at
a later date. However, this may not sufficiently affect incentives. The community could levy taxes on undeveloped land, whether or not future capacity was built for this land. A larger scale of plant could affect the land values to be taxed, but this is likely to cause only a marginal effect on the initial resident's costs and benefits of alternative plant scales.

There are other ways that residents can "buy their way" into a community. Many municipalities require revenue/cost studies before approving any new residential developments, and if the new developments generate greater public revenues than public costs (i.e., increase fiscal surplus) the development plans are approved. If the costs are greater than the revenues, the development is not permitted unless the developers make up the difference in impact fees or development charges or else build additional public capital facilities and deed them to the municipality. This buying into the community yields an increase in efficiency, but it does not entirely eradicate the inefficiency described above. The scale of plant of a public facility is smaller than is socially efficient. The buying in many time periods after the facility is built allows compensation only for congestion costs. The facility's scale was decided in the initial time period.

An example may help illustrate this. New developments can be required to build or pay charges for new water and sewer lines, streets, parks, schools, and other public facilities that directly service the development. In some areas, the municipality may even be compensated for certain environmental damages. However, a problem arises in that the scale of water and sewage treatment plants, streets, and other public facilities shared by the previous residents and the new development has already been determined. These facilities were built in the past.

What is needed is some way for future residents to compensate so that initial residents will have incentives to build larger facilities. However, there are restrictions on the fees that can be charged to new residents. The fees can only be used to finance public facilities used to serve the particular development. To charge more would be tantamount to the municipality's selling development rights. The courts hold that a municipality may
control, but not own, development rights. Thus, these rights cannot be sold without just compensation to the rightful owners. Also, new residents cannot be taxed differentially, simply because they are new. As mentioned above, they can be taxed differently for costs that they impose now. However, the courts may be unwilling to allow price discrimination against new residents to finance a long-completed public facility. Therefore, it may be difficult to completely alter the trade-offs derived from our model.3

Another possible solution involves “the demand revealing process” (Tideman and Tullock, 1975; Tideman, 1979). Designed to overcome the public-goods or free-rider problem, this process is a voting method that involves special tax payments by voters. However, the process is an unfamiliar and complex social institution. Thus, its political acceptability is in doubt. Also, the courts generally deny taxing powers unless expressly conferred by the state. Use of the demand revealing process may require specific state constitutional provisions.

Land-banking is a possible solution to the efficiency problem. The local government could condemn the development rights and compensate the owners. The municipality could then sell these development rights. This would remove the separation of ownership and control, and any gains due to more efficient land use would be captured by the municipality. There has been some use of land-banking as a method of growth control (Wolfram, 1981). However, there are several practical difficulties with land-banking that prevent its widespread use. First, it requires a large financial outlay for compensation and condemnation proceedings. This may impose a financial burden upon the community. Second, the municipality must play the role of a land speculator, since the future is not known with certainty. Thus, land-banking involves risk. Also, the comparative advantage of municipal authorities may not lie in land speculation. Third, the fiscal gains that may be derived from allowing growth may not be obvious to voters, and thus, efficient growth may not be politically popular. Given these problems, authorities may find it easier in many cases just to limit development via regulation.
SUMMARY

This article developed a model in which a local congestible public good requires a capital facility for its provision in a community facing population growth. The model provides an explanation for residential growth controls that is not dependent upon changes in ideology or preferences. Although the model was not rigorously developed, the theoretical results seem to be consistent with casual empiricism.

The model explains why a community may build its public facilities with initial excess capacities. It is also in the interest of residents to limit growth at some point in time. An implication of the analysis was that municipalities may build public facilities that are too small from an efficiency standpoint and then impose growth limitations too soon. Thus the “inadequacy of public facilities,” often cited as a reason for controls, may be a planned inadequacy. Other results explain the high incidence of controls in the 1970s. Also, there is evidence that efficient growth may not be politically popular. The model can be extended to include environmental, political, and social externalities without altering the qualitative results.

Possible solutions to the inefficiency of growth controls were examined. Communities may exact concessions from developers, which may allow additional growth. However, legal constraints on such actions may limit the “gains from trade.” Land-banking was offered as a possible method of obtaining efficient land-use patterns.

This article offered an explanation of some causes and consequences of suburban residential growth controls. A useful future endeavor would be an examination of some global effects of growth controls. However, the model herein presented appears to have some significant explanatory power.

NOTES

1. Tollison (1972) and Kafoglis and Cebula (1981) extend the theory-of-clubs model to include some costs associated with a heterogeneous club membership or population. Since
heterogeneity would tend to increase as population increases, these costs can be incorporated into the present model as additional congestion costs.

2. More realistic assumptions, such as gradual physical depletion of the facility, the scale of plant affecting congestion costs, or endogenous growth rates, would greatly complicate the analysis without offering any additional insight. The qualitative conclusions obtained would not be altered.

3. In reality, cities may get away with collecting fees far in excess of actual additional public service costs. Developers, for a variety of reasons, may be unwilling to "fight city hall." If this is the case, municipalities can price-discriminate against new residents. If it is realized that such future discrimination is possible, initial residents may build a larger scale of plant.

REFERENCES


Robert A. Blewett is Assistant Professor of Economics at Western Illinois University. He received his Ph.D. in economics from Virginia Polytechnic Institute and State University, and his research interests are in the areas of public choice, public finance, and public sector economics.