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A PROPERTY TAX LIMITATION

by

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LOCAL GOVERNMENT LAND-USE ALLOCATION
IN THE WAKE OF A PROPERTY TAX LIMITATION*

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I. INTRODUCTION

Local governments exercise substantial control over the nature of development within their jurisdictions. Through the use of various land-use regulatory instruments, municipalities affect housing stock composition, property values, demand for local public services, and, consequently, the fiscal viability of the jurisdiction. In response to fiscal retrenchment and restraints, municipalities are increasingly using land-use instruments in the design and control of community growth.

Community general-plan zoning and growth-control ordinances have pervaded local management of development. In the city of Petaluma, for example, a Residential Development Control System serves to "control the rate, distribution, quality, and economic level of proposed development. . . ."[1] The neighboring city of Rohnert Park, historically the antithesis of exclusionary zoning and encumbering land-use controls, also recently implemented a strict form of growth management. In fact, approximately thirty-five San Francisco Bay Area jurisdictions have enacted some form of growth management or moratoria on residential development since 1970.[2] For the most part, growth-control plans dictate not only allocation of remaining community land area among

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[1] City of Petaluma, An Ordinance Adding Chapter 17.26 to the Petaluma Municipal Code to Adopt a Residential Development Control System, Ordinance No. 1321 N.C.S., Effective date: 9/21/78, Petaluma, California.

[2] Gabriel, Katz, and Wolch [1979], p. 16.

competing uses, but also allowable rates of development within each
zoned use.

California's recently passed property tax limitation has had sub-
stantial impact on local land-use regulation. As indicated by wide-
spread increases in development fees and user charges, Proposition 13
forced local governments to think twice about the fiscal impact of new
community growth. Post-Proposition 13 survey results show considera-
tion of fiscal impact plays a much more important role in the develop-
ment approval process.[1]

In this paper, we explore the implications of a particular com-
munity fiscal zoning policy--that of fiscal dividend maximization--for
local land-use allocation and preferred rate of growth. After a re-
view of relevant literature, the salient characteristics of a local
land-use allocation model are discussed in section III. The develop-
ment decision is examined from the perspective of both local government
and the private developer, with particular application to a property
tax limitation. Section IV formalizes these elements into an analytical
model of local land-use regulation. In the concluding section, results
and interpretation of the model, and implications for empirical inves-
tigation, are discussed.

II. BACKGROUND

The relevant literature falls roughly into two groups: (1) the-
oretical representations of local government fiscal zoning, and (2)

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[1]Ibid.

dynamic models of optimal community development. The focus of this paper can be described in terms of the intersection of these research areas.

Of the models in the former group, Hamilton [1975] illustrates a basic fiscal motivation for land-use regulation. The model's general zoning ordinance results in perfect homogeneity of housing value in each community. Local governments are unable to engage in fiscal redistribution, and the property tax is converted into a pareto-optimal, noncapitalized, head tax. Here, land-use regulation is utilized to ensure attainment of competitive, private, market efficiency conditions in the provision of the local public good.

White [1975] forsakes the idealized Tiebout world to frame her modeling efforts around "an especially chauvinistic type of local zoning policy under which a community tries to make its own residents better off at the expense of newcomers and outsiders."[1] In the White models, zoning regulations or entrance fees are used by the locality to select only highly profitable residential development. Regulatory instruments are coordinated in a policy of curtailing housing supply, extracting a premium from new development, and/or increasing property values. White focuses primarily on the traditional property tax and public expenditure instruments of local government, maximized over values of minimum lot size and quantity of land to be supplied for development, in designing the fiscal impact of new residential development. The author also introduces into her analysis the additional remuneration required by existing residents to account for their loss in

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[1]White [1975], p. 31.

environmental quality, suggesting a theoretical discussion of local
government land-use decisions based on the social, as well as private,
costs and benefits of new residential development.

Portney and Sonstelie [1978] offer a model formulated explicitly
around "profit maximization as a normative criterion for individual com-
munities in a large, metropolitan area."[1] Yet, differences in property-
value impact among local homeowners are cited as inhibiting implementa-
tion of such a policy objective. Similar to the Hamilton analysis, the
objective of municipal profit maximizing is efficient allocation of the
local public good. As such, local tax and expenditure effects are pri-
marily considered among regulatory instruments, and other fiscal zoning
tools are never explicitly introduced.

Of the dynamic models of optimal community development, Shoup
[1978], in evaluating the question of advance municipal acquisition of
land for public facilities, derives the date and capital intensity of
development that maximizes the present value of community land. Defin-
ing $V(t)$ as the value of land at time t if developed in its high-
est and best use in that period, Shoup maximizes the present value of
land with respect to the date of development. First-order conditions
require $V'(t)/V(t) = r$, which suggests that land should be developed
when the rate of increase in the development value of raw land equals
the discount rate.

Markusen and Scheffman [1978] formulate a two-period, general
equilibrium model of the urban land market, in which they examine the

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[1]Portney and Sonstelie [1978], p. 263.

optimal timing of development as it relates to development costs, ag-
ricultural opportunity costs, level of Ricardian rents, and market
structure. On the model's supply side, developer land sales are max-
imized subject to the constraint that available developable land is
exhausted. Developers are indifferent between sales in the two per-
iods if the difference between the discounted land prices in these
periods just equal the agricultural revenue foregone by developing in
the earlier period, plus the burden of incurring development costs in
the earlier period, rather than in the later period. The authors com-
pare the rate of developer land sales and the path of land-price
increases under both perfect competition and monopoly, delineating cir-
cumstances in which the existence and exercise of monopoly power do not
coincide.

Bahl [1968] presents a model of the landowner's optimal timing
of conversion and development of agricultural land to urban use. The
author formulates the optimality conditions in terms of a ratio of the
difference between rate of return on land and opportunity cost, in the
current period, to the discounted difference between these variables
for all periods. In this model, the landowner evaluates his position
at the beginning of each period and makes a decision on whether to re-
tain the land, based on the present value of aggregated future net re-
turns and those of the current period.

While models of the former type illustrate certain motivations
or implications of local government fiscal zoning, they neglect discus-
sion of the community zoning ordinance, either as a reflection of local

fiscal concerns or as a constraint on municipal development optimization. Thus, these modeling efforts lack any dynamic component or discussion of optimal diming of development from a fiscal-zoning perspective. Models of the latter type illustrate dynamic optimization analysis applied to urban land development, yet they are not formulated in terms of evaluating the impacts of particular local government fiscal zoning strategies on optimal land-use allocation and timing of development. These models ignore community zoning or growth-management plans formulated in the context of optimal or suboptimal, intertemporal community-development allocations. Finally, the above models do not facilitate analysis of municipal land-use regulation in the context of a local government tax limitation, as is relevant to the California case. Yet, changes in development allocation and its timing remain important local government response variables in the wake of fiscal limitation. In the following section, an alternative approach that incorporates these features is described.

III. THE MODELING APPROACH

Developers, together with local land-use regulators, reflecting the preferences of both anticipated and existing community residents, are primary actors in determining the rate and composition of community development. The resultant development allocation directly impacts on builder profits; extent and direction of intrajurisdictional fiscal cross-subsidization; availability of local public service and environmental amenities; and local government fiscal constraint. In this

section, we present the key features and background for the modeling of local land-use decisions from the perspectives of both local government and private developers.

The Local Government Land-Use Decision

A review of existing fiscal zoning literature suggests various characterizations of local government land-use policy, based on such goals as efficient allocation of the local public good, exclusion of service dependents, or maximization of fiscal dividends and/or residential property values. While San Francisco Bay Area communities vary considerably in both resident preferences and ability to obtain fiscal dividends from development, local government fiscal zoning has recently accelerated due to the tax limitation's budgetary squeeze. Survey results suggest relative fiscal profitability of development has become an important municipal decision criterion.[1] In this regard, the modeling of local government fiscal zoning policies, including positive implications thereof, has become an increasingly relevant exercise.

Models of community development allocation should be cognizant of the variety of land-use regulatory controls utilized by local governments. Zoning ordinances or growth-management plans often function as the cornerstone of community policy. As discussed in the Petaluma example, these plans typically specify both allowable rate and type of development. Explicit means of growth control may be replaced by subtle municipal processing delays associated with development permit applications. Jurisdictions may also resort to codification of exclusionary

[1]Gabriel, Katz, and Wolch [1979], p. 16.

objectives in the form of minimum lot size, set-back, or building size requirements. Sometimes communities limit growth by resisting the expansion of public facility capacity to meet projected demand, in turn requiring the imposition of sewer or water connection moratoriums. Often residential "environmental" groups lobby for the allocation of developable land to open space. Finally, in recent years--and particularly in the context of a property-tax limitation--local governments have turned to development fees and exactions as a means of both extracting revenue from and designing growth.[1]

Modeling of local government land-use decisions should account not only for the diverse means available to municipalities in pursuit of a fiscal zoning policy, but should also illuminate fiscal interactions between new development and the existing community base which lie at the core of such a policy. New and existing community property values should come to reflect any intrajurisdictional fiscal cross-subsidization, including environmental or social spillovers. Suburban land-use allocations thus often restrict those uses having significant adverse impact on the real wealth position of existing community residents.

Finally, given the fixed and durable quality of development, fiscal zoning modeling should incorporate a dynamic component, evaluating expected municipal revenue and expenditure flows associated with development at different points in time. The framework should allow for an analysis of future expected prices and trade-offs in timing of development, as well as development options on this basis. Such a structure

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[1]Gabriel, Katz, Wolch [1980], p. 76.

could thus suggest delay or acceleration of development, based on fiscal zoning objectives, and impacts of fiscal limitations on allocation of development over time. The model might also be adapted to the study of gentrification.

The Developer Land-Use Decision

The local land-use question might also be examined from the perspective of the developer. Here we consider the developer's objectives, his interaction with regulatory constraints of the local government, and resultant outcomes with regard to type and rate of community development. It is of special interest to compare the preferred development allocation of developer and municipality, noting potential divergence between the two.

As characterized in the literature cited above, the objective of the developer might be construed to be profit maximization. It is of interest to evaluate the developer's preferred rate of development, when land use is dictated by a community ordinance reflecting a particular fiscal zoning policy, as well as the developer's preferred allocation with regard to both type and rate of development, in the case where the community-imposed constraint is nonbinding. Similar to the dynamic context described above, the framework should allow for the formulation of expected future prices and, therefore, allocation of development over time based on its relative return.

The developer's calculus diverges from that of the local government, however, in that he ignores any intrajurisdictional spillovers associated with his development course. If land use had been determined by the community, the developer's problem reduces to one of the

trade-off in development over time based only on expected variation in sales price and construction costs, plus return and tax liability on interim use. A comparison of municipal and community preferred development paths over time enables a discussion of the conditions required for their convergence. To the extent that these preferred rates diverge, the actual rate of development observed empirically may then reflect the relative ability of these groups to influence local government land-use decision making.

Impact of a Property-Tax Limitation

A statewide, local, property-tax limitation, as in California's Proposition 13, represents a significant change in the regulatory and fiscal constraints faced by local governments and may be accompanied by a variety of community land-use ramifications. The altered circumstances include diminished significance of the primary, local, revenue-raising tool; insufficient funds to maintain municipal services at previous levels; increased reliance on state funding; and a high degree of uncertainty concerning future revenue sources and the level of service provision. Proposition 13 also implies realignment of regulatory tools by local government in an effort to limit local service responsibilities, while attempting to capture, through different policy instruments, revenues lost due to the property-tax limitation. California jurisdictions experienced an approximate halving of property-tax revenues, on average, subsequent to the passage of Proposition 13. Even with emergency state bailout funding, localities registered a revenue shortfall.

The initial response of local governments to the property-tax limitation was primarily to cut back expenditures and increase reliance on

fees and user charges. School funding took a statewide average 10 percent cut from the proposed 1978-79 budget levels, after accounting for receipt of state surplus funds.[1] Survey results show that Proposition 13 resulted in widespread, often substantial, increases in local development fees and exactions related to new construction.[2]

Those same results suggest that while most local governments did not rezone in response to the tax limitation, some may have postponed development within the allocated zones. For many California suburbs, rising property values, coupled with tax limitation's approximate freeze on assessed valuation, provide strong incentives for deferral. Although deferral of development may ease the fiscal squeeze on local government or contribute to escalation in existing housing values, it also tends to create hardship for those attempting to enter the housing market for the first time.

For the developer, housing construction may be reallocated across time due to mandated and induced effects of the tax limitation. The mandated ceiling and approximate freeze in property-tax liability lowers the cost of holding undeveloped land. Development costs increase due to local imposition of developer fees and exactions, as well as delays in permit processing because of cutbacks in staffing. Coupled with expected rising property values and anticipated increases in labor and construction costs, the developer recalculates his preferred rate of development subsequent to the tax limitation.

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[1]Cal-Tax Research Bulletin, November 1978, p. 3.

[2]Gabriel, Katz, and Wolch [1980], p. 76.

Thus, a fiscal zoning model might evaluate certain objectives of local government land-use regulation, cognizant of controls in the form of zoning and growth-management ordinances, as well as the diversity of other more or less explicit instruments. The model should describe fiscal interactions between anticipated and existing community bases, and enable evaluation of important dynamic questions associated with land development. The formal context should consider preferred land-use allocation from the perspective of various community interests, suggesting, as well, testable implications of local government fiscal limitations.

An empirical application of the model might test fiscal zoning hypotheses associated with the nature and timing of local development, utilization of land-use tools, and impacts of fiscal zoning on local property values. The empirical model, especially if applied to the California situation, should enable characterization and explanation of fiscal limitation-induced municipal land-use regulatory response. In the following section, the formal analytical model underlying these hypotheses is presented. Forthcoming research by the author provides empirical tests of the model.

IV. A FORMAL MODEL OF COMMUNITY LAND USE

Local Government Fiscal Optimization

In this section, we formulate a dynamic model of suburban government fiscal zoning. The behavioral assumption underlying this model is that suburban governments, through the use of a variety of zoning allocation and growth management instruments, attempt to regulate entry into their communities so as to maximize fiscal profits associated with new development. In this model, we derive an optimal zoning allocation and rate of community development based on the relative fiscal profitability of local development options.

Begin by assuming that the level of local public services is revised periodically to reflect existing community resident preferences. Community representatives set the terms by which land can be developed and are assumed to face a not perfectly elastic demand for development within the jurisdiction. Also, we assume there exists a perfect capital market with a risk-free, stable, interest rate r that reflects the social rate of discount.

To allocate remaining developable community land area among competing uses and across time, the fiscal profits associated with various development options are evaluated. Here

$$(1.1) \qquad \Pi = \sum_{i=1}^{N} \sum_{t=1}^{I} \left(R_{it}^{e}(0) - E_{it}^{e}(0) \right) \; ,$$

where:

$$(1.2) \qquad R^e_{it}(0) = \sum_{s=1}^{T} \frac{R^e_{it}(Q_{it},s)Q_{it}}{(1+r)^s} \, ,$$

and

$$(1.3) \qquad E^e_{it}(0) = \sum_{s=1}^{T} \frac{E^e_{it}(Q_{it},s)Q_{it}}{(1+r)^s} \, .$$

Defining terms, let

Π = total fiscal profits associated with community development

$R^e_{it}(0)$ = discounted expected revenue stream

$E^e_{it}(0)$ = discounted expected expenditure stream

R^e = expected per-unit revenues

E^e = expected per-unit expenditures

Q = units of new development

r = social discount rate

s = time periods in which fiscal returns are generated

t = time period in which development occurs

i = type of development

Making explicit the sources of local government revenue and expenditure associated with new development,

$$(1.4) \qquad R^e_{it}(Q_{it},s)Q_{it} = \tau P^e_{it}(Q_{it},s)Q_{it} + \Phi^e_{it}(Q_{it},s)Q_{it}$$
$$+ T^e_{it}(Q_{it},s)Q_{it} + F^e_{it}(Q_{it},s)Q_{it} + G^e_{it}(s)Q_{it} \, ,$$

and

$$(1.5) \quad E_{it}^{e}(Q_{it},s)Q_{it} = \varepsilon_{it}^{e}(Q_{it},s)Q_{it} + K_{it}^{e}(Q_{it},s)Q_{it} + S_{it}^{e}(Q_{it},s)Q_{it} \ ,$$

where: τ = local government property tax rate

P^{e} = expected per-unit price of development

Φ^{e} = expected per-unit local government composite development fee and exaction

T^{e} = expected per-unit local attributable sales tax revenues

F^{e} = expected per-unit intrajurisdictional fiscal spillover

G^{e} = expected per-unit intergovernmental grant

ε^{e} = expected per-unit intrajurisdictional environmental spillover

K^{e} = expected per-unit local public capital costs

S^{e} = expected per-unit local public service costs

Note that, in addition to direct revenue and expenditure components, the fiscal profit calculation reflects intracommunity fiscal and environmental spillover effects associated with the various development options. These effects may be either positive or negative in impact, depending on the particular development option and the existing community economic and spatial configuration. Also, expected prices of development are assumed to reflect future demand for those options.

To ascertain the optimal land-use allocation and rate of community development, we consider the constrained optimization problem of:

$$(1.6) \quad \max_{\{Q_{it}\}} \Pi(Q_{it},s) \ \text{s.t.} \ \sum_{i=1}^{N} \sum_{t=1}^{T} Q_{it} = \bar{Q} \ , \quad Q_{it} \geq 0 \ ,$$

where $\bar{Q}$ equals the remaining units of developable land and

$$(1.7) \qquad \Pi = \sum_{i=1}^{N} \sum_{t=1}^{T} \left[\sum_{s=1}^{T} \left(R_{it}^{e}(Q_{it},s)Q_{it} - E_{it}^{e}(Q_{it},s)Q_{it} \right) (1+r)^{-s} \right]$$

$$+ \lambda \left[\bar{Q} - \sum_{i=1}^{N} \sum_{t=1}^{T} Q_{it} \right] .$$

Differentiating the fiscal profit equation, with respect to each Q_{it}, to solve for the optimal development allocation, we obtain:

$$(1.8) \qquad \frac{\partial \Pi}{\partial Q_{it}} = \sum_{s=0}^{T} \left(R_{it}^{e'}(Q_{it},s)Q_{it} + R_{it}^{e}(Q_{it},s) - E_{it}^{e'}(Q_{it},s)Q_{it} \right.$$

$$\left. - E_{it}^{e}(Q_{it},s) \right) (1+r)^{-s} - \lambda = 0 ,$$

for all $i = 1,\ldots,N$, $t = 1,\ldots,T$, and

$$(1.9) \qquad \frac{\partial \Pi}{\partial \lambda} = \bar{Q} - \sum_{i=1}^{N} \sum_{t=1}^{T} Q_{it} = 0 ,$$

for all $i = 1,\ldots,N$, $t = 1,\ldots,T$.

It follows that, evaluated at the optimal Q_{it}^{*} ,

$$(1.10) \qquad \frac{\partial Q_{it}}{\partial Q_{jm}} = \frac{\partial \lambda / \partial Q_{jm}}{\partial \lambda / \partial Q_{it}} =$$

$$\frac{\left[\sum_{s=1}^{T} \left(R_{jm}^{e'}(Q_{jm},s)Q_{jm} + R_{jm}^{e}(Q_{jm},s) - E_{jm}^{e'}(Q_{jm},s)Q_{jm} - E_{jm}^{e}(Q_{jm},s) \right) (1+r)^{-s} \right]}{\left[\sum_{s=1}^{T} \left(R_{it}^{e'}(Q_{it},s)Q_{it} + R_{it}^{e}(Q_{it},s) - E_{it}^{e'}(Q_{it},s)Q_{it} - E_{it}^{e}(Q_{it},s) \right) (1+r)^{-s} \right]}$$

for all $i,j = 1,\ldots,N$, $t,m = 1,\ldots,T$.

This condition requires that the marginal rates of transformation in development allocation equal the corresponding ratios of discounted local government marginal fiscal profit streams. Furthermore,

$$(1.11) \qquad \sum_{s=1}^{T} \left(R_{it}^{e\,'}(Q_{it},s)Q_{it} + R_{it}^{e}(Q_{it},s) - E_{it}^{e\,'}(Q_{it},s)Q_{it} \right.$$
$$\left. - E_{it}^{e}(Q_{it},s) \right)(1+r)^{-s} = \lambda \ ,$$

for all $i = 1,\ldots N$ and $t = 1,\ldots,T$, where λ can be interpreted as the marginal fiscal profit associated with the availability of one more unit of developable land. This condition then implies that:

(1.12)

$$\sum_{s=1}^{T} \left(R_{it}^{e\,'}(Q_{it},s)Q_{it} + R_{it}^{e}(Q_{it},s) - E_{it}^{e\,'}(Q_{it},s)Q_{it} - E_{it}^{e}(Q_{it},s) \right)(1+r)^{-s}$$

$$= \sum_{s=1}^{T} \left(R_{jm}^{e\,'}(Q_{jm},s)Q_{jm} + R_{jm}^{e}(Q_{jm},s) - E_{jm}^{e\,'}(Q_{jm},s)Q_{jm} - E_{jm}^{e}(Q_{jm},s) \right)(1+r)^{-s} \ ,$$

for all $i,j = 1,\ldots,N$ and $t,m = 1,\ldots,T$.

In other words, evaluated at the optimal Q_{it}^{*} for all $i = 1,\ldots,N$ and $t = 1,\ldots,T$, the discounted marginal fiscal profit streams must be equal.

Solving for each optimal Q_{it}^{*} , we obtain the community fiscal profit-maximizing land-use allocation and rate of development. Reflecting demand-side constraints and various intrajurisdictional development

spillovers, the above fiscal zoning allocation maximizes the return on development to existing community residents.

Next, consider an alternative community development plan, in which the allocation of land area among development options is based on other than fiscal profit-maximizing objectives. Then, land-use allocation may reflect a preexisting general plan zoning ordinance or may be formulated on the basis of pressure brought to bear by various resident-constituent groups. Under the guise of environmental protection, local resident lobbies may attempt to restrict allocation to certain development options or expand community open space. Alternatively, local builders may succeed in influencing municipal development allocation with the aim of maximizing private return on development. Furthermore, zoning allocation may simply reflect the outcome of an exercise undertaken by the local planner. Given the zoned allocation of community land area, we here derive the fiscal optimizing rate of development within each zoned use.

In this case, for any development type i, the constrained optimization problem is one of:

$$(1.13) \qquad \max_{\{Q_{it}\}} \Pi_i(Q_{it}, s) \quad \text{s.t.} \quad \sum_{t=1}^{T} Q_{it} = \overline{Q_i} \,, \quad Q_{it} \geq 0 \,,$$

where $\overline{Q_i}$ is the remaining developable land of a particular zoning classification, and

$$(1.14) \qquad \Pi_i = \sum_{t=1}^{T} \left[\sum_{s=1}^{T} \left(R^e_{it}(Q_{it},s)Q_{it} - E^e_{it}(Q_{it},s)Q_{it} \right)(1+r)^{-s} \right]$$

$$+ \lambda \left[\overline{Q_i} - \sum_{t=1}^{T} Q_{it} \right].$$

To solve for the fiscal profit-maximizing rate of development, we differentiate with respect to each Q_{it}. Evaluated at the optimal Q^*_{it},

$$(1.15) \qquad -\frac{\partial Q_{it}}{Q_{ij}} = \frac{\partial \lambda/\partial Q_j}{\partial \lambda/\partial Q_t} =$$

$$\frac{\left[\sum_{s=1}^{T} \left((R^{e'}_{ij}(Q_{ij},s)Q_{ij} + R^e_{ij}(Q_{ij},s) - E^{e'}_{ij}(Q_{ij},s)Q_{ij} - E^e_{ij}(Q_{ij},s) \right)(1+r)^{-s} \right]}{\left[\sum_{s=1}^{T} \left((R^{e'}_{it}(Q_{it},s)Q_{it} + R^e_{it}(Q_{it},s) - E^{e'}_{it}(Q_{it},s)Q_{it} - E^e_{it}(Q_{it},s) \right)(1+r)^{-s} \right]}$$

for all $t,j = 1,\ldots,T$.

This condition requires that the marginal rates of transformation in the allocation of a particular development option over time equal the corresponding ratios of discounted local government marginal fiscal profit streams. Again, we may solve for λ, which in this case can be interpreted as the marginal fiscal profits associated with the availability of one more unit of developable land in the allocated zone. The discounted marginal fiscal profit streams must be equal across time periods in which development occurs.

Finally, we might also examine the case in which the rate of community development is set exogenously, and derive the optimal allocation of development between competing uses in each time period. The rate of

community development might be set by a preexisting growth management plan. Alternatively, bureaucratic constraints may imply that optimization over time is ignored by local decision makers. In this case, the question involves the optimal trade-off between development options in a particular period.

The constrained optimization problem here is analogous to those formulated above, although in this case the fiscal profit equation associated with a particular time period is differentiated with respect to units of each development option to obtain the optimal trade-off among those options. Evaluated at the optimal Q^*_{it}, the marginal rates of transformation across competing development options must equal the corresponding ratios of local government discounted marginal fiscal profit streams. Similarly, for those allocated uses, the discounted marginal fiscal profit streams must be equivalent.

The Developer Land-Use Decision

In this section, we examine issues related to the optimal timing of development from the perspective of the local developer. The analysis in this section is based upon assumptions that the developer:

1) develops his land in a manner consistent with the local zoning ordinance;

2) possesses the same set of information on future prices utilized by the local government in its zoning allocation decision making;

3) is risk-neutral (as are representatives of the local government);

4) is required to sell his development in the same time period as that in which construction takes place;

5) faces a perfect capital market, with a stable, risk-free interest rate ρ that reflects the market rate of discount ($\rho \neq r$).

Let us initially assume that the jurisdictional zoning allocation reflects fiscal profit-maximizing objectives. Recall that the quantity of land allocated to a particular type of development is:

$$(2.1) \qquad \overline{Q_i} = \sum_{t=1}^{T} Q_{it} \; .$$

Assume that the quantity of land $\overline{Q_i}$ is owned by a single developer and that this entails his entire land holdings. We now wish to examine the private profit-maximizing rate of development from the perspective of the developer. To allocate land development across time, the developer calculates his private return on development. Here,

$$(2.2) \qquad \Pi_i^P = \sum_{t=1}^{T} \left(\left(p_{it}^e(Q_{it},t)Q_{it} - c_{it}^e(Q_{it},t)Q_{it} \right)(1+\rho)^{-t} \right.$$

$$\left. - \sum_{s=1}^{t-1} \left(\tau V_{it}^e(Q_{it},s)Q_{it} \right)(1+\rho)^{-s} \right) \; .$$

Defining terms, let:

Π_i^P = private developer profits associated with development type i

  t = time period in which development occurs

p^e = expected per-unit price of development

  Q = units of new development

c^e = expected per-unit costs of development, including construction costs, land preparation, and the like

ρ = market discount rate

v^e = expected per-unit market value of zoned site prior to development

s = periods in which returns on land are generated

τ = property tax rate

Note that unlike the fiscal profit equation, the computation of developer profits excludes terms representing fiscal or environmental spillovers capitalized in neighboring property values and associated with the development.

To ascertain the optimal allocation of development across time, the developer considers the constrained optimization problem of

$$(2.3) \qquad \max_{\{Q_{it}\}} \Pi^P(Q_{it}, s) \quad \text{s.t.} \quad \sum_{t=1}^{T} Q_{it} = \overline{Q_i} \quad , \quad Q_{it} \geq 0 \ , \ \text{where}$$

$$(2.4) \qquad \Pi_i^P = \sum_{t=1}^{T} \left(\left(p_{it}^e(Q_{it}, t) Q_{it} - c_{it}^e(Q_{it}, t) Q_{it} \right) (1+\rho)^{-t} \right.$$

$$\left. - \sum_{s=1}^{t-1} \left(\tau v_{it}^e(Q_{it}, s) Q_{it} \right) (1+\rho)^{-s} \right) + \lambda \left[\overline{Q_i} - \sum_{t=1}^{T} Q_{it} \right] \ .$$

It follows that, evaluated at the optimal Q_{it}^* and Q_{ij}^* ,

$$(2.5) \quad - \frac{\partial Q_{it}}{\partial Q_{ij}} =$$

$$\frac{\left[\left(p_{ij}^{e'}(Q_{ij},t)Q_{ij} + p_{ij}^{e}(Q_{ij},t) - c_{ij}^{e'}(Q_{ij},t)Q_{ij} - c_{ij}^{e}(Q_{ij},t) \right)(1+\rho)^{-j} \right.}{\left[p_{it}^{e'}(Q_{it},t)Q_{it} + p_{it}^{e}(Q_{it},t) - c_{it}^{e}(Q_{it},t)Q_{it} - c_{it}^{e}(Q_{it},t) \; (1+\rho)^{-t} \right.}$$

$$\left. - \frac{\sum_{s=1}^{j-1} \left(rv_{ij}^{e'}(Q_{ij},s)Q_{ij} + rv_{ij}^{e}(Q_{ij},s) \right)(1+\rho)^{-s}}{\sum_{s=1}^{t-1} \left(rv_{it}^{e'}(Q_{it},s)Q_{it} + rv_{it}^{e}(Q_{it},s) \right)(1+\rho)^{-s}} \right] = \frac{\partial \lambda / \partial Q_{ij}}{\partial \lambda / \partial Q_{it}} \; ,$$

for all $t,j = 1,\ldots,T$.

This condition requires that the marginal rates of transformation in the development of type i over time equal the corresponding ratios of discounted developer profits.

Further, at the optimal Q_{it}^{*} ,

$$(2.6) \quad \left(p_{it}^{e'}(Q_{it},t)Q_{it} + p_{it}^{e}(Q_{it},t) - c_{it}^{e'}(Q_{it},t)Q_{t} - c_{it}^{e}(Q_{it},t) \right)(1+\rho)^{-t}$$

$$- \sum_{s=1}^{t-1} \left(rv_{it}^{e'}(Q_{it},s)Q_{it} + v_{it}^{e}(Q_{it},s) \right)(1+\rho)^{-s} = \lambda \; ,$$

for all $t = 1,\ldots,T$, where λ can be interpreted as the marginal developer profits associated with the availability of one more unit of developable land in this zone. This condition implies that:

$$
(2.7) \quad \left(p_{it}^{e'}(Q_{it},t)Q_{it} + p_{it}^{e}(Q_{it},t) - c_{it}^{e'}(Q_{it},t)Q_{it} - c_{it}^{e}(Q_{it},t) \right) (1+\rho)^{-t}
$$

$$
- \sum_{s=1}^{t-1} \left(\tau v_{it}^{e'}(Q_{it},s)Q_{it} - v_{it}^{e}(Q_{it},s) \right) (1+\rho)^{-s}
$$

$$
= \left(p_{ik}^{e'}(Q_{ik},t)Q_{ik} + p_{ik}^{e}(Q_{ik},t) - c_{ik}^{e'}(Q_{ik},t)Q_{ik} - c_{ik}^{e}(Q_{ik},t) \right) (1+\rho) \quad ,
$$

$$
- \sum_{s=1}^{k-1} \left(\tau v_{ik}^{e'}(Q_{ik},s)Q_{ik} - v_{ik}^{e}(Q_{ik},s) \right) (1+\rho)^{-k} \quad ,
$$

for all $t,k = 1,\ldots,T$. In other words, evaluated at the optimal Q_{it}^{*} for all $t = 1,\ldots,T$, the discounted developer marginal profit streams must be equivalent.

For the optimal development path of the developer to coincide with that of the local government requires, in the most general case, that:

$$
(2.8) \quad \alpha \Pi_{it}^{p'}(Q_{it},s) = \Pi_{it}'(Q_{it},s) \quad \text{for all } i = 1,\ldots,N \text{ and } t = 1,\ldots,T ,
$$

where α is some scalar, and $\Pi_{it}' = \partial\Pi_{it}/\partial Q_{it}$.

In other words, the optimal development paths coincide when

$$
(2.8) \quad \alpha \left[\sum_{s=1}^{T} \left(R_{it}^{e'}(Q_{it},s)Q_{it} - R_{it}^{e}(Q_{it},s) - E_{it}^{e'}(Q_{it},s)Q_{it} - E_{it}^{e}(Q_{it},s) \right)(1+r)^{-s} \right]
$$

$$
= \left[p_{it}^{e'}(Q_{it},t)Q_{it} + p_{it}^{e}(Q_{it},t) - c_{it}^{e'}(Q_{it},t)Q_{it} - c_{it}^{e}(Q_{it},t) \right](1+\rho)^{-t}
$$

$$
- \sum_{s=1}^{t-1} \left(\tau v_{it}^{e'}(Q_{it},s)Q_{it} + v_{it}^{e}(Q_{it},s) \right)(1+\rho)^{-s} \quad ,
$$

for all $i = 1,\ldots,N$ and $t = 1,\ldots,T$.

While developers prefer a land-use policy enabling them to maximize return on their investment, community homeowners may promote a development policy aimed at increasing residential property values. There appears little reason, a priori, why the optimal development paths of the developer and local government should coincide.

Impact of a Property-Tax Limitation

Now assume the imposition of a local government property tax limitation that has the effects of (1) imposing a ceiling on local property tax rates equal, on average, to approximately one-half their former values, and (2) approximately limiting changes in assessed valuation to changes in property ownership. Assume that changes in property ownership occur, on average, less frequently than annual assessments, and that property values are expected to continue rising in future years.

Further, let us suggest that the property tax limitation implies other major changes in state and local policy as described above. In this section, we examine these mandated and induced effects of the California property tax limitation on the optimal community and developer rates of development derived above.

In the case of local fiscal optimization for land allocated to a particular zone, recall that:

$$(3.1) \quad \Pi_i(0) = \sum_{t=1}^{T} \left[\sum_{s=1}^{T} \left(R_{it}^e(Q_{it},s)Q_{it} - E_{it}^e(Q_{it},s)Q_{it} \right)(1+r)^{-s} \right] ,$$

where:

(3.2) $\qquad R_{it}^e(Q_{it},s)Q_{it} = \tau P_{it}^e(Q_{it},s)Q_{it} + \phi_{it}^e(Q_{it},s)Q_{it}$

$\qquad\qquad\qquad + T_{it}^e(Q_{it},s)Q_{it} + F_{it}^e(Q_{it},s)Q_{it} + G_{it}^e(Q_{it},s)Q_{it}$

and

(3.3) $\quad E_{it}^e(Q_{it},s)Q_{it} = \varepsilon^e(Q_{it},s)Q_{it} + K_{it}^e(Q_{it},s)Q_{it} + S_{it}^e(Q_{it},s)Q_{it}$.

The imposition of a property-tax limitation, as discussed above, serves to set:

(1) $\tau = \bar{\tau}$, where $\bar{\tau} < \tau$, and

(2) $P_{it,s}^e = \bar{P}$, where $\bar{P} = P_{it,t}$ and $P_{it,t} < P_{it,s}^e$ for all

$\qquad\qquad\qquad$ for all $s = t + 1, \ldots, T$.

Whereas the subscript t denotes the time period in which development occurs, here the subscript s denotes a subsequent period in which revenue from this development is generated.

Furthermore, assume the induced state and local policy response to the tax limitation, as discussed above, is to set:

(3) $\phi_{it}^e(Q_{it},s) = \tilde{\phi}_{it}^e(Q_{it},s)$ where $\tilde{\phi}_{it}^e(Q_{it},s) > \phi_{it}^e(Q_{it},s)$

(4) $G_{it}^e(Q_{it},s) = \tilde{G}_{it}^e(Q_{it},s)$ where $\tilde{G}_{it}^e(Q_{it},s) > G_{it}^e(Q_{it},s)$

(5) $S_{it}^e(Q_{it},s) = \hat{S}_{it}^e(Q_{it},s)$ where $\hat{S}_{it}^e(Q_{it},s) < S_{it}^e(Q_{it},s)$

(6) $K_{it}^e(Q_{it},s) = \hat{K}_{it}^e(Q_{it},s)$ where $\hat{K}_{it}^e(Q_{it},s) < K_{it}^e(Q_{it},s)$

At the initial allocation, prior to the imposition of the property-tax limitation,

(3.4) $\qquad \Pi'_{it}(0) = \Pi'_{ik}(0)$ for all $t,k = 1,\ldots,T$.

The impact of the property-tax limitation on marginal profitability of development, at the initial allocation, is represented by $\delta'_{it}(0)$, where the subscript ℓ represents the fiscal limitation, and

(3.5) $\qquad \delta'_{it}(0) = \Pi'_{it}(0) - \Pi'_{it}(0)_{\ell}$.

(3.6) $\qquad \delta'_{it}(0)_{\ell} \gtrless \delta'_{ik}(0)_{\ell}$ implies that

(3.7) $\qquad \Pi'_{it}(0)_{\ell} \lessgtr \Pi'_{ik}(0)_{\ell}$ for all $t,k = 1,\ldots,T$.

In the case where $t = 1,2$, if the imposition of a tax limitation results in $\Pi'_{i1}(0)_{\ell} \lessgtr \Pi'_{i2}(0)_{\ell}$ at the initial allocation, then development will be reallocated across time such that, at the post-fiscal limitation equilibrium,

(3.8) $\quad Q^*_{i1} \gtrless Q^*_{i1,\ell}$ and $Q^*_{i2} \lessgtr Q^*_{i2,\ell}$ for $\overline{Q_i} = Q^*_{i1} + Q^*_{i2}$.

The case of $t = 1,2$, the impact of a tax limitation on the optimal rate of development, where $\Pi'_{i1}(0)_{\ell} < \Pi'_{i2}(0)_{\ell}$, is shown in Figure 1.

FIGURE 1
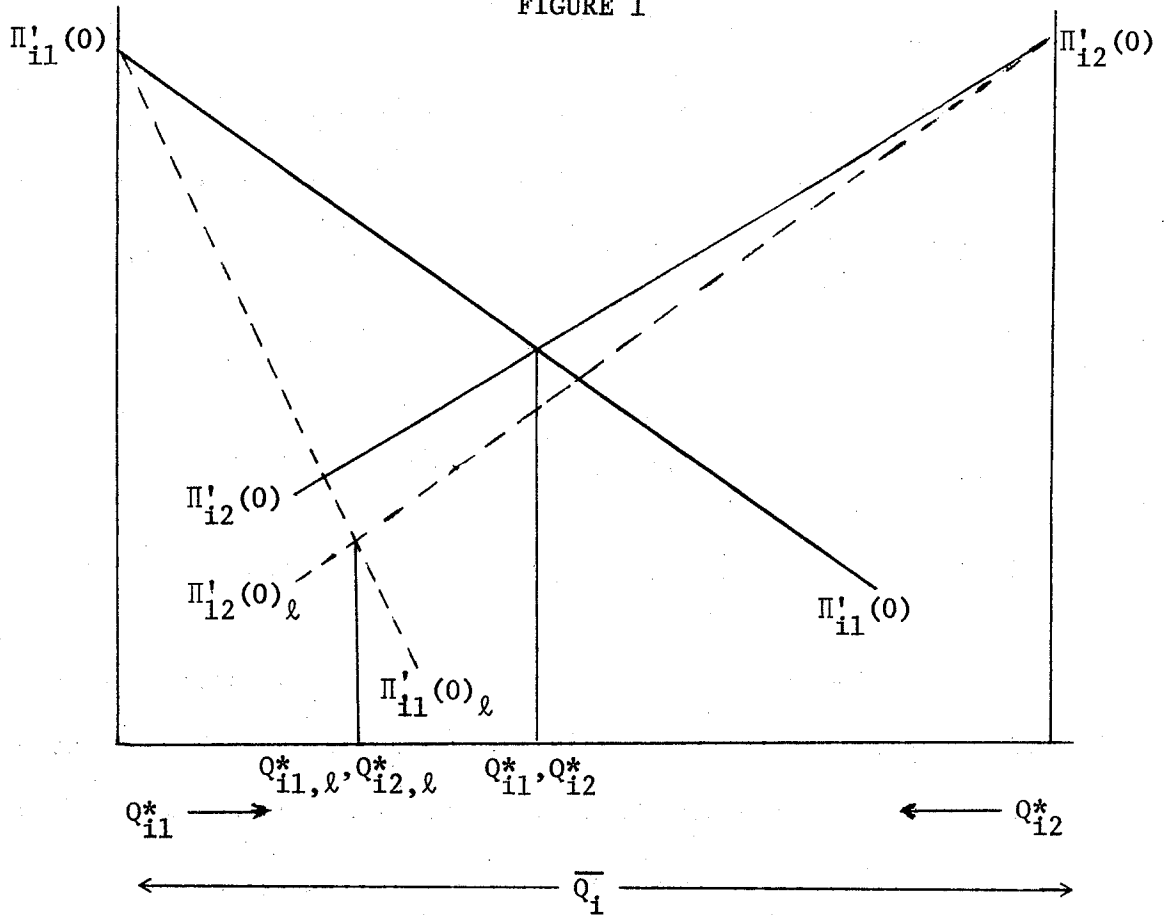
The local representative may attempt to defer development in the case where the discounted marginal returns on development "today" fall, relative to those expected "tomorrow."

Fiscal profit maximization implies that, at the post-property tax limitation allocation,

$$(3.9) \qquad \Pi'_{it}(0)_\ell = \Pi'_{ik}(0)_\ell \qquad \text{for all} \quad t,k = 1,\ldots,T \ .$$

Assume that the individual developer faces certain relevent property tax limitation mandated and induced effects described above.

Here we examine the impact of the fiscal limitation on the optimal private developer rate of development.

$$(3.10) \quad \Pi_i^{p'}(0) =$$

$$\left[P_{it}^{e'}(Q_{it}, t)Q_{it} + P_{it}^{e}(Q_{it}, t) - C_{it}^{e'}(Q_{it}, t)Q_{it} - C_{it}^{e}(Q_{it}, t) \right] (1+\rho)^{-t}$$

$$- \sum_{s=1}^{t-1} \left(\tau V_{it}^{e'}(Q_{it}, s)Q_{it} + \tau V_{it}^{e}(Q_{it}, s) \right) (1+\rho)^{-s} \ .$$

Here, the imposition of a property-tax limitation, including induced effects, is to set:

(1) $\tau = \bar{\tau}$ where $\bar{\tau} < \tau$

(2) $V_{it,s}^{e} = \bar{V}$ where $\bar{V} = V_{it,t}^{e}$ and $V_{it,t}^{e} < V_{it,s}^{e}$ for all $s = t+1, \ldots, T$

(3) $C_{it}^{e}(Q_{it}, t) = \tilde{C}_{it}^{e}(Q_{it}, t)$ where $\tilde{C}_{it}^{e}(Q_{it}, t) > C_{it}^{e}(Q_{it}, t)$,

$$\text{since} \quad \tilde{\phi}_{it}^{e}(Q_{it}, s) > \phi_{it}^{e}(Q_{it}, s) \ .$$

Similarly, at the initial developer allocation, prior to the imposition of the property-tax limitation:

$$(3.11) \qquad \Pi_{it}^{p'}(0) = \Pi_{ik}^{p'}(0) \quad \text{for all} \quad t,k = 1, \ldots, T \ .$$

The impact of the property-tax limitation on developer marginal profitability of development, at the initial allocation, is represented as $\psi_{it}'(0)$, where the subscript ℓ represents the fiscal limitation, and

$$(3.12) \quad \psi_{it}'(0) = \Pi_{it}^{p'}(0) - \Pi_{it}^{p'}(0)_\ell$$

$$= \left(\left(\tilde{c}_{it}^{e}(Q_{it}) - c_{it}^{e}(Q_{it}) \right) Q_{it} \right) (1+\rho)^{-t}$$

$$- \sum_{s=1}^{t-1} \left[(\tau-\bar{\tau}) \left(\left(v_{it}^{e'}(Q_{it},s) - \bar{v}_{it}^{e'}(Q_{it},s) \right) Q_{it} \right) \right.$$

$$\left. + (\tau - \bar{\tau}) \left(v_{it}^{e}(Q_{it},s) - \bar{v}_{it}^{e}(Q_{it},s) \right) \right] (1+\rho)^{-s} .$$

$$(3.13) \quad\quad\quad \psi_{it}'(0) \gtrless \psi_{ik}'(0) \quad \text{implies that}$$

$$(3.14) \quad\quad \Pi_{it}^{p'}(0)_\ell \lessgtr \Pi_{ik}^{p'}(0)_\ell \quad \text{for all} \quad t,k = 1,\ldots,T .$$

Similar to the local government case described above, if the imposition of a fiscal limitation results in $\Pi_{it}^{p'}(0) \gtrless \Pi_{ik}^{p'}(0)_\ell$ at the initial allocation, then the profit-maximizing developer will adjust his development path so as to eliminate this inequality. At the subsequent post-fiscal limitation equilibrium, discounted marginal returns from development are equal across time.

V. SUMMARY AND CONCLUSION

This paper has presented an approach to the modeling of local government land-use allocation. After illuminating shortcomings of previous modeling efforts, background and key features of a dynamic fiscal zoning model are described, including evaluation of a property tax limitation. On this basis, a formal model of local government land-use allocation is presented.

It has been shown that, in the case of community fiscal dividend maximization, development is allocated across competing uses and time periods, so as to equilibrate the discounted marginal fiscal profit streams. A sufficient condition for community fiscal zoning and private builder rates of development to coincide, in general, is that their respective marginal discounted profit streams are separated only by a multiplicative scalar. Differences in both discount rate and relevant effects, however, make such coincidence of optimal rates unlikely. Divergence in preferred land-use allocation implies potential conflict in local development policy, in which the outcomes reflect in part the distribution of political influence between community exclusionary and developer interests.

Mandated impacts of the California property tax limitation may provide incentives for deferral of local development. The fiscal optimization model suggests that deferral occurs when the discounted marginal fiscal profit associated with development "today" falls, relative to that in future periods. Given the effects of Proposition 13, strong

incentives for deferral of development exist in those communities where expected future property value increases are the greatest.

Community development optimization is not presented here as a normative goal of local public policy. Yet, in California, diminished internal redistribution and atomistic fiscal zoning policies have become increasingly prevalent among suburban governments. In this regard, the study of various characterizations of community fiscal zoning policy, including positive implications thereof, becomes increasingly important to the understanding of local government response in the wake of fiscal limitation.

Forthcoming research by the author undertakes empirical application of the modeling contained herein. Specific functional forms are attached to the local government revenue and expenditure components, and comparative statics derivatives are evaluated. Using a sample of fifty-five jurisdictions in the San Francisco Bay Area, and based upon these a priori notions, various regression equations test hypotheses of the fiscal optimization model and impacts of California's property tax limitation.

BIBLIOGRAPHY

Bahl, R. H. 1968. "A Land Speculation Model: The Role of Property Tax
as a Constraint to Urban Sprawl." *Journal of Regional Science* 5:
199-208.

Cal-Tax Research Bulletin. 1978. "Local Government Profile." November.

Gabriel, Stuart; Katz, Lawrence; and Wolch, Jennifer. 1979. "Local
Land-Use Regulation and Proposition 13: Some Findings from a Re-
cent Survey." Working Paper No. 80-4, Program in Real Estate and
Urban Economics, Institute of Business and Economic Research, Uni-
versity of California, Berkeley.

_____. 1980. "Local Land-Use Regulation and Proposition 13." *Tax-
ing and Spending* 3: 73-81.

Hamilton, B. 1975. "Zoning and Property Taxation in a System of Local
Governments." *Urban Studies* 12: 205-211.

Markusen, J. R., and Scheffman, D. T. 1978. "The Timing of Residential
Land Development: A General Equilibrium Approach." *Journal of
Urban Economics* 5: 411-424.

Portney, P., and Sonstelie, J. 1978. "Profit Maximizing Communities
and the Theory of Local Public Expenditures." *Journal of Urban
Economics* 5: 263-277.

Shoup, D. C. 1970. "The Optimal Timing of Urban Land Development."
Papers of the Regional Science Association 25: 33-44.

Weinstein, M., and Zeekhauser, R. 1975. "The Optimal Consumption of
Depletable Natural Resources." *Quarterly Journal of Economics*
371-392.

White, M. 1975. "Fiscal Zoning in Fragmented Metropolitan Areas." In *Fiscal Zoning and Land-Use Controls*. Edited by E. Mills and W. Oates. Lexington, Mass.: Heath-Lexington.

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