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ECONOMIC ANALYSIS OF RESIDENTIAL LAND-USE ALTERNATIVES

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INTRODUCTION

In recent years, land-use control has become a primary issue in many political arenas. It is important to the voters because changes in land use may have a significant impact on the health, safety, environment, and quality of life of the inhabitants in their community. It is important to local and state governments because land-use control has a significant impact on economic growth and on the services that may be provided. Thus, land-use bills have been proposed in many state legislatures and in Congress.

Until recently, land-use regulation was not a major issue because good quality land was most often readily available and the cost of land was not a significant part of the total cost of development. However, with increases in population, increased mobility, and the shift from an industrial economy to a service-oriented economy, land has become a more important factor in economic development. The demand for land in growth-oriented communities has driven real estate prices to unprecedented highs.

Counteractive to relentless development, however, has been the powerful currents of social change. More and more people are beginning to question the value of uncontrolled growth in terms of its economic, social, and environmental implications. Many new public and private development programs have been stopped by active citizens groups exerting pressures on local government officials or through court intervention. Thus, the success of government services programs that require continued and adequate funding, which depends on increased revenue generated from economic growth, has been jeopardized.

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Obviously, the role of land in economic development is a more involved issue than this brief presentation suggests but it should be recognized that land-use control has very important economic implications.

Land-use regulations control what is to be built, where it is to be built, and the scale and shape of any development. Thus, it shapes the growth of a region and creates an economic caste for each land-use category identified in the land-use regulations. This economic caste created by land-use regulation must be considered in designing the regulations. If the economic implications of land-use control are not recognized by both the voters and legislators, land-use control may lead to nonoptimum growth rates and other consequences associated with poor planning. Thus, identifying the benefits and costs of different land uses is a first step in the design of effective land-use regulations and is necessary to assess the impact of future development patterns.

For the past 50 yr, zoning has been a primary technique for regulating land use. In many areas, zoning became an effective technique for protecting single-family residential neighborhoods, thus limiting the growth of alternate forms of residential housing. In the past few decades, the demand for apartments has increased at a higher rate than the demand for single-family detached dwelling units; and recently planned unit developments have been proposed as an economically efficient form of residential housing. The growth of these alternate forms of residential land use has required modification of existing zoning ordinances, often after considerable debate and to the dissatisfaction of many. Much of the debate over zoning for the alternate forms of residential land use appears to stem from the lack of data on the benefits and costs of these different housing forms.

The study reported herein examines the benefits and costs to local governments of two types of residential development: (1) Single-family detached dwelling units; and (2) apartment complexes. Such information may be of value to voters, legislators, and planning agencies.

STUDY AREAS

Several studies have been conducted recently to identify the benefits and costs of various forms of residential housing (1,2,3). Although all such studies do not have identical objectives, the information collected as part of these reports provides a valuable data base for planners and developers.

The data obtained for this study were collected in Frederick County, Maryland, which is within commuting distance from both Baltimore, Md., and Washington, D.C. Since Frederick County has been subjected to rapid increases in population and other developmental pressures resulting from its proximity to these large urban areas, it is quite interested in the benefits and costs of differential residential land-use alternatives. The four developments in Frederick County chosen for this study were: (1) Cloverhill.—A single-family detached dwelling development located approx 1 mile north of Frederick, Md., on Yellow Springs Road; (2) Sugarloaf Estates.—A single-family detached dwelling development located approx 2 miles west of Urbana, Md., on Rhoderick Road; (3) College Estates.—An apartment complex located on Taney Avenue in Frederick, Md., and (4) Dietrick Plaza.—An apartment complex located near Fort Dietrick in Frederick, Md.

ECONOMIC ANALYSIS

Benefits.—Direct benefits were considered to be the sum of the following three sources: (1) Personal income tax; (2) property and real estate taxes; and (3) miscellaneous revenues.

Revenue from personal income tax equals 50% of the Maryland State Personal Income Tax. Individual tax returns were not available for review but estimates of total income were obtained through interviews. Therefore, the revenue from income tax was computed using the standard deduction method for Maryland. Taxable income per household was found by taking a standard deduction per household of \$2,000 and a per capita deduction of \$750 from the total household income. The total state tax is 2% of the first \$1,000 of taxable income plus 3% of the second \$1,000 of taxable income plus 4% of the third \$1,000 of taxable income and 5% of all taxable income above \$3,000. The county tax equals 50% of the computed state tax.

Property and real estate tax revenue is based on a rate of \$2.54/\$100 of the assessed value of the lot and improvements. The assessed value in Frederick County is approximately equal to 60% of the fair market value. The assessed value of each dwelling unit was available through the county assessors' office, and used in computing property and real estate revenue.

Miscellaneous revenues were those revenues other than income and property and real estate taxes and thus, included state and Federal grants, licenses, fees, etc. Miscellaneous revenue per household was taken as the average miscellaneous revenue per capita for the county times the number of individuals in each household.

Costs.—Since the cost of education often represents more than 50% of the total budget, costs were computed as either (1) Educational costs; or (2) noneducational costs. The county education costs were allocated on a cost per pupil basis, the total education budget divided by the number of children in public schools. Thus, the educational cost per household was a function of the number of school children in that household.

Noneducation costs were allocated on a per capita basis, the total noneducational costs divided by the total county population. Total noneducation cost per household was, therefore, dependent upon the number of inhabitants per dwelling.

Results.—Calculation of benefits and costs requires the average number of occupants per household for each size and form of residential housing unit. Table 1 provides the average number of inhabitants and the average number of students in public school for each type of housing and number of bedrooms. Data from the Anne Arundel study (1) are also provided in Table 1 as a basis for comparison. Where comparison between the two studies are possible, the average values are not statistically different at the 5% level of significance. Thus, the results of this study appear to be representative of typical suburban developments and may, therefore, be transferable.

Revenue from personal income tax requires estimates of the annual income and the number of inhabitants per household. The average income for each of the four developments included in this study is given in Table 2. The procedure for computing the benefits given previously was used with all available sample data to compute the revenue from personal income taxes. The average benefits

TABLE 1.—Inhabitants and Students per Dwelling Unit

Location (1)	Housing type (2)	Number of bedrooms (3)	Number of units in survey (4)	Average number of inhabitants (5)	Average number of students in public schools (6)
Frederick County	Single-family	2	1	3.000	1.000
		3	48	3.250	0.750
		4	31	4.613	1.581
		5	4	<u>7.000</u>	<u>2.500</u>
			84	3.929	1.143
Anne Arundel ^a County	Single-family	1	1	2.00	0.00
		2	28	2.21	0.17
		3	479	3.53	0.91
		4	268	4.37	1.44
		5	45	5.64	2.17
		6	5	<u>6.20</u>	<u>2.60</u>
			826	3.88	1.13
Frederick County	Apartment	1	17	1.706	0.059
		2	35	<u>2.743</u>	<u>0.257</u>
			52	2.404	0.192
Anne Arundel ^a County	Apartment	Efficiency	22	1.09	0.00
		1	376	1.56	0.00
		1 + Den	53	1.71	0.01
		2	572	2.44	0.24
		2 + Den	77	2.80	0.45
		3	<u>203</u>	<u>4.00</u>	<u>1.57</u>
			1,303	2.39	0.38

^aData for Anne Arundel County obtained from Ref. 1.

TABLE 2.—Benefit-Cost Analysis

Develop- ment (1)	Average ^a income (2)	Average ^b assessed value (3)	Average benefits for household (4)	Average costs per household (5)	Benefit- cost ratio (6)	Number of ^c dwelling units (7)
Cloverhill	22,062.50	19,281.56	1,178.74	1,100.57	1.07	32
Sugarloaf	17,725.81	19,831.94	1,071.08	934.18	1.15	31
College Es- tates	12,459.09	10,795.70	656.04	502.92	1.30	22
Dietrick Plaza	13,340.00	13,682.00	729.14	218.97	3.33	30

^a1973 income per household.

^b1973 assessment at \$2.54/\$100 of assessed value.

^cSample sizes reduced due to lack of income data for each household.

per household, of which the revenue from personal income tax is part, are also given in Table 2.

Calculation of the revenue from property and real estate taxes requires the assessed value of the property. The average assessed value is also given in Table 2 for each of the four developments. The revenue from property and real estate taxes is included as part of the average revenue given in Table 2.

The average cost per household was computed as the sum of the education costs and noneducation costs. In Frederick County, the education portion represents approx 65% of the annual budget. Thus, the average cost is very sensitive to the number of children in the household. The average cost for the single-family dwellings was \$1,018.69 while for the two apartment complexes the average cost was \$339.10. This difference in average cost was expected since the average number of students per single-family resident was almost six times greater than for apartment dwellings.

The computed benefits and costs were used to obtain estimates of the benefit-cost ratios for the two residential housing alternatives. The average benefit-cost ratio for the two residential developments was 1.11 while an average value of 2.47 was obtained for the two apartment complexes. The average benefit-cost ratio for the apartments is high because one complex contains an unusually high number of one and two-bedroom units and the occupants are predominantly single people. But since the ratios for both apartments are higher than those for the single-family detached dwelling units, it is suggested that the return from apartment complexes is at least as great as the return from single-family detached dwelling units. In the past, local governments have questioned the economic feasibility of apartment housing. Thus, there was a tendency to refrain from zoning for multifamily dwelling. But with changes in life styles and thus demand, multifamily housing appears to be a sound investment alternative for local governments.

Using the benefit and cost figures from the Anne Arundel County study (1), average benefit-cost ratios of 0.843 and 1.737 were computed for single-family residential developments and multifamily apartment developments, respectively. The average ratios for Anne Arundel County are slightly lower than those computed for the Frederick County Study reported herein because in the Anne Arundel study miscellaneous revenues were not considered in estimating the benefits. In Frederick County, miscellaneous revenues account for approx 25% of the total county revenue. If the benefits for Anne Arundel County were increased 25%, the benefit-cost ratios would be 1.06 and 2.17, respectively, for single-family detached units and apartments. These compare favorably with those reported herein for the Frederick County data.

RELATIVE IMPORTANCE OF FACTORS AFFECTING BENEFIT-COST RATIO

The relative sensitivity of the benefit-cost ratio with respect to change in a factor that influences the ratio is a useful measure of the relative importance of that factor. Relative sensitivity R_s is defined as the percentage change in the benefit-cost ratio that results from a 1% change in the factor; it can be estimated using the following finite difference approximation (4):

$$R_s = \frac{\frac{\Delta BCR}{BCR}}{\frac{\Delta F}{F}} = \frac{\Delta BCR}{\Delta F} \frac{F}{BCR} \dots \dots \dots (1)$$

in which F is the causative factor; BCR = the benefit-cost ratio; and ΔF and ΔBCR are the incremental changes in F and BCR , respectively. While the magnitude of the relative sensitivity indicates the relative importance of the factor, the sign of the relative sensitivity indicates the direction of change, i.e., a negative R_s indicates that a positive change in F will be accompanied by a negative change in BCR .

The relative importance of factors that influence the benefit-cost ratio would be of interest to local governments because it may be used in selecting the most economical planning alternative and so that the change in a factor required to achieve a desired change in the benefits can be estimated. For example, the relative sensitivity of the benefit-cost ratio to the property tax assessment rate could be used to estimate the effect of changes in the property tax assessment rate on benefits. As part of this study, the relative sensitivity of the benefit-cost ratio was computed for the following four factors: (1) The property tax assessment rate; (2) the average income per household; (3) the average number of school children per dwelling unit; and (4) the average number of inhabitants per dwelling.

Property Tax Assessment Rate.—The relative sensitivity of the benefit-cost ratio to a change in the property tax assessment rate was calculated to be 0.52 for single-family detached dwelling units and 0.40 for apartment complexes. In other words, a positive change of 10% in the assessment rate would increase the benefit-cost ratio by 5.2% for single-family residences and 4.8% for apartment complexes. A change in the assessment rate has a greater effect on the BCR for single-family residences because revenue from single-family residences is more dependent upon the assessment rate and because a single-family housing unit has a higher assessed value than one living unit of an apartment complex.

Average Income.—A 10% increase in total income per dwelling would result in a 3.5% and 5.5% increase in BCR for single-family units and apartment units, respectively. Revenue from income tax is obviously affected by the number of standard deductions. A higher average number of inhabitants was found for the single-family residences. The higher number of deductions serves as a buffer and thus, the benefit-cost ratio is less sensitive to changes in income for single-family residences.

Average Number of School Children.—Because a large portion of Frederick County's Annual Budget is designated for the educational system the benefit-cost ratio should be highly sensitive to the number of school children per dwelling. Computed relative sensitivities indicate that a 10% increase in the average number of public school children per dwelling caused a 7.0% change in the BCR for single-family residences and 2.9% change for apartment complexes. Increases in the number of school children has a two-fold effect, i.e., costs increase with increases in the number of school children per household and revenues decrease because of the number of income tax deductions. Since apartment complexes have a lower number of school children per household, BCR is less sensitive for apartment units.

Average Number of Total Inhabitants.—Although there appeared to be some correlation between the number of inhabitants and school children per dwelling, the relative sensitivities for the average number of total inhabitants are somewhat different. Specifically, a 10% increase in the number of inhabitants per dwelling would cause a decrease in the BCR of 1.7% and 4.4%, respectively, for single-family and apartment complexes. In apartment complexes, a lower proportion of the total number of inhabitants per dwelling attend public schools (i.e., a higher proportion of preschool children, working individuals and retirees) than for single-family residences. Therefore, the BCR for single-family dwellings would be less sensitive to changes in total inhabitants than changes in the average number of school children. With the smaller proportion of school children in apartment units, the BCR for apartments is less sensitive to changes in school children than total inhabitants.

SUMMARY AND CONCLUSIONS

As indicated previously, land-use regulations, such as zoning, have important economic implications. In order for land-use controls to be effective in regulating growth, the economic implications of land-use controls must be recognized, understood, and quantitatively identified. The study reported herein provides insight into the benefits and costs associated with two forms of residential housing. It appears that investment in apartment complexes may be an economically feasible housing alternative for local governments. The development of apartment complexes can provide revenue to sustain existing county services and to initiate new programs. These economical implications should be a factor when establishing land use regulations.

Multifamily housing provides other advantages that must also be considered in establishing land-use regulations. Specifically, multifamily housing requires less land per dwelling unit, and thus, the rapid conversion of prime agricultural land to land for urban uses that is taking place near many metropolitan areas can be moderated. This will slow the rate of growth of taxes on land and thus reduce the tax burden on farmers. Other important advantages of multifamily housing have been examined by McCuen and Piper (5).

By themselves, the benefit-cost ratios are inadequate for establishing land-use regulations. Planners should also have some knowledge of the effect of various benefit and cost factors on the benefit-cost ratio. A sensitivity analysis of various factors that influence the benefit-cost ratio can be used to assess their relative importance.

The relative sensitivity of the benefit-cost ratio was examined for four factors: (1) Property tax assessment rate; (2) the average income per household; (3) the average number of school children per dwelling unit; and (4) the average number of inhabitants per dwelling. The relative sensitivity of the assessment rate may be useful in examining the economic effect of proposed changes in the assessment rate. However, except for the assessment rate, local governments do not have direct control of the four factors used. But the relative sensitivities of these three factors may be useful for other local planning decisions. Specifically, the economic effect of population and of the decline in the birthrate over a period of years may be of value in developing planning projections and proposed land-use maps.

APPENDIX.—REFERENCES

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KEY WORDS: **Benefit cost analysis; Buildings (residential); Economic analysis; Housing; Land use; Regional planning; Sensitivity analysis; Taxes; Urban development**

ABSTRACT: To establish optimum land-use policies, it is important that local planners understand the economic implications of various land-use alternatives. Data were collected for two alternative forms of residential housing, single-family detached homes and apartment complexes in Frederick County, Maryland. A benefit-cost analysis was performed to determine the relative profitability of these housing forms in Frederick County. The results compared favorably to a similar study conducted in Anne Arundel County, Maryland. Additionally, sensitivity analyses were performed to determine the relative importance of factors affecting the benefit-cost ratio. These factors included (1) The property tax assessment rate; (2) the average household income; (3) the average number of school children per dwelling; and (4) the average number of inhabitants per dwelling.

REFERENCE: Curtis, David C., and McCuen, Richard H., "Economic Analysis of Residential Land-Use Alternatives," *Journal of the Urban Planning and Development Division*, ASCE, Vol. 101, No. UP2, Proc. Paper 11678, November, 1975, pp. 109-116