Analysis of an Agricultural Land Zoning Program: Frederick County, Maryland

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Logit analysis is used to evaluate the performance of the zoning body in Frederick County, Maryland, in terms of its statutory policy objectives. Models are formulated to test the hypothesis that the rezoning process is consistent with the guidelines specified in the County Zoning Ordinance. An analysis of 59 requests for rezoning from agricultural to other uses indicates that, in general, both the Planning Commission staff and the County Commissioners conform to the Ordinance. At the Commissioners' level, a development bias in favor of industrial use was found. The methodology may also be used to forecast the probability a particular rezoning request would be approved.

Numerous programs have been proposed or implemented in several states that seek to restrict the conversion of agricultural land to nonagricultural uses. These include agricultural zoning, current-use taxation, transfer of development rights (TDR) and purchase of development rights (PDR). Although zoning appears to be the most direct approach to the problem of agricultural land conversion it may be criticized because: (1) zoning is unlikely to bring about an efficient allocation of land among its various uses since use decisions are made by a local planning body, not a market mechanism (see for example, Wolfram) and (2) zoning decisions tend to be strongly influenced by interest group pressure. These criticisms have led many economists and policymakers to reject zoning in favor of more market oriented programs (PFR and TDR). Zoning remains, however, the most prevalent form of land-use control in the U.S. (Coughlin and Keene).

Most zoning programs are based on the Standard State Zoning Enabling Act, first published in 1924 by the Department of Commerce (Roberts). A typical program is composed of an ordinance and zoning map, an administrating body, an appeals process and a provision for systematic review of the ordinance itself. The ordinance, as enacted by the local government, divides the region into zones and defines the permissible uses for each zone.

If it is assumed that the ordinance reflects the preferences of society, the success of a zoning program becomes a function of the adminisrators' adherence to the precepts of the ordinance. The objective of this paper is to develop and apply a methodology for evaluating the performance of a rezoning process in terms of its statutory policy. Frederick County, Maryland, is chosen to represent a typical rural county concerned with the loss of farmland. Logit analysis is employed to express the probability that a given parcel will be rezoned in terms of the owner's intention and the characteristics of the parcel. The findings are used to compare the rezoning process in Frederick County with policy goals stated in the Frederick County Zoning Ordinance. The logit models may also be used to forecast the probability a particular rezoning request will be approved.

Background

Frederick County lies to the northwest of the Washington, D.C. Metropolitan Area. The 663 square-mile county has a population of 114,792 and was classified in the 1980 Census as 61.4 percent rural. The main agricultural products are dairy, livestock, corn and hay. Zoning of agricultural land was first implemented in 1959 when 66 percent of the

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county was zoned as an agricultural district. The current Comprehensive Plan was revised in 1972 and was scheduled for further revision in 1982.

Frederick County's Comprehensive Plan defines six land-use zoning Districts. Those examined in this paper are Agricultural, Commercial, Industrial and Residential. As stated in the Zoning Ordinance, "the purpose of the Agricultural Zoning District is to preserve productive agricultural land, preserve the character and quality of the rural environment, and prevent urbanization where roads and other public facilities are scaled to meet only rural needs." The Commercial Zoning Districts are to provide sufficient convenient locations throughout the County for commercial uses that serve the needs of local areas, the larger community land and region. Industrial Zoning Districts are to provide suitable sites for development of industrial uses that would supply employment opportunities for the County. Residential Density Zoning Districts are to promote a healthful and convenient distribution of population with sufficient densities to maintain a high standard of physical design and community service.

The rezoning process allows for liberal interpretation and an extensive, although little used, appeals process. The terms of the Ordinance are themselves to be liberally construed and applied to promote underlying purposes and policies. Upon receipt of an application for change in zoning, the Planning Commission staff prepares an investigative report, including recommendations. The planning Commission (chaired by a County Commissioner with members selected by the County Commission) holds a public hearing on the proposed amendment and makes a recommendation to the County Commission. The County Commission also holds a public hearing before making its decision to approve or disapprove the application. Appeal of the decision may be made to the Board of Appeals, in which case the County Commissioners may appeal the ruling of the Board of Appeals to the Circuit Court of Frederick County. The appeals procedure may continue through the Court of Special Appeals of Maryland or to the Court of Appeals of Maryland. An examination of zoning commission records found that between 1959 and 1981, only 4 out of 205 applications for rezoning from agricultural land had been appealed to the courts.

The County Commissioners are directed to consider the following factors in making a rezoning decision: population change, availability of public facilities, present and future transportation patterns, compatibility with existing and proposed development in the area, the recommendation of the Planning Commission and the relationship of the proposed amendment to the jurisdiction's plan. The basis for a change in zoning is to be either an original error in classification or a change in neighborhood in terms of the considerations mentioned.

Methodology

Available staff reports for rezoning applications received by the Frederick County Planning Commission between 1959 and 1981 were examined. Due to greater completeness of more recent reports and the scheduling for revision of the 1972 Comprehensive Plan in 1982, 1972–1981 was selected as the appropriate period of study. During this period, fifty-nine rezoning requests were received, and forty-three were approved by the County Commissioners.[1] The Planning Commission staff had recommended approval for approximately one-half of the fifty-nine cases.

Variables and proxy variables were selected from the fifty-nine reports based on their importance in the rezoning process as specified in the 1977 Frederick County Zoning Ordinance. These variables were: decision of County Commission, recommendation of Planning Commission staff, type of change, size, conformance with Comprehensive Plan, planning region, adequacy of school capacity, distance to fire and rescue service facility, availability of water service, availability of sewer service, compatibility with neighborhood zoning, compatibility with adjacent zoning, volume of traffic, road frontage, travel distance to federal highway, percentage within floodplain and angle of slopes.

The next step involved the development of models to predict the outcomes of rezoning decisions. The above set of variables was reduced to the following for use in empirical estimation: the final decision of the county commission (yes = 1, no = 0), the recommendation of the Planning Commission staff

[1] All requests considered involved rezoning from agricultural to residential, commercial or industrial use. Also, only uncontested decisions were examined, i.e., decisions that were not subsequently appealed.

(yes = 1, no = 0), size in acres, conformity to Comprehensive Plan (yes = 1, no = 0), rezoning to commercial use (yes = 1, no = 0), rezoning to industrial use (yes = 1, no = 0), compatibility wih neighborhood zoning (yes = 1, no = 0), and compatibility with adjacent zoning (yes = 1, no = 0).[2] These variables were believed adequately to capture the spirit of the Zoning Ordinance while allowing for the testing of consistency of rezoning decisions with statutory intent.

Under the null hypothesis that both the Planning Commission staff and County Commissioners adhere to the Zoning Ordinance, their decisions should be negatively related to size in acres (the larger the parcel the greater the marginal impact on the agricultural land base) and positively related to compatibility with Comprehensive Plan, neighborhood zoning and adjacent zoning. The commissioners are directed to consider the recommendation of the Planning Commission, so their decision should be positively related to the Planning Commission's recommendation. The type of rezoning request (commercial or industrial) was included to detect a possible development bias *vis-à-vis* residential use.

Logit regression (Pindyck and Rubinfeld) was used to estimate models for determining the probability of staff approval and of the commissioners' final decision. Statistical analyses were conducted to test the qualitative restrictions imposed by the null hypothesis. Regression equations were accepted if the variables included were each significant at the .1 level for the two-tailed t-test. The .1 level of significnce was selected *a priori*. Further discrimination between accepted models was conducted on the basis of likelihood ratio tests.[3] A model with more explanatory variables, i.e., a less restricted model, was preferred if the improvement was significant at the .1 level.

Models of the Planning Commission Staff's Recommendation

Using the statistical selection procedure described above, two models were accepted for predicting the recommendation of the Planning Commission Staff

$$(A.1)\quad P = 1/(1 + e^{-(-.94 - .021X_1 + 3.15X_2 + 1.45X_7)})$$

$$(A.2)\quad P = 1/(1 + e^{-(1.10 - 2.35X_6 + 1.95X_7)})$$

where P is the probability that the staff would recommend approval,[4] X_1 is the size in acres, X_2 is conformity to Comprehensive Plan, X_6 is compatibility with neighborhood zoning and X_7 is compatibility with adjacent zoning. Using model A-1, an average-size parcel would be favorably recommended for rezoning with a 93 percent probability, if adjacent zoning is compatible and the request is in conformance with the Comprehensive Plan. If there is compatibility with adjacent and neighboring zoning, the probability generated by model A-2 would be 67 percent. Simulated probabilities of the Planning Commission staff's recommendation for hypothetical parcels are presented in Table 1.

All estimated coefficients in the two models have the sign anticipated under the null hypothesis, except for compatibility with neighborhood zoning (A-2). The negative sign for this coefficient, coupled with the positive

Table 1. Simulated Probabilities of Planning Commission Staff's Recommendation

Model[b]	Variables[a] X_1	X_2	X_6	X_7	Probability of Approval
A-1	0.5	1	—	1	.97
	0.5	1	—	0	.90
	0.5	0	—	1	.62
	0.5	0	—	0	.28
	55.4	1	—	1	.93
	55.4	1	—	0	.75
	55.4	0	—	1	.35
	55.4	0	—	0	.11
	208.9	1	—	1	.35
	208.9	1	—	0	.11
	208.9	0	—	1	.02
	208.9	0	—	0	.01
A-2	—	—	1	1	.67
	—	—	1	0	.22
	—	—	0	1	.95
	—	—	0	0	.75

[a] X_1, size in acres; X_2, conformity to Comprehensive Plan; X_6, compatibility with neighborhood zoning; X_7, compatibility with adjacent zoning.

[b] The minimum size of sampled parcels is 0.5 acres, the mean size is 55.4 acres and the maximum size is 208.9 acres.

[2] If any adjacent or neighborhood (square-mile area with site at center) parcel is zoned for the same use as the proposed change, the rezoning application is defined to be compatible with adjacent or neighborhood zoning, respectively.

[3] Using the ratio of the maximum values of the likelihood functions for the restricted model and the unrestricted model estimated for identical samples, a statistic may be computed: $-2 \ln (L_R/L_u)$. This can be reduced to $-2 (\ln L_R - \ln L_u)$. The resulting statistic is asymptotically distributed chi-square with the number of degrees of freedom equal to the number of restrictions tested.

[4] The t ratios for the coefficients of X_1, X_2, X_7 in (A.1) and X_6, X_7 in (A.2) are, respectively, −2.00, 3.37. 1.72, −1.83 and 2.88.

coefficient for compatibility with adjacent zoning could indicate a desire to encourage neighborhood diversity or to discourage congestion. The Planning Commission was not found to be influenced by the type of rezoning request (industrial, commercial or residential).

Models of the Board of County Commissioners' Decision

Two models were selected for predicting the County Commissioner's decision. The first was:

$$(B.1) \quad P = 1/(1 + e^{-(1.14 - .02X_1 + 1.56X_2 + 2.44X_5)})$$

where X_1 is size in acres, X_2 is conformity to the Comprehensive Plan and X_5 is rezoning to Industrial District.[5] A second model which did not have variables in common with the other accepted models was:

$$(B.2) \quad P = 1/(1 + e^{-(2.60X_3)})$$

where X_3 represents the recommendation of the Planning Commission staff. Simulated probabilities using accepted models of the County Commissioners' decision are presented in Table 2.

The sign of the estimated coefficients for parcel size, conformity to Comprehensive Plan, and recommendation of the Planning Commission staff all support the null hypothesis that the County Commission's decisions are based on the Zoning Ordinance. County Commission decisions are biased in favor of industrial development as shown by the positive sign for rezoning to industrial uses in equation (B-1). This bias in the rezoning process is not mandated by the Zoning Ordinance, and should be evaluated by the policymaking body.

[5] The t ratios for the coefficients of X_1, X_2 and X_5 are, respectively, −2.36, 2.01 and 1.77.

Table 2. Simulated Probabilities of County Commissioners' Decision

Model[b]	Variables[a]				Probability of Approval
	X_1	X_2	X_3	X_5	
B-1	0.5	1	—	1	.99
	0.5	1	—	0	.94
	0.5	0	—	1	.97
	0.5	0	—	0	.76
	55.4	1	—	1	.99
	55.4	1	—	0	.86
	55.4	0	—	1	.94
	55.4	0	—	0	.56
	208.9	1	—	1	.86
	208.9	1	—	0	.34
	208.9	0	—	1	.55
	208.9	0	—	0	.10
B-2	—	—	1	—	.93
	—	—	0	—	.50

[a] X_1, size in acres; X_2, conformity to Comprehensive Plan; X_3, recommendation of Planning Commission staff; X_5, rezoning to Industrial District.

[b] The minimum size of sampled parcels is 0.5 acres, the mean size is 55.4 acres and the maximum size is 208.9 acres.

Summary and Conclusions

The estimated models generally support the null hypothesis that both the Planning Commission staff and the County Commissioners act in conformance with the Zoning Ordinance in the rezoning process. The estimated model parameters may be used to measure the relative importance of selected parcel characteristics in the final decision.

It appears relatively easy to move land out of agriculture in Frederick County, since 73 percent of the rezoning cases that involved applications for changing from Agricultural Zoning District to another Zoning District were approved.[6] However, the study indicates that it is more difficult to remove larger sections of land from the Agricultural Zoning District.

The parcels most likely to be preserved have the following characteristics: large-size (parcels of 150 or more acres have a 50 percent or smaller likelihood to be rezoned according to the analysis); situated within an area designated for agricultural use by the Comprehensive Plan; having commercial potential; existing in a neighborhood in which other sites have been zoned Commercial, with no adjacent property zoned Commercial. Land that has the greatest propensity to "leak" into the broader land market has opposite attributes from the land being preserved, and in addition is likely to be used for industrial activities (the size of parcels easily rezoned are of sufficient size for industrial use).

The study showed that the land market in Frederick County is only moderately segmented by zoning. Land may be classified into segments according to the zoning district in which it is contained, but there is a probability

[6] The ease of movement may be overstated, since the degree to which preselection occurs is not known, i.e., owners might not attempt rezonings that are likely to be disapproved.

that permission to rezone will be granted. Since rezoning decisions have been shown to be predictable, predictions may be made concerning individual parcels of land. It is also possible to predict future stocks of various categories of land, but with less certainty since it is difficult to know for which parcels rezoning will be requested.

Measurably influential variables for predicting rezoning decision outcomes included change to Industrial District, conformity to Comprehensive Plan, parcel size and staff recommendation, which was itself influenced by compatibility with adjacent zoning, compatibility with neighborhood zoning, conformity to Comprehensive Plan and parcel size.

The Planning Commission staff and the Board of County Commissioners are clearly influenced by the Comprehensive Plan. Both the Board and the staff decided or recommended in favor of approving 86 per cent of the cases that were in conformance with the Comprehensive Plan. However, the Commissioners approved over one-half of the cases for which the requested change was at odds with the mapping of intended uses as set forth in the Comprehensive Plan. Less than one-third of those that were not in conformance received approval recommendations from the staff. The Planning Commission staff then adheres more strictly to the Plan.

An examination of model B-1 indicated that the County Commissioners are strongly influenced by the desire to increase the stock of industrial land. Conformity to Comprehensive Plan has less than two-thirds the influence that a request to rezone to Industrial District has on the County Commissioners, according to a comparison of coefficient magnitudes (1.5610 vs. 2.4367). For the staff, however, conformity to the Comprehensive Plan was the most important measured criteria. This could imply that the County Commission is more responsive to external pressure or that it has a greater desire to increase the industrial development (employment and tax base) of the area.

In conclusion, the methodology employed in this paper provided a useful means of testing the consistency of a rezoning process with its statutory policy objectives. The technique, of course, is not limited to evaluation of agricultural zoning programs and may be used in many other situations. In general, it will be most successful for programs in which the choices being evaluated and the policy objectives are quantifiable, either in a continuous or discrete sense.

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