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LANDOWNER INCENTIVES TO PARTICIPATE IN A PURCHASE OF DEVELOPMENT RIGHTS PROGRAM
WITH APPLICATION TO MARYLAND

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ABSTRACT

A theory-based participation model is developed using the assumptions of perfect capital markets and perfect information. Given this specification it is shown that participation in a PDR program is always equivalent in present value terms to selling the land, and is always at least as good as not participating and remaining in farming.

In order to investigate participation rates in the Maryland PDR program a less restrictive model is developed which relaxes the perfect capital markets assumption. It is found that a PDR program is most likely to be successful in regions characterized by relatively low levels of development pressure, and least likely to be successful in areas experiencing high rates of growth or areas that are not undergoing development pressure.

INTRODUCTION

The preservation of agricultural land is a topic of considerable interest to the public as well as policymakers. Numerous programs that attempt to encourage the retention of land within the agricultural sector have been proposed or implemented in several states. These include zoning, current use property taxation, agricultural districting, purchase of development rights (PDR) and transferable development rights (TDR). Small and Derr have analyzed the market for transferable development rights, concentrating on the demand for development rights. Gardner has critically appraised the types of market failure that could bring about the need for land use controls. Wolfram has examined the relative efficiency of PDR and zoning programs, finding that under certain conditions PDR programs may lead to an efficient allocation of land and open space.

The current trend in land use legislation has involved a movement away from mandatory programs, such as zoning, towards voluntary programs such as agricultural districting and the purchase of development rights. Because of the voluntary nature of many of these programs a key factor in their potential success lies with the incentives each offers a participating landowner. As would be expected, increasing the incentives to participate generally raises the cost of a program, e.g., a reduction in the property tax assessment for farmers in an agricultural district. A policymaker, therefore, faces a crucial tradeoff between the rate of participation in a voluntary program and its cost. Kramer and Pope have examined the participation decision for farmers in commodity programs based upon the risk reducing nature of these programs. This paper seeks to

examine the decision of whether or not to participate in a PDR program as made by a wealth maximizing, perfectly competitive farmer. While there are certain risk related factors involved in this decision, this study abstracts from the problem of risk by assuming certainty with respect to current and future prices and rates of return. A theoretical model is developed and then used to examine participation in the Maryland Agricultural Land Preservation Foundation.

A PDR program is based upon the notion of the separation of the legal right to develop a parcel of land from the remaining bundle of property rights. In most programs¹ if a parcel meets certain locational, productivity, minimum size and other criteria, the landowner may offer to sell a development right to a state or county agency. Once the right is sold the landowner is precluded from subdividing the land for commercial purposes. The value of a development right is defined to be the difference between the market value of the land with full rights and the price the land would sell for without the development right. In practice this value is determined by appraisal. The Maryland program will be discussed in more detail after development of the theoretical model.

The Decision Model: The theoretical decision model is developed for a wealth maximizing perfectly competitive farmer possessing perfect information about current and future prices. It is assumed that the economy is composed of two sectors, each with a competing demand for agricultural land: (1) the derived demand for farmland to be used in agricultural production, and, (2) the derived demand for farmland to be developed for nonagricultural commercial use. The market for land is assumed to be perfect in the sense that the market price of land is defined as the present value of the rent stream it would earn in its best and highest use.

At any point in time, then, the observed market price (P_{m0}) of land will be given by:

$$(1) \quad P_{m0} = \int_0^{\infty} e^{-rt} \max \{R_{ft}, R_{dt}\} dt$$

where R_{ft} and R_{dt} are the rents the parcel of land would earn in agricultural or developed use respectively, and r is the discount rate.

It is also necessary to define a nonobservable price, termed the agricultural use value of the land (P_{f0}):

$$(2) \quad P_{f0} = \int_0^{\infty} e^{-rt} R_{ft} dt$$

This would be the market price of the land if

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¹ To date, PDR programs have been proposed or implemented in Connecticut; Maryland; Suffolk County, New York; King County, Washington; and Pennsylvania.

the parcel were restricted to agricultural use.

Prior to the introduction of a PDR program the landowner is faced with two possibilities concerning a parcel of land:

1) The land may be farmed for T years and then sold at the market price P_{mT} .

2) The land may be sold now with the proceeds invested at the opportunity rate of return (r).

Without loss of generality it is assumed that the landowner holds one acre. The present value of each action is given below:

$$(3) \quad PV(1) = \int_0^T e^{-rt} R_{ft} dt + e^{-rT} P_{mT}$$

$$(4) \quad PV(2) = P_{m0}$$

The relationship between the two possible acts is given below:

Proposition I: $PV(2) > PV(1)$, with the strict inequality holding if $\bar{R}_{dt} > R_{ft}$ for any $t \in [0, T]$.

Proof: From (1)

$$\begin{aligned} PV(2) = P_{m0} &= \int_0^T e^{-rt} \max\{R_{ft}, R_{dt}\} dt + \int_0^\infty e^{-rt} \\ &\quad \max\{R_{ft}, R_{dt}\} dt \\ &= \int_0^T e^{-rt} \max\{R_{ft}, R_{dt}\} dt + e^{-rT} P_{mT} \end{aligned}$$

So, $PV(2) \geq PV(1)$ as

$$\int_0^T e^{-rt} \max\{R_{ft}, R_{dt}\} dt \geq \int_0^T e^{-rt} R_{ft} dt,$$

If $R_{ft} \geq R_{dt}$ for all $t \in [0, T]$, $PV(2) = PV(1)$.

If $R_{ft} < R_{dt}$ for any $t \in [0, T]$, $PV(2) > PV(1)$.

In words, if farming represents the best and highest use of the land during the holding period, the landowner would be indifferent between farming the land and selling it. Conversely, if developed use is the best and highest use of the land at any time in the holding period, the landowner would be better off selling the land. If R_{ft} and R_{dt} are both strictly monotonic functions of time, the optimal time to sell or convert the land is the point where the rent from developed use exceeds the agricultural rent.

So, in the absence of a PDR program, a present value of wealth maximizing landowner will sell or convert the land to developed use if $R_{dt} > R_{ft}$. This is the type of market induced land conversion that a PDR program seeks to curtail.

The addition of a PDR program gives a landowner a third option:

3) A development right may be sold at a price $P_{m0} - P_{f0}$, with the land being farmed for T years and then sold at its use value, P_{ft} .

The present value of this alternative is:

$$(5) \quad PV(3) = P_{m0} - P_{f0} + \int_0^T e^{-rt} R_{ft} dt + e^{-rT} P_{ft}$$

The following two propositions examine the relative present values of actions 1, 2 and 3.

Proposition II: $PV(3) = PV(2)$ for all possible future rent streams.

Proof: From (2)

$$\begin{aligned} P_{f0} &= \int_0^T e^{-rt} R_{ft} dt + \int_T^\infty e^{-rt} R_{ft} dt \\ &= \int_0^T e^{-rt} R_{ft} dt + e^{-rT} P_{fT} \end{aligned}$$

which indicates that the three terms on the right hand side of (5) cancel.

Therefore: $PV(3) = P_{m0} = PV(2)$.

Proposition III: $PV(3) \geq PV(1)$.

Proof: From Proposition II, $PV(3) = PV(2)$ and from Proposition I, $PV(2) > PV(1)$, therefore $PV(3) > PV(1)$ with strict inequality when $R_{dt} > R_{ft}$ for some $t \in [0, T]$.

In words, a landowner will always be indifferent between selling the land now and selling a development right and farming the land for T years. This occurs because the option to sell the development right allows the farmer to capture the difference between the market value of the land and its use value in farming [which is always non-negative, by (1)] and invest it at the opportunity rate of return. This, in turn, reduces the landowner's effective investment in land to its use value in agriculture, so a landowner will again earn a normal rate of return on the total investment.

Clearly, under the above assumptions, a PDR program may have the desired effect of retaining agricultural land in its current use by providing the owner with an option that is equivalent in present value terms to selling or developing the land. If the landowner is also a farmer who derives positive satisfaction from the act of farming, alternative 3 may be preferred to alternative 2, even though both are equivalent in present value terms.

The preceding development may be termed the theoretical basis for a PDR program. Since it relies on the assumptions of perfect capital markets and perfect information it may be regarded as a representation of the equilibrium, or long run relationships among the three alternatives.

The next section presents a summary of the Maryland PDR program and then uses a simplified version of the above model to examine the actual rates of participation in four counties.

The Maryland Program: The following is a brief description of the Maryland Land Preservation Foundation Program.³ The Maryland program

² The action in period T could also be viewed as an intergenerational transfer instead of a sale as long as the owner seeks to maximize the present value of ownership.

³ For further information see Phipps, Bellows or the Maryland Annotated Code, Sections 2-501 to 2-515.

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is administered by a state level board of trustees and county level agricultural preservation advisory boards. Participating farmers must be included in an agricultural district meeting certain productivity, size and locational criteria before an offer to sell a development right may be made. If the offer is approved at both the county and state levels and if sufficient funds exist the foundation may make an offer to buy the development right. The foundation is supported by state appropriation and county level matching funds.

As with most PDR programs, there are generally more offers to sell easements than may be purchased, given current funding levels. The Maryland program, therefore, gives a funding priority to landowners who are willing to offer their development rights at less than their full market value. As of January 1982, 49,034 acres of land were enrolled in agricultural districts and easements had been purchased on 7800 acres at an average cost of \$896 per acre. The average assessed value of the easement was \$977 per acre, so in general, landowners have been willing to offer their easements at less than full market value. Currently, offers to sell easements have been tendered on 13,288 additional acres. These offers will be considered as funding permits.

Table 1 presents average land prices in four Maryland counties for the Census of Agriculture years 1969, 1974 and 1978. The growth rate figure refers to the average continuous rate of growth in land prices for the four years 1974 to 1978. The first county, Queen Anne's, located on Maryland's Eastern Shore, is the only Maryland county to be classified as 100% rural in the 1970 Census. The main agricultural products are corn, soybeans and broilers. Queen Anne's will represent a region in which land prices are determined by their use value in agriculture.

Montgomery County represents a suburban county in which land prices tend to be determined by their value in non-farm use. Bordering on the District of Columbia, Montgomery's 1970 population of 522,809 was classified as 89% urban. The main agricultural commodities produced are corn, hay and livestock.

Carroll County is a predominantly rural county that has undergone some suburban pressure

in the form of large lot developments.⁴ Its population of 69,006 was classified as 90% rural in 1970. The major agricultural enterprises are cattle, dairy, hogs and pigs, corn for grain and silage, and hay.

Howard County lies between Montgomery and Carroll Counties both geographically and in terms of its level of development. In 1970 its population of 61,911 was classed as 35.5% urban. The major agricultural products are livestock (including dairy) and corn.

The analysis of the incentives to participate in the PDR program will use the following assumptions:

- i) The price of land in Queen Anne's County, since it is predominantly rural, represents the average use value of agricultural land in Maryland.
- ii) The rates of growth in land prices in each county over the period 1974 to 1978 are expected to remain the same in the future.

The decision to be examined is whether or not a landowner should sell a development right given his intention to remain in farming for T years. The choice to participate involves some distinct tradeoffs. Comparing alternatives 1 and 3 above, a participating landowner gains the value of the development right ($P_0 - P_{ft}$) but loses the present value of future capital appreciation due to development pressure, $e^{-rt}(P_{ft} - P_{ft})$. Farm based land rents will be earned whether or not the development right is sold so the term,

$$\int_0^T e^{-rt} R_{ft} dt$$

may be disregarded.

The participation decision, then, should be positively related to the amount offered for the

⁴ See Farmland Preservation Survey, March 1982, p. 6-7.

⁵ While the validity of this assumption is open to question because of the agricultural differences between the counties, the average assessed use value for enrolled land in 1980 was \$1740 per acre which is quite close to the average value of land in Queen Anne's County.

Table 1: Per Acre Land Prices for Four Maryland Counties*

| Year | County | | | |
|------------------------|------------|---------|--------|--------------|
| | Montgomery | Carroll | Howard | Queen Anne's |
| 1978 | 3629 | 1717 | 2999 | 1696 |
| 1974 | 1779 | 1169 | 1742 | 948 |
| 1969 | 1655 | 566 | 1004 | 497 |
| Average rate of growth | 17.8% | 9.6% | 13.6% | 14.5% |

* Taken from 1978 Census of Agriculture, Volume 1 part 20, U.S. Department of Commerce, Bureau of the Census.

development right, the discount rate and the rate of growth in the value of farmland, and negatively related to the rate of growth in the value of developed land.

While the theoretical analysis demonstrated that participating is always at least as good in present value terms as not participating, this is not necessarily the case when the assumption of perfect capital markets is relaxed. It is hypothesized that a farmer's current decision will be a function of land price relationships experienced in the past, in the sense that past observations of land price trends influence expectations of future price trends. This hypothesis will be examined by comparing a landowner's optimal decision for the period 1974 to 1978 (the last available Census of Agriculture) with participation rates in the Maryland PDR program for the years 1980 through 1982.

In order to evaluate the participation decision it is necessary to develop a proxy for the opportunity cost of a farmer's investment in a development right. This is not a simple matter, for in 1974 the Federal Land Bank loan rate was 8.1%, the rate on newly issued Aaa corporate bonds was 7.5%, and the rate of increase in the value of unrestricted farmland varied from 9.6% in Carroll County to 17.8% in Montgomery County. Given the rapid increase in agricultural land prices over the period 1974 to 1978, a farmer's best investment was probably farmland. For this reason, the rate of change in the use value of farmland (14.5%) will be used as a proxy for the opportunity cost of investment. It should be noted that this rate understates the true return to land since it doesn't include land rent.

Table 2 compares the value of a development right in 1974 for each county with the present value of capital appreciation foregone by participation. Clearly a Montgomery County landowner would have been better off not participating since the present value of the gains due to development pressure greatly exceed the value of the development right. In Carroll County, given much lower growth rates in land prices, a landowner would have been better off participating. Howard County landowners would also have been better off participating, though the difference between the two alternatives is much smaller than for Carroll County. It should also be noted that in this case the optimal choice is very sensitive to the discount rate. A discount rate lower than 12.4% would have led to a nonparticipation decision. In Queen Anne's County, a landowner would have no incentive to participate since by defini-

tion the value of a development right is zero.

So, if past rates of land price appreciation partially determine landowner's expectations of future land prices, we would expect to see fairly high levels of participation in Carroll and Howard Counties and low levels in Montgomery and Queen Anne's Counties.

Table 3 presents the participation rates for the four counties as of January, 1982. The rates shown consist of the number of acres in which development rights have been purchased plus pending applications of sale. As expected, the highest rates are observed in Carroll and Howard Counties, each with 4.9% of their farmland under development restriction. Queen Anne's County has had no participants to date, and Montgomery County has had a very low level of activity, with 0.4% of its land in farms under easement.⁶ So the observed participation rates tend to be in line with the predictions of the simple model.

While it is difficult to draw policy implications from such a small sample the following observations emerge from the analysis:

(1) In order to induce landowners in high growth areas, such as Montgomery County, to participate it will probably be necessary to offer the landowner more than the assessed value of the development right. This would tend to increase the cost of what is already a very expensive program and would require a change in the Maryland law that prevents the foundation from paying more than the assessed value of the easement.

(2) Participation is likely to be highest in predominantly rural areas that are undergoing relatively low levels of development pressure, such as Carroll County.

(3) Participation rates will be very low in rural areas not subject to impending development, such as Queen Anne's County.

It appears, then, that a voluntary PDR program is most likely to be successful in rural areas that are undergoing some development pressure but have not entered the rapid growth phase of the suburban Maryland Counties. The major implication is that a PDR program has a distinct role in the land use planning process as a long-term policy instrument to be used in conjunction with other programs such as zoning and transferable development rights.

⁶ Montgomery County also has a county level TDR program, though to date activity has been very low.

Table 2: Comparison of the Participation Decision for Four Maryland Counties, 1974 to 1978

| | County | | | |
|--|------------|---------|--------|--------------|
| | Montgomery | Carroll | Howard | Queen Anne's |
| Development Right Value | 831 | 221 | 794 | 0 |
| Present Value of Foregone Capital Gain | 1547.56 | 11.76 | 729.55 | 0 |

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Table 3: Participation Rates in Maryland PDR Program in Acres*

| | County | | | |
|-----------------------|------------|---------|--------|--------------|
| | Montgomery | Carroll | Howard | Queen Anne's |
| Land in Farms | 115,316 | 178,381 | 58,075 | 173,064 |
| Land under Easement** | 510 | 8,678 | 2,846 | 0 |
| Rate of Participation | 0.4% | 4.9% | 4.9% | 0% |

* As of January, 1982.

** Or with easement sale application pending.

CONCLUSIONS

In the theory section it was demonstrated that given the assumptions of perfect capital markets and perfect information, participating in a PDR program is always equivalent in present value terms to selling the land, and is always at least as good as not selling a development right and remaining in farming.

When the perfect capital markets assumption is relaxed the theory based ordering of alternatives does not necessarily hold true in the short run. In analyzing participation rates in the Maryland program it is found that a PDR program is most likely to be successful if concentrated on areas undergoing relatively low levels of development pressure instead of focusing on areas experiencing high levels of growth.

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