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# An Economic Analysis of Farmland Development

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Farmland has long been regarded as the most nearly perfect example of a fixed resource. Because it is fixed, its return depends on the price of the product it produces and the supply of complementary and substitute inputs. As the classical economists realized, a complex problem can be greatly simplified if the quantity of one factor is assumed to be completely fixed (land) and the supply of another factor (labor) is assumed to be perfectly elastic at a given price (e.g., the subsistence wage). The power of analysis which results from similar simplifying assumptions has been widely recognized. The analysis in some cases has been so powerful that the results of the particular example have been remembered but the limitations of the analysis have been forgotten. In a sense, the classical lesson about land has been learned too well. It may have been true that the supply of land was once fixed but it clearly is not true of farmland in the United States at the present time.[1] Land not now in farm production can be altered and brought into farms. The productivity of land already being farmed can be greatly improved by addition of nonland factors such as drainage and irrigation systems, and through such activities as contouring and leveling.

The extent to which the stock[2] of farmland in the United States has been altered can be demonstrated by using data on drainage and reclamation for the last 60 years. More than 92 million acres in organized drainage districts have been affected by drainage activities since 1910 (17, p. 28).[3] An additional 29 million acres were provided with irrigation facilities between 1900 and 1964 (4, p. 40). These two activities have increased the cropland productive potential by perhaps as much as 22 percent of the 1910 base.[4] Probably the major additions to the land stock have already taken place, but large adjustments are still possible. Additional clearing, drainage, and irrigation activities could conceivably add 200 to 300 million more acres to the farmland stock at some cost (15, p. 13).

Land development activities may be reasonable for individual firms in responding to the costs and returns they face. But large aggregate land development may not be in order at this time. An average of more than 50 million acres of cropland have been diverted annually in the last 5 years with annual Treasury payments for price support and diversion running around $2.5 billion. The diversion programs have made land scarce relative to labor and raised product prices above levels which would otherwise have prevailed. Additions to the land stock over the last two decades may have been as large as the current rate of diversion of the voluntary programs (4; 16, p. 46). Conceivably, history could repeat itself in the next 20 years by reducing the effectiveness or increasing the costs of the diversion programs.

In addition to product price policies, Federal tax policies and input payments may be affecting the rate of land productivity. The major policies of product price enhancement and payments could lead to the creation of a larger

[1] Some economists may be concerned that little distinction is made in this paper between land and capital as distinct input categories. As assets, land values have many of the same characteristics as nonland capital values. When development is possible but costly, the supply curve of land may have many of the same characteristics as the supply curve of another reproducible capital good. Any further concern about the distinction between land and nonland capital goods should probably turn on the elasticity of substitution in production, which is basically an empirical question.

[2] The stock of land differs from the services of land in that the flow of services from one physical source persists over time. This means the stock can take on a present value of expected future services and be traded in a capital market. Components of the land stock probably include the capability of the soil to serve as a medium for nutrient transfer to plants, the available nutrients themselves, soil moisture, humidity, temperature patterns, and associated physical nonsoil capabilities which become attached to the land and are sold with it.

[3] Underscored numbers in parentheses refer to the Literature Cited, p. 43.

[4] Based on the assumptions (1) that the productivity of land in drainage districts was improved by 50 percent, (2) that the average productivity of additional irrigated land (part of which was pasture rather than cropland) was equal to cropland already in production, and (3) that there were approximately 335 million acres of cropland in 1910. A more detailed estimate of changes in farmland stock is incorporated in the author's unpublished dissertation (6, app. A).



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land stock than would otherwise exist. This in turn would lead to lower product prices than would occur in the absence of Government programs. The irony of this situation is that programs put forward in the name of income transfers to farmers may result in pressures for their continued use because of their unintended impact on the total productivity of the farm sector.

This paper outlines the steps needed in estimating the response landowners would make to policies that affect costs and returns associated with land stock development and improvement. Only if farmer-developer response to specific economic forces is accurately estimated will it be possible to develop efficient farm product price and development policies. If land development response to current product prices and diversion payments is substantial, internally consistent policies would include discontinuation of the various subsidies to development. They would also include either (a) discontinuation of voluntary diversion programs and reliance on a system of marketing quotas or acreage allotments for all major crops, or (b) sufficient reduction of current support prices to discourage any land development which would not take place at free market prices for farm products. Income transfers to farmers could then be made on some basis other than agricultural output and development investment. The current set of policies also have specific interregional and intercrop implications but these are not analyzed in this paper.[5]

## Supply and Demand Functions for Farmland Development

The value of land arises from services produced over time. It is the present value of these future services relative to the cost of producing the stock that determines the amount of development that is likely to occur. If the level of returns rises or the period over which returns occur is lengthened, development activity will probably increase. If the costs of developing the stock fall, development activity will probably increase. The problem at hand is to measure the responsiveness of development to a number of economic forces.

In most economic problems the division of the various forces into supply and demand categories has been productive. A capital goods market has some special hazards and analytical peculiarities, but traditional demand and supply concepts are helpful. It is necessary to analyze the entire farm real estate market to understand farmland development.

### THE MARKET FOR LAND

At a particular time, the stock of land is fixed and can be altered only through development or abandonment. With a fixed supply the price of land is determined by demand factors. This type of model is known as a reservation demand model.[6] Owners decide whether to sell or to reserve their land for themselves. It is the "offer" curve of the owners and demand curves of would-be owners that are aggregated in constructing the demand curve for land (figure 1).

The characteristics of owners and would-be owners will determine where they are on the reservation demand curve and the distribution of these characteristics will determine the slope of this demand curve. For example, persons with optimistic expectations about future land returns, those with low opportunity costs, and those who receive nonpecuniary income from owning farmland will be on the left portion of the demand curve. Persons with the opposite characteristics will be on the right portion of the demand curve and will be less likely to retain ownership of land or to purchase it. Entering and expanding farmers may be able to reduce annual land costs by buying rather than renting land. Retiring farmers may have relatively high opportunity costs if they wish to transform some of their savings held in real estate into consumption goods. Certainly expectations are not the same for all demanders but they exist relative to a given set of programs and price prospects. Thus, there will be some slope to the reservation demand curve. This slope is of interest because of the role it plays in the demand for land development.

### THE DEMAND CURVE FOR NEW LAND

Assume that newly developed land of standard productivity is a perfect substitute for land

[5] In the presence of programs limiting agricultural output, development of new productive capacity in one region will mean a reduction in employment in another. The interregional impact of development has been dealt with by Back and Jansma (3), Tolley (12), and Howe and Easter (7).

[6] An alternative model of the land market which focuses on the market for the exchange of the stock could be used to develop implications concerning the demand and supply of new land. The exchange market model has been used in analyzing real estate values by Herdt and Cochrane (5), and Reynolds and Timmons (11). The exchange market model is not altogether appropriate for the analysis of new land development because its focus remains on land that is exchanged. Much of the newly developed land is held by the developer for farming purposes. The reservation demand model leads to a new land market in which total development is of interest.

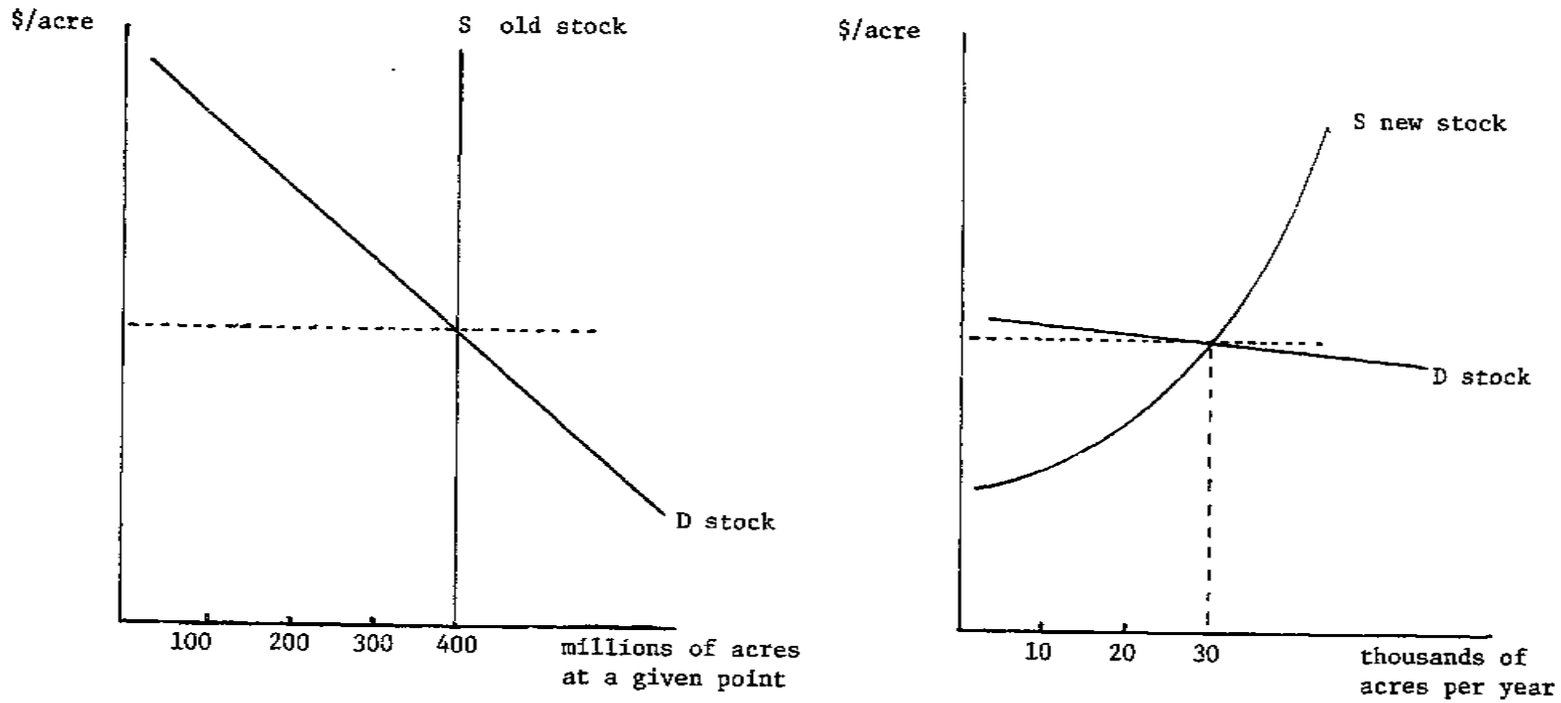


Figure 1. Hypothetical stock and flow markets for agricultural land of standard productivity using the concept of reservation demand

that is already developed. This is equivalent to assuming that farm operating units can be adjusted without cost so that the geographical dispersion of new units of the land is not an element in the demand for land.[7] In this case the demand curve for new land has the same slope as the demand curve for the current stock of land; that is, there is one demand curve that can be viewed in either the "old" or the "new" land market. For most practical considerations this means that the demand for new lands added in any one period is nearly horizontal (figure 1). This follows from the assumptions that the amount of new land in any one time period is very small relative to the amount of developed land and that the demand curve for land is fairly elastic. In the market for new land, then, the level of the demand curve and not its slope will be of prime empirical concern. The determinants of the level of demand will be examined next.

The price a purchaser is willing to pay for land is equal to the present value of its discounted future earnings. The discount factor is subject to change from time to time but outside of changes in the expected rate of inflation, there is little reason to expect sudden and dramatic shifts in the discount rate. On the other hand, changes in the expected annual rate are subject to a number of policy actions. This is where we center our attention.

The annual rent or return to land is a joint function of the production function (or basic productivity of land), the cost of annual inputs, and the price of the product. In recent years, Government price support levels and diversion programs have been a major factor in shaping prices of nearly all farm products, including most of those for which there are no visible price supports. For example, feed grain diversion programs indirectly affect livestock prices. Unsupported crops which have substantial substitution possibilities are also affected by Government programs. Some of the unsupported crops could be grown on land shifted from supported crops. Substitution possibilities are extensive. For example, without a feed grain program of substantial magnitude in the last 8 years, Government stocks of soybeans would have accumulated at the existing support price.

To illustrate the impact of Federal programs on land rent, consider the case in which one product is produced on homogeneous land. Also assume that a Cobb-Douglas production function is an adequate representation of input-output relationships and resulting income distribution. Government policy is to divert land. As the result of an inelastic demand for the product, a larger net rent is paid to land because of the programs. A constant share of larger gross receipts is distributed to fewer acres. Land that is diverted is paid approximately the same amount as land left in production. This source of revenue augments land rent also.

This overly simple model can be applied to U.S. agriculture with the following result. The share (production elasticity in the Cobb-Douglas function) of net income going to land has been about 0.20 in periods of unrestricted production.[8] Net receipts excluding Government payments have recently run about $11 billion but they probably would have been about $9 billion in the absence of restraints on production.[9] In addition to market receipts, payments to producers have recently run to about $3 billion a year. Assume that half of these payments are ascribable to land because they are related to one kind of diversion or another. Rent returns in the absence and in the presence of the programs are estimated in table 1 at $1.8 and $3.7 billion, respectively. The estimate of the absolute value of rent under these assumptions may be in error but under many reasonable assumptions rent would be reduced by half if the programs were suddenly ended.

Because many of the supply-management programs are voluntary, a land developer can obtain part of the benefits of higher land rents arising from higher market prices. The market price of corn, for example, has probably been around $0.25 per bushel above unrestrained market levels (13). On the basis of a budget estimate of recent costs and prices for an assumed yield of 80 bushels per acre, the programs are responsible for about $20 of the approximately $35 rent per acre.[10] This example assumes that no changes occur in the intensity with which other factors are used. If some adjustment in other factor use took place, net rent might not be reduced quite so

[7] The physical location of the new units of the land stock may affect their value relative to previously developed land. For example, a new unit of land stock developed by closing ditches, increasing row length, etc., may be worth more to a particular farmer than new land developed in a nonfarm area. However, market valuation should operate to make all new land on the margin have approximately the same value per acre as all old land where both are of standard productivity.

[8] Estimated from data for 1938-40 presented by MacEachern and Ruttan (8, p. 208).

[9] Inferred from a prediction by USDA that net farm income would fall $5 billion in the absence of current programs (13).

[10] This budget estimate was derived from (9, p. 8).

much. If the farmer-developer could obtain an expansion in the feed grain base on which he can earn direct payments, or if he could obtain a soybean allotment if they are established, the benefits might be even further increased.

A third rent model might be useful. Consider a case in which substantial diversion occurs in a neighborhood experiencing growth in optimum-sized units. Machinery-owning operators are now pitted against each other in the land-rent market. Because laborers and machinery are fixed in the short run, diversion puts considerable pressure on the rental market. Cash rents are bid up or some of the costs traditionally borne by the landlord are shifted to the tenant. As a result, rent responds to diversion as well as to product price.

The three rental examples (models) lead to the same conclusion: Federal government programs affect current real estate returns directly and substantially. The impact of the programs on real estate values is not necessarily as great as on current rents. If the programs are not expected to continue, they may not affect values greatly. Even the most casual observer, however, would conclude that the land market has responded as if Government programs are expected to continue and the benefits of current programs have been capitalized to a substantial degree. A change in Government programs could decisively affect the level of the demand curve for developing lands. With farm product prices consistent with unrestricted production the amount of development could fall substantially and perhaps cease altogether.

### THE SUPPLY CURVE OF NEW LAND

If the demand curve for developing lands is very elastic and not shifted in a given period of time, the level and shape of the supply curve for development activity is the primary determinant of the rate of development. If costs are high and increase rapidly with the rate of development, not much development will occur. Alternatively, if costs are low and the supply curve has little slope, a great deal of development will occur.

The supply curve for development for a short to medium run will have an upward slope for several reasons. First, as the rate of development increases, the cost of services used in the activity will probably rise because land clearing and drainage machines and skills are limited in any given local area. In a period of one to five years, a doubling of the desired rate of development would probably bid up factor prices noticeably. In addition, a spurt in the rate of development would probably be

Table 1.--Estimated returns to land assuming a Cobb-Douglas production function with a 20 percent share of net market income [a]

| Item | Returns if production were unrestrained | Returns with programs about as in recent years |
|---|---|---|
| Net income excluding Government payments: | Billion dollars | Billion dollars |
| Total return..... | 9 | 11 |
| Return to land..... | 1.8 | 2.2 |
| Government payments: | | |
| Total return..... | -- | 3.0 |
| Return to land..... | -- | 1.5 |
| Total income to land.... | 1.8 | 3.7 |

[a] Net market income is defined as net farm income less Government payments. Data were selected from various documents to represent recent experience but they do not correspond to any particular year. Defense of the assumption about the share of net market incomes (0.20) and the share of Government payments (0.50) attributed to land may be found in the text.

accompanied by a decline in the efficiency with which inputs are used. The development activity is fairly complex, involving considerable coordination and proper scheduling for lowest costs. Rate of supply has been recognized as a cost factor distinct from volume of supply by Alchian and others. (1)

The other factors that affect the slope of the short-run and intermediate-run supply curve are cost-sharing programs for inputs and tax policy concerning development costs. Cost-sharing by Federal agencies is probably the better known and more important way in which private costs are altered by Government policy. A number of cost-sharing activities have been developed over the years. When some of the costs are paid by a Federal agency, the effective private price for the inputs is reduced and the supply of new lands is shifted to the right. In the instance of Agricultural Conservation Program (ACP) payments, the effective private price is only half the purchase price of the inputs because of the 50 percent cost-sharing arrangement. The impact of Government programs on private prices is very small for activities in which Soil Conservation Service technicians provide technical assistance at no cost to the land developer. For PL-566[11] activities servicing groups of landowners, up to 50 percent of the drainage costs for construction are paid by Federal funds. For flood prevention, in PL-566, 100 percent of the construction costs are federally funded. When PL-566 sponsors are eligible for development loans by Farmers Home Administration, the interest rate is below the private market level.

In the ACP program, the limitation on the amount of cost-sharing per farm permitted each year is fairly restrictive. The cost faced by a given farmer would be low for the portion of work qualifying for cost-sharing, but beyond this basic unit the farmer-developer has to bear all of the cost of development. At that point the supply curve would reflect the full factor cost and would be considerably higher than the earlier work. On each farm the cost curve would be discontinuous at the point at which cost-sharing provisions are exhausted. When the supply curve for all farms is aggregated from individual farm cost curves, the discontinuities would come at different points and the total supply curve would rise if for no other reason than the limit on cost-sharing for the various development activities.

The other way in which the slope and level of the supply curve is affected is through a taxation policy which allows costs incurred in the development process to be charged against current income for tax purposes rather than against the income generated by the investment (2, p. 9). In addition, it is possible for land developers to report some development expenses as if they were current operational expenses.[12] This postpones taxes in the same way as allowable development expense deductions. Assuming, for example, that an investment has a life of 20 years and an 8 percent interest rate is used to discount future income, the present value of the real costs after accounting for the value of taxes postponed may be halved by allowing a present year deduction. As a result the supply curve is shifted to the right.

Even if the short-run supply curve is very inelastic at a particular point the long-run curve would be very elastic (as cost-sharing appropriations are aggregated over time to cover greater acreages). However, the long-run supply curve of newly developed land would be affected by the ease or difficulty of clearing and draining land. Not all land can be cleared with equal ease. The least-cost land would be cleared first. Thus, the long-run supply curve of development probably will be upward sloping even if the cost of factors and the efficiency with which they are used are constant. Other long-run factors include the cost of development inputs which are determined by their alternative uses in industrial activities and the efficiency with which factors can be used in the land development process. Changes in technology are likely to occur which will shift the supply curve of new lands but the magnitude of the shifts cannot be predicted.

## SUMMARY OF DEMAND AND SUPPLY FORCES

Usually supply and demand forces jointly determine price and quantity of the good being studied. In the present case expectations of future agricultural earnings determine the price of developed land, which in turn is essentially a perfect substitute for new land. The level of demand is readily observed as the market price for agricultural land. As a consequence the quantity of new land (rate of development) will be the focus of interest in most

[11] Watershed Protection and Flood Prevention Act.

[12] See, for example, Reinsel (10, p. 27-29), where the USDA estimate of net realized income exceeds Internal Revenue Service net farm profits by a factor of 4 to 1. This divergence in net income arises almost entirely from the IRS system of accounting for expenses. This is necessarily the case because gross receipts reported to IRS are nearly as large as those estimated by USDA.

empirical analyses of land development. This does not mean demand factors can be set aside. It means that land price (excluding allotment values) may be used directly to represent the demand factor rather than resorting to two data series which are less well defined: (1) agricultural price support levels with or without lags to represent expectations, and (2) agricultural or alternative interest rates to represent discount rates. Demand factors will influence the rate and quantity of development but causation runs one way: the price of land influences the quantity of development but the quantity of development does not influence price in the market for new land. As a result a single-equation model can be used rather than the more complicated model in which both quantity and price are determined simultaneously.

If cost-sharing and tax allowances are small in the aggregate and evenly distributed among potential land suppliers, the supply curve may be very inelastic in the short run at the point at which cost-sharing benefits and tax allowances are exhausted. This could give rise to a rate of development directly related to Federal benefits. It might lead to a rate which is apparently not responsive to demand considerations on the margin. In such a situation it would be false to conclude that demand forces have no effect on the rate of development. At some level of land prices, new land development would surely drop very close to zero. Thus, an empirical analysis of development could easily lead to an understatement of the importance of demand. Long-run swings in the rate of development might more nearly reflect the importance of demand factors. Even so, if there are long-run shifts in technology which affect the cost per unit of development and if there are limited quantities of the most easily developed acreage the importance of demand factors will be extremely difficult to recognize.

## Concluding Comments

Few data are available concerning the size of the farmland stock and its change over time. Consequently, empirical studies in the near future will either be limited in scope or expensive. Nevertheless, studies in this area may have a high social benefit-cost ratio. The failure to develop a refined series of data is at least partially due to the conceptual problems of aggregating acres which have various levels of productivity and which produce different crops. Accounting for changes in fertility, moisture utilization capacity and other characteristics, many of which are steadily affected by the use of nonland inputs, has been an additional impediment to the development of an adequate measure of the land stock.

Uncritical theorizing has been another obstacle to the development of a land stock measure because it has led many to the notion that the stock of land is unalterable except in a downward direction. This theory alone would place emphasis on losses rather than on investment and development activities. The doctrine that the stock can be reduced but not increased would support conservation expenditures beyond levels which are efficient and which are consistent with national public priorities. The same position might lead to an overvaluation of land. Land prices based on population changes might not appear to be out of line so long as they are reinforced by the farm programs (diversion and direct payments) and nominal capital gains. Eventually, however, a revaluation might have cruel redistribution effects on persons who had sunk their life savings in land and who failed to understand the economic forces at work.

In addition to developing studies of recent changes in the stock of land and in the flow of land services, research resources should be invested in the development of appropriate concepts and the required measurements needed to construct and maintain an estimate of the land stock in this country. The development of more adequate concepts could begin with a review of a number of excellent studies sponsored by the USDA and other public groups. Hopefully, this research activity would lead to a continuing measure of the land stock which is similar to the "Conservation Needs Inventory," which is brought up to date at intervals (14). Such a measure would be more difficult to produce than the measure of the growing stock of timber which is updated periodically by the U.S. Forest Service, because productive potential is more difficult to estimate than is the current volume of growth of a particular class of plants. The land stock measure would have to deal with measures of nonland investments incorporated in land as well as physical surfaces. Even though the problems are formidable, the potential returns are substantial.

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