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A HEDONIC STUDY OF AGRICULTURAL LAND RENT IN SOUTHWESTERN ONTARIO

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1 Introduction

Land rent is defined as the difference between total revenue and total nonland production costs of a particular site. It is affected by prevailing output prices, nonland input prices, nonland input quantities, location of site relative to service centres and markets as well as site productivity. Land productivity is the result of prevailing climatic conditions, natural endowment of the soil and of such man made practices as improving land, causing deterioration, applying new technologies as well as employing various amounts of nonland inputs on land.

Since land is a heterogeneous input containing a variety of natural or man made physical characteristics, there is keen interest in examining their impact on land value. Several authors have statistically explored the contribution of factors determining the value of land (Downing, 1973; Jennings and Kletka, 1977; Chicoine, 1981; Miranowski and Hammes, 1984; Gardner and Barrows, 1985; King and Sinden, 1988; Palmquist, 1989; Palmquist and Danielson, 1989). The emphasis in empirical research has been on the effect of physical land features on land value rather than on land rent. Although physical features of the soil are expected to affect rent like they do land value, there remain other important features unique to tenancy. In addition to physical features of the soil, terms of the contract and characteristics of market participants are expected to influence rent.

In order to test the impact of the above mentioned variables on land rent, a hedonic price function is postulated for agricultural rents. Such a function yields implicit prices for the various characteristics determining land rent. Data for this study were gathered from a mailed questionnaire sent by the authors in 1989 to farmers in southwestern Ontario (Canada) who rented land in census year 1986. The response rate was 21 percent. Addresses were randomly selected and provided by Statistics Canada. The data refer to cropping year 1988. Only part owner-part tenant farmers were surveyed since, for other research purposes, the management ability of the farmer operating owned and rented land had to be identical. The majority of leased land in Ontario (84%) is rented by part owners. The studied area consists of the 12 adjoining counties in the most southwesterly part of the Province. This area contains cash crop, dairy, mixed, and specialty farms. Only fixed cash rent contracts are investigated. Seventy-two percent of the contracts in the area are fixed cash leases.

Information from a hedonic price function is important for several reasons. First, tenants and landlords entering into a contract need some kind of appraisal information to prepare bid and offer prices. As opposed to the usual process of ex ante farm land appraisal, which is predicated on subjective assessments of values of characteristics based on comparable cases, the implicit price approach instead yields ex post objective empirical estimates of the values of particular characteristics. Empirical estimates are useful as verification of values assigned by appraisers. Second, arguments persist that land productivity is not fully reflected in land prices and rents. Less productive and more erosive land is said to exchange at prices too high relative to land of higher quality, ceteris paribus. Inconclusive evidence on this issue has been reported by Erving and Mill (1985) and for not readily visible erosion by Gardner and Barrows (1985). A hedonic price function can reveal whether or not a relationship exists between land rent and certain land characteristics determining land quality, such as the drainage condition of the soil and the degree of erosion. However, absence of a statistically significant relationship is no proof of market failure. Land quality and rent are linked through productivity and production cost impacts. If a certain characteristic such as soil erosion has no effect on either productivity or production costs, no effect on rent is expected. Third, information on implicit prices is important for characteristics that can be manipulated. Implicit prices assist in making investment decisions.

The purpose of this study is to examine the effect on agricultural land rent of 1) soil and climate characteristics, 2) location, 3) land utilization, 4) contract terms, and 5) attributes of market participants. This is done by development and empirical estimation of a hedonic price model. Theory underlying the hedonic price function is explored. The data are then discussed and the model is presented with impact expectations of the various characteristics on land rent. This is followed by presenting model estimates and a discussion of the results. Finally, some pertinent implications are considered.

2 The Hedonic Price Function

The hedonic price function and the underlying production theory are predicated on the assumption that inputs are heterogeneous and that firms therefore employ the characteristics of such inputs. These characteristics rather than the inputs themselves become the arguments in a firm's production and profit functions.

The hedonic technique has been applied to heterogeneous inputs and outputs (for example, Ladd and Martin, 1976; Prescott and Puttock, 1990; Wilson, 1984; Veeman, 1987). As indicated, the technique has frequently been applied to land. The technique has also been used to estimate the value of nonmarket goods, such as outdoor recreation and pollution (Ridker and Henning, 1967; Deyak and Smith, 1978; McConnell, 1979; Adamowicz and Phillips, 1983).

The total contribution of a heterogeneous input such as land depends on both the number and the amount of the various characteristics provided. Total output therefore also depends on the total number and amount of characteristics (Ladd and Martin, 1976). The production function of a profit maximizing firm can therefore be depicted as:

$$q_y = f(v_{1y} \ldots v_{ny}) \tag{1}$$

q_y = quantity of output y (y = 1 ... Y); and

v_{jy} = the quantity of input characteristic j (j = 1 ... n) used in the production of commodity y.

The firm's profit function can be written as:

$$\pi = \sum_{y=1}^{Y} p_y f(v_{1y} \ldots v_{ny}) - \sum_{y=1}^{Y} \sum_{i=1}^{m} p_{xi} x_{iy} \tag{2}$$

where:

p_y = the price of commodity y

p_{xi} = the price of input x_i

x_{iy} = the quantity of market input i (i=1 ... m) used in the production of commodity y.

The first-order conditions for profit maximization are:

$$\frac{\partial \pi}{\partial x_i} = \sum_{y=1}^{Y} p_y \sum_{j=1}^{n} \frac{\partial f}{\partial v_{jy}} \frac{\partial v_{jy}}{\partial x_{iy}} - p_{xi} = 0, \quad i=1...m \tag{3}$$

Solving for p_{xi} gives:

$$p_{xi} = \sum_{y=1}^{Y} p_y \sum_{j=1}^{n} \frac{\partial f}{\partial v_{jy}} \frac{\partial v_{jy}}{\partial x_{iy}} \tag{4}$$

where:

$\frac{\partial v_{jy}}{\partial x_{iy}}$ = the marginal contribution of the ith input to the jth characteristic used in producing y; and

$\frac{\partial f}{\partial v_{jy}}$ = the marginal physical product of a unit of characteristic j in the production of y

The term $p_y \frac{\partial f}{\partial v_{jy}}$ is the marginal value product of characteristic j in the production of y. Over the range of variation in the data it is assumed that $\frac{\partial f}{\partial v_{jy}}$ is approximated by a constant α_{jy}. Equation (4) can then be written as:

$$p_{xi} = \sum_{y=1}^{Y} p_y \sum_{j=1}^{n} \alpha_{jy} \frac{\partial v_{jy}}{\partial x_{iy}} \tag{5}$$

Another assumption is that the quantity of characteristic j is proportional to the number of units of x_i; thus

$$\frac{\partial v_{jy}}{\partial x_{iy}} = V_{ji} = \frac{v_{jy}}{x_{iy}}$$

Let

$$p_y \sum_{j=1}^{n} a_{jy} = \sum_{j=1}^{n} \beta_j$$

then equation (5) can be written as:

$$p_{xi} = \sum_{j=1}^{n} \beta_j V_{ji} \qquad (6)$$

Equation (6) is the hedonic price function where:

β_j = the marginal value product of the jth characteristic in the production of y, which is the marginal implicit value of a unit of characteristic j or the hedonic price of a unit of that characteristic.

V_{ji} = the amount of characteristic j per unit of input i.

Given data on per unit input prices p_{xi} and the amount of characteristics, j, per unit of input, i, regression analysis can be used to obtain estimates of β_j. For the production factor land the hedonic price function in equation (6) implies that the annual rent per unit of land is equal to the sum of marginal implicit prices, β_j, of each characteristic times the total quantity of each characteristic per unit of land, V_j.

Theory does not indicate the exact form of equation (6). Usually the best fitting functional form is used. Some economists have used a linear relationship, while others have utilized semilogarithmic or log-linear specifications.

The hedonic pricing method is based on several assumptions. The total area under investigation, in this case the 12 adjoining counties in southwestern Ontario, is considered a single market. In addition, landlords and tenants have adequate information on the characteristics of parcels, as well as of contracts and participants in the market, so that they have knowledge of all options available to them. Furthermore, the tenancy market is in equilibrium. The demand for land and contracts with specific levels of characteristics is equal to the supply of land and contracts with those attributes. The price clears the market for each bundle of characteristics. If the rental market is in equilibrium then each tenant acts to maximize profits given alternative land parcels and contracts. Finally, a large number of available parcels for rent exists having different characteristics from among which tenants may choose. This will allow tenants to choose a parcel and contract which will maximize profits (Miranowski and Hammes, 1984).

3 The Model and Data

The model determining rents of agricultural land as outlined here does not use the conventional demand and supply approach where land is considered to be a homogeneous commodity measured in divisible land units. The conventional approach uses a set of simultaneous equations to estimate rent. In actuality, land is transferred in indivisible units through various contracts. Both land and contracts are heterogeneous items, thus the homogeneity assumption underlying the single market is violated. Many markets exist with each submarket displaying identical characteristics. In this analysis each observation is a contract with indivisible land units and the concomitant price is the equilibrium rent in the pertinent submarket.

Agricultural land rent is affected by economic, physical, locational, and institutional factors. The data refer to a cross section of contracts in 1988 in which economic variables such as output and input prices as well as interest rates are assumed to be constant over all observations. Therefore, the model does not incorporate these economic variables. Their impact ends up in the constant term of the regression equation.

Given the macro economic climate, agricultural land rent is hypothesized to be a function of five groups of characteristics: 1) the physical properties of the land itself and climatic conditions; 2) the utilization of the site; 3) the location of the parcel relative to urban centres; 4) the content of the contract; 5) the participants in the markets.

3.1 Soil and Climate Characteristics

Land varies in physical properties. Soil texture, drainage, topography, erosion damage (loss of soil by water and wind), level of stoniness, damage due to periodic flooding, and depth to bedrock vary among parcels. Quality differences of these features are expressed in encumbrance points (Noble, 1977). This system was developed in the Department of Land Resource Science at the University of Guelph. The number of encumbrance points assigned to each feature of a particular parcel measures the degree of limitation of that feature for agricultural productivity. The minimum number of encumbrance points is zero, indicating no physical limitation, while the maximum value varies with the importance of the maximum limitation of that particular feature for agricultural use. For example, the maximum encumbrance points for drainage are 40, corresponding to very poor drainage (usually swamps or bogs), while the maximum points for erosion are 20, indicating severe erosion damage where all surface soil has been removed. Weighted average encumbrance points are calculated for each soil characteristic, the weight being the percentage of land in the contract having a particular limitation of that soil characteristic.

Seven soil characteristics are used in this analysis: soil texture, drainage condition, topography, erosion damage, stoniness, periodic flooding, and depth to bedrock. Five soil types are distinguished within soil texture. Loam and silt loam are considered to have no physical limitation for agricultural production, corresponding to zero encumbrance points. Sandy loam and clay loam have some limitations, corresponding to 5 points, while clay (15)[1] and sand (20) are considered more severe limitations for agricultural production. The drainage condition of soil is not considered to be a hazard for agricultural production if movement of air and water is unrestricted. The condition is fair (10) if some limitation for air and water movement exists, and poor (25) if water and air movement is restricted. Topography distinguishes several hazard intensities: level (0), 3 to 6% slopes (5), 7 to 12% slopes (10), and 13 to 20% slopes (20). Topography not only limits productivity because of erosion hazards but can lead to higher production costs per unit of land, both factors expected to exert downward pressure on rent. Erosion damage is reported as: no damage (0), and where considerable surface soil has been removed as moderately damaged (10). If all surface soil has been removed, the damage is severe (20). The

[1] Figures in brackets indicate encumbrance points for the respective soil feature.

degrees of stoniness are: stone-free (0), moderately stony (10), which indicates stone interference with cultivation of crops and use of machinery, and very stony (25), when too many stones are present for cultivation, but allowing suitability for pasture. Depth to bedrock is measured as: over 3 feet (0), 2 to 3 feet (20), 1 to 2 feet (40), and less than 1 foot (65). The summation of encumbrance points presents an indication of soil quality. The higher the encumbrance points, the poorer the soil quality and the lower the productivity of the soil. Hoffman (1971) found a statistically significant relationship between the aggregate encumbrance points for all soil features and yield of corn, barley and oats per unit of land. Our questionnaire provided descriptions detailing the above noted physical features of land, which farmers were asked to rate, relative to their land. A negative relationship is expected between rent and encumbrance points.

Climatic conditions are expected to have an important bearing on soil productivity and hence on rent. Climate is measured in terms of corn heat units (CHU). These are values based on the relationship between temperature and corn development (Brown, 1985). The system calculates a daily rate of corn development from average daily temperatures during the growing season. These daily rates are added over the entire growing season into CHUs. The higher the CHUs, the warmer the climate and the higher the soil productivity. As a result, rent is expected to be positively related to CHUs. CHUs in the area vary between 2300 and 3500.

3.2 **Land Utilization**

Land rent is affected by the kind of crops grown. Crop choice depends on various factors such as price, proximity to processing plants, soil conditions and climate. Two dummy variables are included to express land utilization. First, a dummy is assigned to contracts whose area occupies fifty-one percent or more in fruit and vegetables. Horticultural commodities are high value crops and land use on such farms is usually intensive, resulting in higher per unit land earnings than on land growing crops of lower value. To a great extent, specific soil characteristics and micro climate favourable for horticulture, but not captured by the included soil and climate variables in the model, as well as proximity to processing plants determine the location of horticultural production.

Second, among agricultural commodities a distinction can be made between crops with high and low gross margins. The gross margin is the difference between gross revenue and variable costs per unit of land, excepting rent. The gross margin must be shared by the operator in the form of wages and management allowance, by investment in the form of interest and depreciation allowance, and by land in the form of rent. Typical high gross margin crops include white and kidney beans, soybeans, tobacco, winter and spring wheat, corn grain, corn silage, and peanuts. A dummy is assigned when the contracted area contains 51% or more in such high gross margin crops. Observation shows that either the vast majority of the contracted area is occupied by high gross margin crops, or that the entire area is occupied by low gross margin crops.

Customarily, the kinds of commodities that tenants intend to grow is an important consideration during rent negotiation in the study area. Why this is so is not entirely clear. In certain instances tenants are limited in their crop choice. Certain soil characteristics and micro climate not captured by the variables included in the model may preclude cultivation of high gross margin crops. Moreover, soils susceptible to erosion or other forms of degradation may be better suited for low gross margin crops which can sustain productivity in the long run. Several high gross margin crops are highly erosion prone. Landlords may be better off negotiating a low gross margin cropping pattern with concomitant lower rents on land susceptible to erosion if land values are positively affected. Such negotiable terms are usually not explicitly included as restrictive covenants in the lease. In any case, due to the prevailing custom, rents in the study area are expected to be affected by land use instead of land use being affected by prevailing rents. Land utilisation by horticultural and high gross margin crops is expected to exert a positive influence on land rent.

3.3 Location

Net prices received and paid differ among farmers because of transportation costs. Locational advantage is expected to be reflected in land rents. For this study, the distance from the centre of the township in which the farm is located to the nearest population centre of 20,000 or more inhabitants is used as location variable. A negative relationship between distance and land rent is expected.

3.4 Contract Terms

A fourth group of characteristics relates to the contract. This consists of 1) the type of lease, either verbal or written, 2) the time period covering the lease, called lease duration, 3) any restrictive covenants and compensation clauses, and 4) parcel size.

Transactions in the market involve bilateral contracts between landlord and tenant. Transaction costs for information gathering, negotiation, legal consultation, monitoring, and enforcement differ among various contracts and parties. In addition, various contractual arrangements allow for different distributions of income variance among contracting parties (Cheung, 1969). For the purpose of this paper, both parties involved in contracting constitute a team. Each team is expected to reach an agreement that maximizes the sum of gains to both. In determining that sum, the concept of maximum bid price and minimum offer price is useful. The maximum bid price of prospective tenants is that which makes them as well off as they would be by not entering into agreement at all. In calculating the maximum bid price, prospective tenants will use opportunity costs of their resources. The minimum offer price of landlords is that which makes them as well off as they would be by utilizing the land in the next best alternative use (for example, either farming it personally or by hiring managers, or by selling). Tenants naturally would rather pay less than maximum bids but never more, and conversely, landlords would rather accept more than minimum offers, but never less. An increase in transaction costs as well as in income and/or asset value variance will decrease maximum bid prices and increase minimum offer prices. Teams are expected to choose that arrangement yielding the highest combined return to both tenant and landlord. This is equivalent to a contract yielding the greatest spread between maximum bid price and minimum offer price, assuming that the maximum bid exceeds the minimum offer.

3.4.1 Lease Type

A verbal lease contrasted with a written one is not notarized and usually contains fewer clauses. Such contracts are expected to result in lower negotiation and initial legal costs and thus in higher maximum bids and lower minimum offers. Since the terms are not well specified, this kind of arrangement is less certain than a written contract. As a consequence, it could lead to higher enforcement costs and to a greater variance in income, resulting in an opposite effect on maximum bid and minimum offer prices. Ciriacy-Wantrup (1963) mentions that local custom and tradition on the other hand may make such tenure arrangements quite secure. If this is accurate, then verbal contracts would lead to lower transaction costs with little increase in income variance. This probably explains why the majority of contracts in the region are verbal (69%).

Teams choosing a written contract in preference to a verbal one expect to gain more from a formal contract. Otherwise they would forego it. The financial impact of a written lease on land rent is uncertain. The impact of a decrease in possible enforcement costs as well as in income and asset value variance from a written lease must exceed such increases in costs as for initial negotiation and possible legal fees, otherwise the parties would choose a verbal lease. If both parties in the bargaining team gain from a written lease, rents may not be affected at all. The ultimate outcome will then depend on the relative bargaining strength of each party.

3.4.2 Lease Duration

The stipulated period of time over which the owner's use rights are surrendered (lease duration), creates an uncertain impact on land rent because several opposing forces are operating. There is an increase in the maximum bid price by a prospective tenant choosing a relatively long lease duration over one of short duration, because tenant investment in longer term assets becomes more profitable. The longer the lease duration, the more likely a tenant paid asset yielding its services over several years will become exhausted, thus reducing dismantling and moving costs. This is particularly relevant for inputs attached to land (land improvement). Moreover, different farming practices (for example conservation tillage) may be adopted since they yield benefits in the long run and result in higher income over the same time period than do practices yielding immediate benefits (for example conventional tillage) under a relatively short lease duration. On the other hand, tenants face great uncertainty about future earnings from the land. This exerts downward pressure on the maximum bid price under risk aversion. The resulting maximum bid price could be higher, lower or equal to that for relatively short lease durations depending on the strength of the above opposing forces.

Landlords' minimum offer prices are affected by several factors. Landlords may believe that land is better cared for under long-term contracts and thus the value of the land at the termination of the lease will be higher at the same point in time than under short-term lease contracts. Although the landlord is faced with a fixed annual rent over the entire duration of the lease (unless the contract calls for renegotiating rents should economic conditions change), this does not imply zero variance of such fixed amounts. If economic conditions deteriorate, tenants might not be able to pay negotiated rents and landlords might have to settle for rent abatements. On the other hand, if economic conditions turn out better than foreseen during negotiations, landlords do not share in the higher returns. Enforcement costs for long duration contracts may be higher than those for short duration. In the event of violation of the contracted terms, tenancy dismissal may be the cheapest way to settle the matter. Tenancy dismissal is facilitated under relatively short lease durations. Higher enforcement costs and greater income variance for long duration contracts decrease maximum bids and increase minimum offers. The resulting minimum offer price could be higher, lower or equal to that for relatively short lease durations depending on the strength of the above forces.

One expects that teams choose a lease duration leading to the greatest difference between maximum bid and minimum offer prices, assuming the former exceeds the latter. For the majority of contracts in the region (79%), this is a 1-year contract. The spread between maximum bid and minimum offer prices is expected to increase for teams choosing long-term lease durations over short durations, otherwise short-term contracts would have been preferred. If maximum bid prices increase and minimum offer prices decrease as compared with short-term contracts, rents could remain the same, benefitting both contracting parties. The outcome depends largely on the relative bargaining strength of each party. Usually the party expecting the least change in maximum bid or minimum offer price is in a stronger bargaining position.

3.4.3 Restrictive Covenants and Compensation Clauses

Five restrictive covenants are included in this study: the kind of crops to be grown, crop rotation and tillage methods to be followed, erosion control methods to be applied, and weed control. If tenants utilize these practices regardless of whether or not the contract contains such demands, the maximum bid price will not be expected to differ between contracts either with or without restrictive covenants. If these practices are not to tenant advantage, the maximum bid price for a contract with restrictive covenants is expected to be lower than for one without them. The landlord incurs higher transaction costs for a contract with restrictive covenants, for monitoring the tenant's practices and for enforcement in case of noncompliance. On the other hand, the landlord expects the value of the land to be higher at the termination of the lease. The net effect will tend to produce a decline in the minimum offer price when compared with a contract lacking restrictive covenants, otherwise the landlord would not insist on those clauses. If tenants do not gain from restrictive covenants, rents of such contracts are expected to be lower than for non-covenant contracts in order to induce tenants to accept restrictive clauses. If tenants perform the required practices anyway regardless of contract wording, rent may not be affected at all.

Compensation by landlords for land improvements made by tenants and unexhausted at the termination of the lease is expected to exert a positive influence on land rent if the value of the depreciated asset is fully compensated. If the net present value of a land improvement is negative over a period equal to the lease duration but positive over a longer time period, the tenant will refrain from undertaking such improvement. However, both parties might benefit from negotiating a contract containing a compensation clause. Suppose the compensation at lease termination date is equal to the difference between the value of the land with and without improvement. In such case the landlord gains nothing while running the risk that net benefits of the improvement after the current lease termination date will be lower than expected. Consequently, rents charged to future tenants will not be as high as could otherwise be expected. Moreover, considerable transaction costs are incurred in assessing the value of the land with and without the improvement. As a consequence, landlords require higher rents for contracts with compensation clauses. Tenants also incur higher transaction costs in estimating the depreciated value of the improvement, but their income from land is positively affected. Since there are so few contracts with compensation clauses (only 5% of all contracts in the region) one must conclude that in most cases the spread between maximum bid and minimum offer prices does not increase by negotiating such clauses. It is possible for a lower compensation to be negotiated, for example, 50% of the depreciated asset value. Here, rents could be lower for such contracts. No information is available concerning details of the compensation clause. The only information available is whether or not the compensation clause is extant. Thus the direction of the impact is difficult to predict.

3.4.4 Parcel Size

Parcel size is expected to affect rent if economies of size can be obtained by renting additional land. It is widely recognized that unit costs of agricultural output initially decline sharply with size, measured in output volume or sales volume, and remain more or less constant thereafter (Miller et al., 1981). The most salient characteristic of the cost structure is that diseconomies of size appear to be absent. Land tends to be complementary to output or sales volume. If farms have different nonland costs per unit of output because of size, then economic returns per unit of land will differ. As a consequence, maximum bid prices will differ. The residual return to land tends to be greatest on large farms. Since we are dealing with rented parcels added to existing farms, the rented parcel size has no unique relationship to farm size. It is the latter that determines the maximum bid price and not the size of the rented parcel. Parcel size has therefore been excluded from the model.

3.5 Characteristics of Market Participants

A fifth group of characteristics expected to exert an impact on land rent is associated with market participants. For such participants to have an effect on land rent, either the landlord must face different risks or transaction costs for different groups of prospective tenants, or prospective tenants must face different risks or transaction costs for the various groups of landlords. The residence of the landlord, whether local or absentee, kinship between landlord and tenant, and length of time the tenant has rented the parcel from the same landlord are factors relevant in this regard.

3.5.1 Residence of the Landlord

It is expected that transaction costs are higher due to higher communication costs for prospective tenants if they rent from an absentee landlord. For the purpose of this study, a landlord residing within 15 miles of the property is considered a local landlord. The 15 mile radius is arbitrary, but is the only figure available from the questionnaire. Everything else being equal, the prospective tenant is able to bid more for land from a local than from an absentee landlord because of lower communication costs. Were contract rents the same on the two parcels, a tenant would gain more from a rental from a local landlord. This would exert increasing demand for parcels from local landlords, and result in upward pressure on rent for those parcels. Demand for parcels from absentee landlords would decrease, as would rent on those parcels. This is elucidated by the Edgeworth process of contracting and re-contracting (Roumasset, 1979). Assume a situation of two landlords, one local and the other absentee and two prospective tenants. Assume that everything is equal between the parcels, including similar minimum offer prices. Prospective tenants have the same maximum bid price for the same parcel, but the bid price for a parcel from a local landlord exceeds that for a parcel from an absentee landlord. Suppose that the two preliminary contracts are identical in rent. Such contracts can always be blocked. A tenant who has a preliminary contract with an absentee landlord can enter into a new coalition with the local landlord by offering a higher rent than initially negotiated with the absentee landlord, making both parties in the new coalition better off. An equilibrium will be reached when both tenants face the same difference between maximum bid price and contract rent on each parcel. Since the maximum bid price for a contract from an absentee landlord is lower, ceteris paribus, the resulting contract rent is expected to be lower than for a similar contract from a local landlord.

3.5.2 Kinship Between Landlord and Tenant

Kinship between landlord and tenant can affect rent. From the landlord's point of view, renting to a relative reduces contracting costs and uncertainty since it is assumed that the landlord is already knowledgeable about the entrepreneurship and stewardship of the relative. The contracting cost for a relative is also usually lower than for a non-related prospective tenant, since the relative avoids the expense of locating a farm and checking its characteristics. The relative also faces less uncertainty than a non-related prospective tenant since there is usually familiarity with the land to be rented.

Assume a situation with two landlords and two tenants, one of the tenants related to one of the landlords and the other tenant related to neither. Suppose that preliminary contracts are between the two teams of unrelated parties. Everything else being the same, rent on the two parcels should be identical. However, this is not an equilibrium situation. A new coalition can be formed between the two related parties. The effect that the new coalition has on rent is uncertain. The related tenant can bid at a higher rent while the related landlord can offer the parcel to his relative at a lower rent than to a non-relative.

Thus rent can be identical between parcels let from a relative or a non-relative, while related parties are better off than nonrelated parties.

The impact on land rent is largely determined by relative potential gains to be made and by relative bargaining positions. The potential gain of a related tenant is the difference between the maximum bid price for a parcel let from a related landlord as opposed to one who is unrelated. The potential gain for the related landlord is the difference between the minimum offer price to a nonrelated tenant and that to a relative. If the potential gain to landlords exceeds that to related tenants, the latter are usually in a stronger bargaining position and rents are expected to be lower on parcels rented from relatives, everything else being equal. If the opposite occurs, rents are expected to be higher on parcels rented from relatives.

3.5.3 Length of Tenant Occupancy

The number of years a parcel has been rented to the same tenant by the same landlord can affect rent. This situation is very similar to that of kinship discussed under the previous heading. Sitting tenants avoid moving and adjustment costs by continuing on the same parcel. They also avoid the cost of locating a new parcel as well as identifying soil characteristics needed to establish a maximum bid price. Landlords face lower contracting costs for a sitting tenant. Acquainting themselves with the competence and stewardship of a new prospective tenant is unnecessary. Landlords may also feel more secure with a sitting tenant, expecting a higher asset value at the end of the term.

When the previous contract has expired, sitting tenants hold advantages in bidding for a new contract compared to other potential tenants. However, this does not imply that sitting tenants' maximum bid prices necessarily exceed those of other potential bidders. Managerial ability and other resources at their disposal which affect maximum bid prices, can differ greatly among the various bidders. Whether or not a sitting tenant can be outbid by a rival with a higher maximum bid price depends on other contract opportunities available to the rival. The maximum bid price of a rival also depends on the rent at which other comparable contracts can be obtained.

Since landlord and sitting tenant can both gain from renewing the lease, provided that the sitting tenant cannot be outbid by a rival bidder, the impact of length of tenant occupancy on rent becomes indeterminate. It is largely a result of relative gains to be made and relative bargaining strength.

3.6 Model Specification

Several functional forms were tried in investigation of the relationship between agricultural land rent and the variables described above. On the basis of adjusted R^2 as well as statistical significance levels and correctness of signs of regression coefficients, the linear and semi-logarithmic equations were rejected. The following best fitting functional form was used:

$$Y_i = \alpha_0 X_{i1}^{\alpha_1} X_{i2}^{\alpha_2} X_{i3}^{\alpha_3} \exp\left(\sum_{j=4}^{n} \alpha_j X_{ij} \right) \tag{7}$$

where Y_i is the rent per acre of contract i, X_{i1} is the length of occupancy on the same parcel of a tenant with contract i, X_{i2} is the stipulated period of time over which use rights are surrendered in contract i, X_{i3} is the distance from the centre of the township in which the property with contract i is located to the nearest population centre of over 20,000 inhabitants, and X_{ij} are the remaining measures of soil, climate, land utilization, contract and market participant characteristics describing contract i.

4 Results and Discussion

The model was estimated by taking the natural logarithm of both sides of equation (7) and utilizing ordinary least squares. The regression estimates are reported in Table 1.

TABLE 1

ESTIMATES OF THE IMPACT OF SELECTED CHARACTERISTICS ON PER-ACRE AGRICULTURAL LAND RENT

Characteristic	Parameter estimate (*t*-values)	Standard. paramet. estimate	Characteristic	Parameter estimate (*t*-values)	Standard. paramet. estimate
			Location:		
			Distance to urban centres of 20,000 and over	-.14308 (-2.072)	-.157
Soil and climate characteristics:					
Soil texture	.00021 (.017)	.001	**Contract terms:**		
			Lease type (1 verbal, 0 written)	-.21324 (-2.094)	-.148
Drainage condition	-.02707 (-5.253)	-.390	Lease duration	.00927 (.139)	.010
Stoniness	.02229 (2.188)	.189	Restrictive covenants (1, 0 otherwise)	.02616 (.254)	.018
Topography	-.02756 (-1.771)	-.159	Compensation clauses (1, 0 otherwise)	-.20651 (-.452)	-.035
Erosion damage	-.00089 (-.052)	-.005	**Market participant characteristics:**		
Flood damage	-.00231 (-.234)	-.018	Residence of landlord (1 local, 0 absentee)	.30367 (2.382)	.172
Depth to bedrock	-.00349 (-.867)	-.063	Kinship (1 related, 0 non-related)	.10936 (.448)	.034
Corn heat units	.00099 (4.250)	.347	Length of tenant occupancy	-.15943 (2.740)	-.194
Land utilization characteristics:			Constant	1.68764 (2.385)	
Fruit & vegetable farms (1 if 51% or more of the land is occupied by fruits and vegetables, 0 otherwise)	.72769 (3.987)	.329	*R*-Square	.4834	
			Adjusted *R*-Square	.4059	
High gross margin crops (1 if 51% or more of the land is occupied by high gross margin crops, 0 otherwise)	.30047 (2.382)	.200	*F*-Value	6.2370	
			N	139	

4.1 Soil and Climate Characteristics

Five of the seven soil characteristic variables are negatively signed, as expected, but only the coefficients on the soil's drainage condition and topography encumbrance points are statistically significant at the 10% level or better. The coefficient for the degree of stoniness is statistically significant but has the wrong sign.

Average encumbrance points (AEP) for drainage are 10.28 with a 10.22 standard deviation (σ). Compared with encumbrance points of other soil features these statistics are relatively high. It is well known that drainage has an important impact on yield in Ontario (van Vuuren and Jorjani, 1984). The effect of drainage on rent is therefore not surprising. AEP and σ for topography are 4.16 and 4.08, respectively.

The effect of topography on land rent can be caused by tillage costs and erosion susceptibility. The more level the land, the lower the tillage costs and erosion potential. Erosivity potential is expected to play only a minor if any role at all in the rental market. Tenants are interested in current productivity. Under short term leases without compensation clauses they do not bear the cost of a future decline in productivity due to their current actions. Thus their maximum bid price is not affected by erosion susceptibility. Landlords perceive a decline over time in the value of their asset due to erosion potential which is expected to occur. They prefer to be compensated for this possible future loss in value by charging higher rents. On the other hand, higher rents provide no inducements to protect from erosion. Because of these opposing forces, minimum offer prices are most likely not affected. The effect of topography on land rent is therefore most likely caused by differences in tillage costs.

Neither soil texture, depth to bedrock nor soil damage due to soil erosion or flooding have any statistically significant effect on land rent. Gardner and Barrows (1985) attribute lack of a similar relationship in the land market between not readily visible soil erosion and land value to imperfect buyer knowledge. In the rental market, this would be identical to imperfect tenant knowledge. However, this is unlikely in the study area. Tenants were asked to rate erosion damage on their rented land and thus such damage had not gone unnoticed. Moreover, 88 percent of tenants in the area had occupied their rental parcels for more than one year, providing them knowledge of productivity effects of soil erosion. A more reasonable explanation for the lack of relationship is that the extent of soil damage caused by erosion and flooding had a negligible effect on productivity and/or production costs. Damage to erosion and to flooding are relatively slight with AEPs of 1.87 and 2.45 and corresponding σ of 3.68 and 5.42 respectively.

AEP and σ for soil texture are 5.80 and 4.26 respectively. The 5.80 average is representative for both sandy and clay loams which are given five points in the encumbrance classification system. Since the σ is relatively small, most observations do not deviate greatly from the above average. Therefore the variation in soil texture is probably not large enough to have a statistically significant impact on yield and/or production costs. The effect of the level of stoniness on rent is puzzling since it shows as positive instead of negative.

The climate characteristic represented by CHUs bears the correct positive sign and is statistically highly significant. Drainage encumbrance points and CHUs are the two most important variables determining rent levels, judged in terms of the standardized regression coefficients. These coefficients are derived from the variables in the model expressed in the number of standard deviations away from their means.

4.2 **Land Utilization and Location**

The two variables representing use of land for fruit and vegetables and for high gross margin agricultural crops, show the correct positive signs and are both statistically highly significant.

The location of the parcel relative to urban population centres has a statistically significant effect on land rent. The coefficient is negatively signed, as expected.

4.3 Contract Terms

The type of lease used has a statistically significant effect on land rent. Rents of verbal lease contracts are lower than those of written contracts, ceteris paribus. As indicated, the direction of the impact cannot be postulated a priori. Impact depends on which party gains. Since the sign is negative, tenants seem to be the principal beneficiaries of written leases where these leases have a greater spread between maximum bid and minimum offer prices than do verbal leases. The greater security of tenure that a written lease provides is apparently more important to tenants than to landlords. The rent difference between a written and verbal lease is relatively large. On average land leased with a verbal contract rents per acre at 81 percent of land leased via a written contract, ceteris paribus.

The length of time over which use rights are surrendered has no statistically significant effect on land rent. As indicated earlier, the impact of lease duration on rent cannot be postulated unambiguously. Since multiple-year contracts go for the same rent as 1-year contracts, ceteris paribus, it appears that both landlords and tenants gain from multiple-year contracts if the spread between maximum bid and minimum offer prices exceeds that of 1-year contracts. Rent does not act as an incentive to adopt long-term leases for either landlord or tenant. The incentive for the tenant comes from the net effect of the various forces increasing maximum bid prices and for the landlord from the net effect of the various forces decreasing minimum offer prices.

Neither restrictive covenants nor compensation clauses have any statistically significant effect on land rent, although theory postulates a positive impact from compensation at the termination of the lease for land improvement made by tenants. Since restrictive covenants do not impact negatively on land rent, one must conclude that tenants faced with such clauses performed the prescribed practices regardless of whether or not the contract contained such covenants. About a quarter of the contracts contained restrictive covenants. These covenants can have an important positive environmental impact. Nevertheless, rent provides no incentive for inclusion of such covenants in contracts. The content of compensation clauses can differ greatly among contracts. The heterogeneity of this variable is probably the reason why no relationship was detected between the existence of a compensation clause and rent. Moreover, the number of contracts with compensation clauses was limited to approximately five percent of all contracts.

4.4 **Landlord and Tenant Characteristics**

The place of residence of the landlord creates a statistically significant effect on land rent. The coefficient has the expected positive sign. Everything else being equal, rent for parcels leased from a local landlord is higher per acre than for parcels rented from an absentee landlord.

Rent of parcels contracted between related parties does not differ statistically from that of parcels contracted between non-related parties. The fact that rents do not differ between teams of related and unrelated parties suggests that tenant and landlord who are related both gain as compared to a contract with a potential non-related party.

The number of years a parcel has been rented to the same tenant by the same landlord has a statistically significant negative effect on rent. The longer a tenant rents from the same landlord, the lower the rent. Theory cannot postulate the direction of the impact a priori. A negative impact of tenant occupancy on land rent appears to indicate that landlords are the major beneficiaries of longer-term occupancy and that sitting tenants increase their bargaining power the longer they occupy the land.

5 **Summary and Conclusions**

The purpose of this study is to make a contribution to the understanding of agricultural land rent determination. Such understanding is valuable in ex post verification of ex ante land appraisal on the basis of comparable rentals. In addition it provides groundwork for investment decisions. Further, it furnishes insight into the effects of both contract terms as well as market participants on land rent.

Five different kinds of characteristics were postulated to determine land rent. Of the various soil and climate characteristics, drainage encumbrance points and CHUs stand out as major determinants in the formation of agricultural land rent. A second important soil feature affecting land rent is topography. Soil texture, depth, and damage due to soil erosion and/or flooding do not impact on land rent.

The kind of crops grown on land is also a major determinant in rent formation. Land used for horticultural crops (fruit and vegetables) rents at a considerably higher price than that employed for agricultural crops, ceteris paribus. The growing of high gross margin agricultural crops also exerts a strong positive impact on land rent. In addition to climate and two of the seven listed soil features as well as land utilization, the location of a parcel relative to urban centres has an influence on land rent.

Contract theory explaining the effect of transaction costs and income and asset value variance on rent has not been well developed (Coase, 1992). We have suggested several hypotheses concerning contract terms and market participants as they relate to land rent. In various cases no unambiguous effects could be hypothesized. Of the characteristics associated with the contract we found that only lease type, either oral or written, shows any influence. Of all characteristics associated with market participants, landlord residence and length of tenant occupancy have an impact on land rent.

The hypothesis that poorer quality land is exchanged at too high a price relative to good quality land cannot be conclusively verified by a hedonic price function. As indicated, the relationship between soil quality and rent is linked through yield as well as production cost impacts. Such linkages cannot be captured in a single hedonic price equation. Soil deterioration does not necessarily result in loss of yield or increase in production costs. Crosson and Stout (1983) found that among counties with five tons of soil erosion per acre or less in the Corn Belt, Northern Plains and Palouse Region, corn, soybean and wheat yields grew faster in counties that had higher erosion. If soil deterioration does not impact negatively on yield or positively on production cost, no effect on rent is expected.

Lately much interest has been expressed in the performance of the land market with respect to soil productivity consequences of soil erosion. Whether or not the market reflects these consequences has important ramifications for the formation of soil conservation policy designed to protect soil productivity. Although certain soil characteristics affect land rent in the study area, damage due to soil erosion does not. Lack of this relationship is no proof of market failure, however.

Lack of a relationship can also be caused by flaws in the measuring device itself and/or in the use of such device in measuring soil characteristics. Accurate measurement requires an objective yardstick with benchmarks. The benchmarks (encumbrance points) may not adequately reflect the state of the land with respect to its productivity. A point assigned to the quality of a particular soil feature must have a similar effect on productivity as a point assigned to the quality of any other soil feature. For example, topography with 7-12% slopes and drainage condition of the soil where some limitation of air and water movement exists, are both assigned 10 encumbrance points. This implies that the ceteris paribus effect of these quality features on productivity must be the same. Some kind of subjectivity was probably extant when the points were originally assigned for the various soil hazard qualities. How the yardstick is used is also important. Measurement of soil hazards in the study area was done by each tenant. A subjective assessment of soil hazards by tenants has its limitations. Such assessment may lack uniformity. One farmer may assess his land as having no erosion damage, while another may assess land of the same quality as being moderately damaged. More objective information from soil maps or measurements from the universal soil loss equation are often too gross to accurately assess damage on individual parcels. These macro measurements lack detail. As Erwin and Mill (1985) state, soil quality assessment requires painstakingly detailed work fraught with many conceptual and measurement complications.

In addition to measuring the effect of physical, locational and institutional factors on land rent, a hedonic pricing model also proves useful in evaluating changes in characteristics which can be manipulated. In that case the model can be used to value land improvements, such as installing subsurface drainage. Poorly drained land which scores 25 encumbrance points can be drained at a cost of approximately $500/acre to provide conversion into land of well-drained soil, ranking zero encumbrance points. As a result, rent increases by a factor 1.967 (computed from Table 1). Suppose poorly drained land rents for $35/acre. When upgraded, drained land will then rent for $69/acre. The resulting $34 annual increase in rent can be compared with the investment cost in order to determine whether it pays the landlord or tenant to upgrade.

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