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Estimation of Farmland Values for Assessment and Property Taxation in North Dakota

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FOREWORD

The authors wish to acknowledge the contribution of several Department of Agricultural Economics staff members in development of the land valuation model. They are: Dr. Jerome E. Johnson, Mr. LeRoy Schaffner, and Mr. Harvey Vreugenhil. Financial support for this study was provided by the North Dakota Legislative Council and the Department of Agricultural Economics, North Dakota Agricultural Experiment Station.

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Highlights

Property taxes will continue to be an important source of revenue for local units of government in the state. A recently enacted law which made two major adjustments in the assessment of real property is evaluated concerning tax shift between property classes and impact on farmland values. The new assessments law defines true and full value of farmland and range and pastureland to be its value as determined by the capitalization of income. Secondly, most classes of real property are moved to a uniform rate of assessment.

Use valuation of farmland results in adjustments within the local tax base. Changes occur in taxable valuation for each property class as a percent of total county taxable valuation. The effective tax rates on all property classes change with resulting tax shifts. Realignment of the assessment rates leads to a reduction of the tax shift impact. Tax shifts at the county level were estimated using 1979 revenue needs. Substantial variation is found in the direction and magnitude of shifts at the county level. Railroad and utility taxes are generally shifted to the other three property classes (agricultural, residential, and commercial). Several factors influence the magnitude of the tax shift: 1) the level of taxation, 2) the value and composition of the local tax base, and 3) the degree of adjustment required to conform with mandated state assessment levels.

A land valuation model is described which was developed to estimate productivity value of farm and rangeland. The valuation model produces average county land value estimates for the years, 1965 to 1979, using secondary data. The computer model is useful in equalization of assessments among counties. The impact of these changes in the assessment law may take several years to be reflected in land values. The impact on farmland values is expected to be small.

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The ad valorem property tax is a major source of revenues for financing goods and services provided by local governmental units. The property tax has been the target of much criticism and reform in recent years. Criticisms traditionally focus on the perceived inequity of the tax. Opponents of the tax challenge its relationship to ability to pay or to benefits received by the taxpayer [Beattie and Ransom, 1979]. Economic justification for continuation of the property tax rests on several historical bases [Raup, 1973]. It has been regarded as a wealth tax, where land and real property comprises the primary component of financial wealth. Secondly, if the relationship between income from property and the value of property is strong, the tax burden correlates with the flow of income.

Those who would abolish or reduce the role of the property tax, along with those advocating that the property tax be continued, reach a consensus relative to how the tax should be administered. Both groups agree that equity of the tax would be improved if greater uniformity of assessment were achieved in conjunction with other administrative reforms.

Jordre (1967) found that land with a lower market value was commonly assessed at a higher rate than land with a higher market value in North Dakota. The lack of uniformity between assessment districts and counties is related to several assessment practices and procedures.

Reforms in administration of the tax are slow, but have accelerated due to: 1) the impact of inflation and other economic pressures on land values; and 2) resulting decline of assessment ratios. The traditional capitalization of income method for valuing farmland and a summary of how it is currently applied in North Dakota are presented in this report.

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The Assessment Problem

Administration of the property tax is made difficult in periods of inflation. The process of assessment does not keep up with rising property market values. Since land is viewed as a good inflation hedge due to its scarcity as a resource, anticipated appreciation in market value leads to increased demand for land resources. Inflationary pressures distort the conventional relationship between productivity, as measured by the historic net income flow, and market value. Historically, classification of land by productivity in certain uses provided close correspondence between market value and economic activity. Impacts of inflation on market values reduce that correspondence and make these classes less functional as a basis for property tax administration.

Since a property tax based upon market value of real property is severely impacted by inflation, population, and other demand factors (not directly related to productivity), an alternative value base has been suggested and recently implemented in several states. The alternative which has been widely adopted for farmland is use-value or productivity-value assessment.

Several factors affect productivity of farmland: commodity prices, technological change, farm programs, and input costs [McD. Herr, 1979]. These factors are in turn influenced by inflation; therefore, land values based on a productivity (or use-value) approach are indirectly influenced by inflation. A productivity approach is less dramatically affected by inflation; therefore, farmland owners generally prefer it to current cash market value as a basis for taxation. Productivity value ignores the direct impact of inflation and population pressures on agricultural land prices due to scarcity when determining the full and true value of farmland for assessment.

An important economic issue concerns capitalization of resulting property tax differentials into real farm property values. Pasour [1975] found that property tax burden differentials are generally capitalized into farm real estate values. It takes years to fully evaluate the extent to which changes in property tax levels are capitalized into land market values. Changes in assessment rate or basis for valuation have almost immediate impact on property taxes if assessment ratios for the various classes of property are adjusted by different percentage amounts. If all classes of property experience the same relative change in assessment level and local

revenue needs are held constant, property taxes would remain unchanged. The full impact of these changes on land values, however, cannot be known until actual sales occur.

The shift to a system of use-value assessment is expected to influence land values. The magnitude by which property tax rate differentials are capitalized into land values varies from county to county as the effective tax rate changes . This differential impact occurs for two reasons:

1) Each category of taxable property (if assessed at a different ratio) has a unique effective tax rate equal to the nominal tax rate times the assessment ratio for that category of property, and

2) Certain differences exist among counties in the magnitudes and proportions of total market value comprised by the various categories of real property.

The effective tax rate for a given category of property in a particular period of time is a function of the revenue needs of the local governmental unit, the nominal tax rate, the assessment ratio for that category of real property, and the magnitude and underlying distribution of market values for the entire set of property categories [Deaton and Mundy, 1975]. Given constant total revenue demands of the taxing unit, the tax cost for a particular category of property will vary according to its percentage of total real property in each county.

Capitalization Method of Valuation

Farmland that continues to be used for farming has a value which is logically dependent upon the current and future income to be realized in agriculture. It is appropriate to utilize a method of valuation which relates the expected earnings from land over time to its current value. The method of converting an expected stream of cash returns to a current value equivalent is not new. Practically, however, the task of applying the technique to farmland is complicated by changes in interest rates, variability of annual returns, and rising price levels. The method of discounting cash flows to estimate land values is briefly developed in this section. The resulting capitalization formula is evaluated with and without the influence of taxes.

The value of farmland is defined as the discounted present value of expected income plus the discounted value of the land when resold. Value can be related to the constant stream of annual returns, R, for n years by using a constant annual discount rate, r.

$$(1)\quad V = \frac{R}{(1+r)} + \ldots + \frac{R}{(1+r)^n} + \frac{V}{(1+r)^n}$$

Equation (1) assumes that the price of land remains constant over time, and is the least complicated expression for the present value, V, of land. The cash returns are assumed constant, and the interest rate used to discount the cash flow is also constant.

The value expression in (1) can be viewed as a perpetual annuity if n is a sufficiently large number of years. The discounted sum, A, of the series of cash returns alone is then equal to,[1/]

$$(2)\quad A = R[1 - (1+r)^{-n}] /r$$

Substituting the right side of (2) into the value expression in equation (1) and solving for V, the familiar "capitalization formula" results,

$$(3)\quad V = R/r$$

The capitalization formula is an often used short method for approximating the value of farmland. Crowley [1974] suggests that the formula provides an accurate value estimate only if three conditions are satisfied: 1) if returns are constant, 2) if the capitalization rate, r, is constant, and 3) if an extremely long planning period is being considered. When these three conditions are not met (they rarely are) the capitalization method underestimates the actual rate of return on farmland. The capitalization formula is still frequently used to approximate the value of farmland even though it has several limitations.

Property taxes are levied against the value of farmland, yet are paid out of current revenues. To determine how property taxes potentially affect land values, the tax is deducted from returns before capitalizing.

$$(4)\quad V^1 = \frac{R - tV}{r}$$

where, t = the nominal tax rate

Rewriting (4) to place the land value variable on one side,

$$(5)\quad V^1 = R/ (r + t)$$

For positive tax rates the property tax implies that lower land values will result if the tax rate is raised. If land prices were allowed to rise at some constant rate, g, due to increasing annual income, an increase in the rate of property taxation would reduce the rate of value appreciation. The dollar

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[1]If equation (1) is treated as a perpetual annuity the present value of the land when resold becomes insignificantly small and can be ignored.

value of farmland theoretically would be higher than V^1 if property tax rates are less than the rate of growth in income.

Methodological Considerations

Defendants of the capitalization method concede that for the method to be applicable certain modifications are needed [Lee, 1976]. By expanding the capitalization formula to include more of the variables that affect income and the discount rate, the price estimate should be more realistic. It is generally agreed that usefulness of the capitalization method of valuation for the individual investor hinges upon the ability of the user to include additional factors in the value expression. These factors include: individual tax rates, growth of returns, opportunity cost of capital, financing terms, and others.

Our concern here is not with individual investor decisions relative to what land is worth as an investment. Rather, the impact of property taxes is a market problem. The value of land according to the productivity criterion can usefully be estimated to evaluate the impact of property taxes without greatly altering the capitalization formula. Average productivity value estimates for the market, or more limited geographic areas (counties), can be made with some confidence. Reliability of the implied farmland value estimates depends upon the representativeness of the underlying data and related methodological choices.

Two methods have commonly been used to estimate the capitalized value of farmland in its current agricultural use. The net returns method estimates the expected return per acre, deducts the normal costs of production and management, then divides the resulting net return per acre by the appropriate capitalization rate. The cash rental data method requires that sufficient cash rental data be available to estimate the average rental per acre. The average rental is divided by the appropriate capitalization rate to arrive at an estimate of the value of bare land. Theoretically, these two capitalization methods lead to approximately the same result. This is expected to occur since both the net return and the cash rent (under restrictive assumptions about competition in the land market) are estimates of the return to the land resource.

Net income from an acre of wheat in East Central North Dakota is computed in Table 1. The net return per acre equals $61.07 excluding indirect costs of ownership. Reducing the net return by a management charge of 9

percent of all nonland costs results in a net return of $54.41. If indirect ownership costs of machinery and equipment excluding land are deducted from this net return figure, the resulting net return per acre is $36.89. In this example the property tax on land is not included as an expense item. Capitalization of that expected net income using an arbitrary interest rate of 8 percent yields $461.13 as the estimated average value per acre for land with the assumed expected yield.

TABLE 1. ENTERPRISE BUDGET FOR ONE ACRE OF MEDIUM YIELD WHEAT IN EAST CENTRAL NORTH DAKOTA

Gross Income (35 bu. x $3.25)		$113.75
Expenses		
Seed	$ 8.25	
Fertilizer	5.45	
Herbicides	5.58	
Fuel and Lubrication	12.63	
Repairs	6.24	
Labor	6.66	
Other Expenses (including interest on operating capital)	7.87	
		$ 52.68
Net Income (gross income less expenses)		61.07

SOURCE: Reff and Schaffner, 1981.

A third variation of the capitalization method uses a landowner's net share method which is similar to the rental data method discussed above [Pederson, 1981]. This method capitalizes the landowner's share of gross returns per acre. No explicit accounting for the costs of production is made. Costs of production may vary from year to year and across crop enterprises, yet the landowner's share of gross returns (on a crop share basis) remains relatively stable from year to year. Crop share is subject to only a small amount of contract-to-contract variability and is commonly used in North Dakota. A one-third, two-thirds landowner-tenant arrangement is common in cropping areas of the state. The statewide distribution of crop share arrangements is illustrated in Figure 1.

The landowner's crop share is divided by a discount rate to yield a comparable capitalized value for agricultural land. The landowner's share of gross returns per acre of wheat would be $37.54 (.33 x $113.75) using

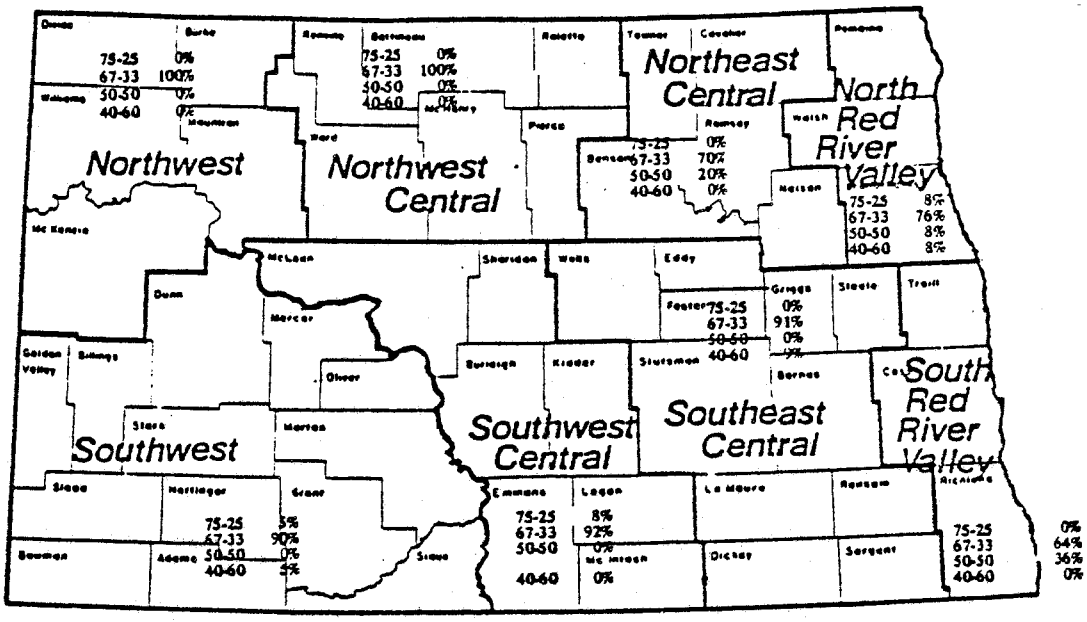

Figure 1. Percent of Crop Share Leases for Wheat in North Dakota, 1980

SOURCE: Johnson, 1981.

the above example. Capitalization of the landowner's share at 8 percent yields $469.25 as the estimated value per acre. The standard net returns method estimate ($461.13) and the landowner's net share method estimate are apparently quite comparable figures.

These two methods can be used to explicitly consider the expected impact of a change in the property tax rate on land value. Assume that the current ad valorem tax rate is zero percent, and increased to 1 percent. Since the property tax is a fixed expense assigned to land, it can be directly included in the total of expenses in the net returns method. Alternatively, the effective property tax rate could be added to the capitalization rate as shown above. When using the landowner's net share method, the property tax per acre could be deducted from the landowner's share in dollars, or the percentage share could be reduced by the property tax rate before estimating the landowner's share in dollars. Alternatively, the effective property tax rate could be added to the capitalization rate as discussed above. Table 2 illustrates the expected impact of a 1-percent increase in property tax rates upon the capitalized value per acre using the above hypothetical example.

TABLE 2. COMPARISON OF EXPECTED CHANGES IN CAPITALIZED VALUE PER ACRE WITH A ONE PERCENT INCREASE IN THE PROPERTY TAX RATE USING TWO CAPITALIZATION METHODS[a/]

	Net Returns Method		Landowner's Share Method	
	Property tax rate is		Property tax rate is	
	0%	1%	0%	1%
Property Tax/Acre	$ 0	$ 4.61	$ 0	$ 4.69
Returns/Acre (to be capitalized)	36.89	32.28	37.54	32.85
Capitalized Value/Acre	461.13	403.50	469.25	410.63

[a]An 8 percent capitalization rate is assumed.

The landowner's net return data substitute for actual rental data which are not always available or sufficiently reliable for use in determining land values. Moreover, the landowner's net return is an expected return and represents the land contribution to the returns which are generated. Both of these features are consistent with the capitalization method.

Use of share rents has been criticized as being a less reliable indicator of income from farmland [Beattie and Ransom, 1979]. The contention is that because share rents are stated in percentage terms, they can vary in amounts and cash equivalence with tenant management skills, weather conditions, and numerous market conditions which are relatively short-lived. These criticisms can be largely overcome in practice when working at the county level of aggregation and through the use of price and yield data which are not producer-specific, yet reflect the average actual experience of farmers.

An Agricultural Land Valuation Model

The North Dakota Legislative Assembly passed into law a system for assessing farmland, commerical-industrial, and railroad real property at the same percentage of true and full value in 1981.[2/] The law defines the true and full value of land used in agriculture to be the capitalized value of the landowner's net return per acre. The land valuation model which will be described in this section is the data system which was developed to determine average

[2]The exceptions are utility property which is assessed on a five-year declining assessment ratio schedule beginning at 14 percent in 1981 and declining to 10 percent by 1985, and residential property which is to assessed at a uniform 9 percent level.

county values of farmland. The model will be utilized in equalization of farmland assessments in the state as mandated by law.

The North Dakota farmland valuation model consists of two major components--a data processing model and an agricultural data bank. The data processing model is a computerized model which performs all necessary mathematical calculations. An earlier version of the data processing model has been reprogrammed into component programs to facilitate the processing of a large volume of stored data. This restructuring of the model results in a smaller, more efficient and flexible data processing system. Operationally, the model is designed to be interactive and conversational. Both features simplify use of the model. The processing model and the data bank are stored in North Dakota State University Virtual Storage Personal Computing (VSPC) on-line files. The data system is accessible through and compatible with standard computer printing terminals.

Agricultural Data Base

The agricultural data bank contains 20 years of historical data. Crop production and market price data are included for 22 major crop enterprises and summer fallow in North Dakota. Noncrop production data include rangeland and pastureland estimates. Major crops include: spring wheat (fallow), spring wheat (continuous), durum (fallow), durum (continuous), barley (fallow), barley (continuous), oats, rye, sunflower (oil), sunflower (non-oil), flaxseed, corn grain, corn silage, alfalfa hay, other hay, soybeans, sugarbeets, potato, durum (irrigated), spring wheat (irrigated), barley (irrigated), winter wheat, and summer fallow. Cropland production data consist of: acres planted, acres harvested, yield per acre planted, yield per acre harvested, summer fallow acreage, and production for the 22 crops listed above.

Market prices are estimated for all 22 major crops. The average annual state prices are adjusted to sub-state regional prices to reflect transportation cost differentials within the state.[3/] The nine crop reporting districts in North Dakota, as shown in Figure 2, were used as the basis for constructing the regional crop price estimates. Price indices are determined by calculating the ratio of average annual district prices to the state prices for one or a combination of crops. Separate indices are developed for: durum,

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[3]A price adjustment routine was developed by LeRoy Schaffner to index prices according to crop reporting districts in the state.

spring wheat and rye, winter wheat, oats, barley, and flax and sunflowers. Other crop prices remain at the state average price since production is marketed and used locally. The state price is converted to a county price estimate by multiplying by the price adjustment index.

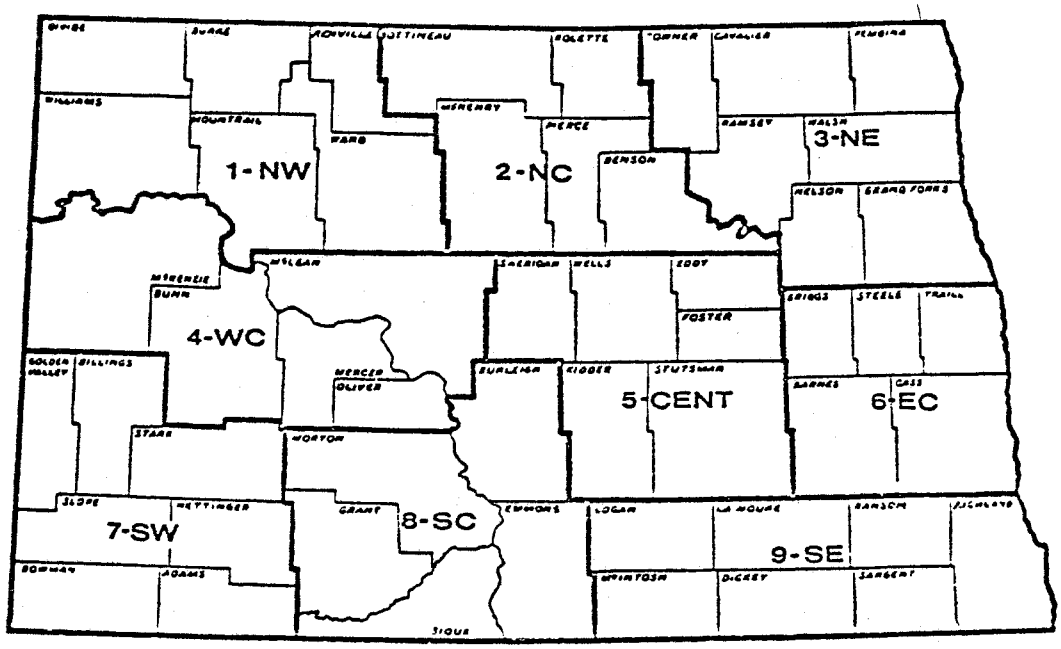

Figure 2. North Dakota Crop Reporting Districts

Government payment receipts are included in model estimates of gross returns. These payments are added to total cropland revenue estimates. Government payments data are included for the years 1967-79. Payment categories incorporated into the 1967-75 data set include: 1) agricultural conservation program, 2) cropland adjustment program, 3) conservation reserve program, 4) cropland conversion program, 5) wool applications, 6) feed grain program, 7) the wheat program, and 8) sugar program. The data set is comprised of disaster and deficiency payments for the major crops for the period, 1976-79.

Noncropland Production

Range and pastureland used in livestock production are two noncrop uses of land. County level estimates of acres in range and pasture are available

for 1958, 1967, and 1980.[4/] Acreages are converted to standard animal unit months (AUM) by multiplying carrying capacity per acre and the corresponding number of rangeland and pastureland acres. Animal carrying capacities are determined for the vegetation zones of North Dakota. Each zone is characterized by several site classifications. The "overflow, saline lowland, closed depression" classification for rangeland is built into the model [Dodds and Galt, 1973]. Pastureland has a 0.05 greater carrying capacity than rangeland in a comparable site class [Shaver, 1977]. Total revenue attributable to noncropland is derived by multiplying the number of AUM's and the value per AUM. The value per AUM is equal to .6494 (a feed conversion factor) times a composite price of hay. Table 3 illustrates the set of computations and data estimates which were used to derive total noncrop revenues for 1979.

Model Refinement

Criticisms of the landowner's share rent method can largely be circumvented through aggregation of data and choice of a reasonably comprehensive and representative set of farm enterprises. Capitalization of the landowner's share, as implemented in this model, produces reliable estimates of average value of farm and rangeland for two reasons. First, a large number of crop and noncrop activities are incorporated into the data set. Individual crops may be subject to large variations in yields and acreages in a given location. It is less likely that all crops will illustrate that degree of variability. Second, year-to-year fluctuations of individual crop prices illustrate short term market adjustments of supply and demand. All crop prices do not move together during these periods of price adjustment. While individual crop prices may illustrate seasonal or random changes, crops in aggregate maintain greater revenue stability. Even with the additional stability provided by crop aggregation, significant year-to-year

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[4]Estimates of the areas of private rangeland and pastureland by county in North Dakota were obtained from James L. Kramer with the Soil Conservation Service of the USDA in Bismarck. Range and pastureland estimates at the county level are not highly accurate figures. The acreage figures in most counties apparently underestimate the actual number of acres used for range and pasture. Comparison of 1979 Agriculture Census acreage with 1980 Conservation Service estimates indicate that in ten counties the Conservation Service figures significantly understate the number of range and pastureland acres. Those counties include: Bottineau, Dickey, Eddy, Emmons, LaMoure, McIntosh, Morton, Ransom, Rolette, and Slope.

TABLE 3. TOTAL NONCROPLAND REVENUE, NONCROPLAND REVENUE PER ACRE, AND LANDLORD'S SHARE OF NONCROPLAND REVENUE PER ACRE BY COUNTY IN NORTH DAKOTA, 1979

YEAR: 1979

COUNTY	ACRES RANGE	ACRES PASTURE	TOTAL ACRES	AUM RANGE	AUM PASTURE	TOTAL REVENUE	TOT REV/ACRE	LANDLORD SHARE
ADAMS	232814.	16780.	249594.	0.55	0.60	$ 3408305.	$ 13.66	$ 6.83
BARNES	29387.	48936.	78322.	0.75	0.80	$ 1509963.	$ 19.28	$ 9.64
BENSON	77624.	55879.	133503.	0.65	0.70	$ 2210353.	$ 16.56	$ 8.28
BILLINGS	241362.	3692.	245054.	0.55	0.60	$ 3128987.	$ 12.77	$ 6.38
BOTTINEAU	70838.	8158.	78996.	0.65	0.70	$ 1277181.	$ 16.17	$ 8.08
BOWMAN	337399.	30031.	367430.	0.45	0.50	$ 4117271.	$ 11.21	$ 5.60
BURKE	120956.	10195.	131151.	0.60	0.65	$ 1954448.	$ 14.90	$ 7.45
BURLEIGH	361990.	49267.	411257.	0.60	0.65	$ 6149991.	$ 14.95	$ 7.48
CASS	9179.	20154.	29333.	0.75	0.80	$ 567758.	$ 19.36	$ 9.68
CAVALIER	45842.	25538.	71381.	0.65	0.70	$ 1176467.	$ 16.48	$ 8.24
DICKEY	114087.	35320.	149406.	0.75	0.80	$ 2808777.	$ 18.80	$ 9.40
DIVIDE	187423.	11008.	198430.	0.60	0.65	$ 2951605.	$ 14.87	$ 7.44
DUNN	748416.	36181.	784597.	0.55	0.60	$ 10693557.	$ 13.63	$ 6.81
EDDY	10205.	48404.	58609.	0.65	0.70	$ 999823.	$ 17.06	$ 8.53
EMMONS	295321.	11861.	307182.	0.60	0.65	$ 4562844.	$ 14.85	$ 7.43
FOSTER	35530.	16238.	51767.	0.65	0.70	$ 850391.	$ 16.43	$ 8.21
GOLDEN VALLE	275516.	20993.	296508.	0.45	0.50	$ 3318547.	$ 11.19	$ 5.60
GRAND FORKS	26343.	25619.	51962.	0.75	0.80	$ 993317.	$ 19.12	$ 9.56
GRANT	517398.	28104.	545502.	0.55	0.60	$ 7438485.	$ 13.64	$ 6.82
GRIGGS	46020.	13021.	59041.	0.65	0.70	$ 963096.	$ 16.31	$ 8.16
HETTINGER	128565.	6443.	135009.	0.55	0.60	$ 1840347.	$ 13.63	$ 6.82
KIDDER	276587.	84753.	361340.	0.60	0.65	$ 5454692.	$ 15.10	$ 7.55
LAMOURE	7037.	72676.	79713.	0.75	0.80	$ 1564992.	$ 19.63	$ 9.82
LOGAN	207178.	24008.	231185.	0.60	0.65	$ 3452625.	$ 14.93	$ 7.47
MCHENRY	370570.	43920.	414489.	0.65	0.70	$ 6702673.	$ 16.17	$ 8.09
MCINTOSH	161260.	8868.	170128.	0.60	0.65	$ 2529903.	$ 14.87	$ 7.44
MCKENZIE	644849.	11077.	655926.	0.55	0.60	$ 8916193.	$ 13.59	$ 6.80
MCLEAN	304387.	25569.	329956.	0.60	0.65	$ 4916978.	$ 14.90	$ 7.45
MERCER	295658.	7708.	303367.	0.55	0.60	$ 4126941.	$ 13.60	$ 6.80
MORTON	604434.	16989.	621423.	0.55	0.60	$ 8455191.	$ 13.61	$ 6.80
MOUNTRAIL	525942.	7949.	533891.	0.60	0.65	$ 7914762.	$ 14.82	$ 7.41
NELSON	72721.	18998.	91719.	0.65	0.70	$ 1494627.	$ 16.30	$ 8.15
OLIVER	231995.	19720.	251715.	0.55	0.60	$ 3440728.	$ 13.67	$ 6.83
PEMBINA	2044.	12200.	14244.	0.75	0.80	$ 278678.	$ 19.56	$ 9.78
PIERCE	115340.	32613.	147953.	0.65	0.70	$ 2413437.	$ 16.31	$ 8.16
RAMSEY	5283.	38490.	43773.	0.65	0.70	$ 749615.	$ 17.13	$ 8.56
RANSOM	50995.	8990.	59985.	0.75	0.80	$ 1121293.	$ 18.69	$ 9.35
RENVILLE	59041.	12217.	71257.	0.65	0.70	$ 1158055.	$ 16.25	$ 8.13
RICHLAND	29167.	93349.	122515.	0.75	0.80	$ 2382677.	$ 19.45	$ 9.72
ROLETTE	55392.	10015.	65407.	0.65	0.70	$ 1061502.	$ 16.23	$ 8.11
SARGENT	44300.	57993.	102293.	0.75	0.80	$ 1984522.	$ 19.21	$ 9.61
SHERIDAN	221213.	10141.	231354.	0.60	0.65	$ 3438018.	$ 14.86	$ 7.43
SIOUX	511553.	29950.	541503.	0.55	0.60	$ 7386478.	$ 13.64	$ 6.82
SLOPE	290570.	20302.	310872.	0.55	0.60	$ 3860770.	$ 12.42	$ 6.21
STARK	262272.	22703.	284975.	0.55	0.60	$ 3895819.	$ 13.67	$ 6.84
STEELE	23285.	8048.	31333.	0.65	0.70	$ 512513.	$ 16.36	$ 8.18
STUTSMAN	302252.	38984.	341236.	0.75	0.80	$ 6363659.	$ 18.65	$ 9.32
TOWNER	14295.	30679.	44975.	0.65	0.70	$ 759255.	$ 16.88	$ 8.44
TRAIL	4989.	5705.	10694.	0.75	0.80	$ 204958.	$ 19.17	$ 9.58
WALSH	20814.	17788.	38602.	0.65	0.70	$ 688756.	$ 17.84	$ 8.92
WARD	279335.	5009.	284344.	0.60	0.65	$ 4216263.	$ 14.83	$ 7.41
WELLS	93344.	28547.	121891.	0.65	0.70	$ 1990363.	$ 16.33	$ 8.16
WILLIAMS	376904.	39635.	416539.	0.60	0.65	$ 6216313.	$ 14.92	$ 7.46
NORTH DAKOTA	10377220.	1388413.	11765634.			$ 172574804.	$ 14.67	$ 7.33

variations occur in landowner's share of gross returns. Consequently, several moving-average techniques were evaluated during the modeling phase to determine which averaging method most effectively smoothed the yearly county estimates of gross returns (see Appendix A).

Selection of a capitalization rate to use in the capitalization formula is a potentially difficult problem. The capitalization rate should theoretically reflect the opportunity cost of capital for investments with comparable risk, return, and maturity characteristics. Yet, there are few if any close substitutes for investment in farmland, especially for farmers. Consequently, states which have implemented a capitalization of income approach to valuation of farmland have adopted a moving average of the district Federal Land Bank mortgage interest rate for farm loans.

Federal Land Bank mortgage rates on real estate loans in recent years have increased as the cost of bonds, used by the Farm Credit System to acquire debt capital, has increased. The interest rate charged to FLB borrowers does not change as rapidly as the cost of new debt acquired by the System. This occurs due to the blending of the cost of all outstanding debt (new and old) of the Federal Land Bank. Consequently, the variable billing rate is lower than current market rates of interest and adjusts with a lag to changes in money market rates. The billing rate was used to develop the capitalization rate in this study. Since it changes at irregular times during the year, it is converted to an annual series for use in the model (Appendix B). The capitalized value of farmland is highly sensitive to variation in the chosen interest rate. A five-year simple moving average of the annual FLB mortgage rate series is used in the model. Excessive averaging of the FLB rate obscures financial market trends and distorts the opportunity cost of capital estimate. The five-year method has been used in several states and has been adopted by the Internal Revenue Service for purposes of capitalizing rents for valuation of gross estates [Harl, 1980a; Harl, 1980b].[5/]

Model Structure and Operation

Figure 3 is a schematic diagram of the data processing model and illustrates the logic and flow of data through the model. Total revenue from cropland, total revenue from noncropland, cropland acres and noncropland

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[5]The capitalization of rents method used by the Internal Revenue Service uses effective annual FLB rates. Effective rates are simply the 12-month rate divided by .95 to account for the 5 percent stock purchase requirement.

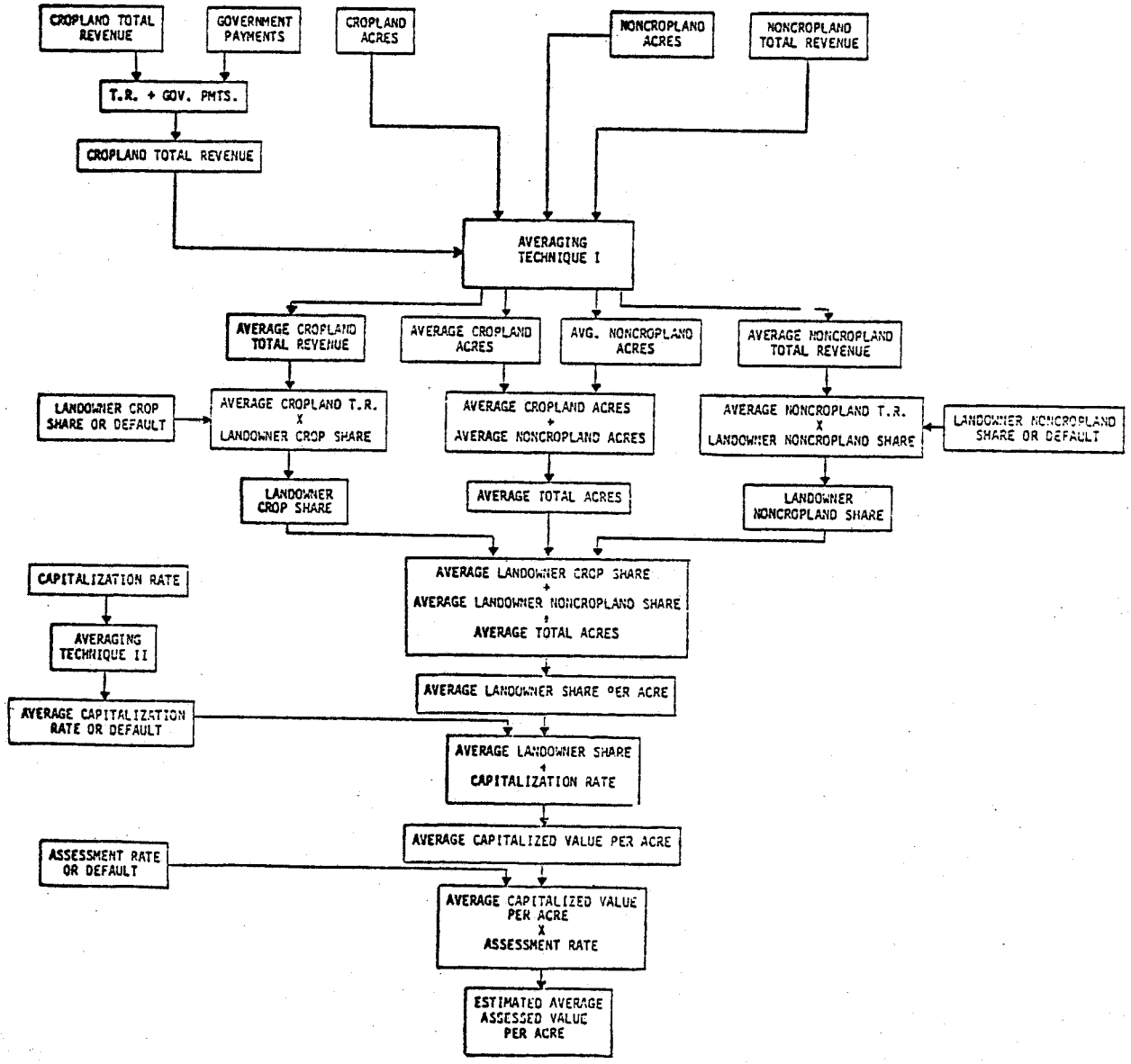

Figure 3. Schematic Diagram of Computer Program to Estimate Average County Agricultural Land Values in North Dakota

acres are the major data inputs. These revenue and acreage estimates are the result of submodel calculations.

Total county revenue from cropland is added to government payments to estimate total cropland revenue. Total cropland revenue, cropland acres, total noncropland revenues, and noncropland acres are averaged separately using the six-year moving averaging technique (Technique I) described in Appendix A. Average total cropland revenue is multiplied by the landowner's percentage crop share to estimate the landowner's share of gross returns. Similarly, average total noncropland revenue is multiplied by the landowner's percentage noncrop share to estimate the landowner's share of noncropland revenue. Different percentages are used for the landowner's share, 30 percent for cropland and 50 percent for noncropland. Average landowner share of crop plus noncrop revenues is divided by average total acres to yield an estimate of average landowner's share per acre. The Federal Land Bank capitalization rate is averaged using a five-year simple moving average (Technique II). An estimate of the productivity value of land results from dividing the average landowner's share per acre by the average FLB capitalization rate. Finally, an estimated average assessed value per acre is determined by multiplying the capitalized value per acre by an assumed percentage rate of assessment.

Submodels are utilized to calculate total cropland revenue and total noncropland revenue - the two major inputs to the main model. Total annual county crop revenue estimates are transferred to the main model by the cropland submodel described in Appendix C. Once animal unit carrying capacities have been estimated, the estimate of total county noncropland revenues is transferred to the main model by the noncropland submodel as detailed in Appendix D.

Numerical Results

In this section two sets of numerical results are reported. The first set of summary results provides state-level comparisons of model estimates with a proxy land market value (USDA market value estimate) and actual assessed value per acre. These initial comparisons (shown in Figures 4 and 5) use an 8.5 percent capitalization rate (which is consistent with technique II and original development of the model) and are provided to illustrate how the productivity model estimate adjusts over time. The second set of results is detailed by county to provide a basis for county-level comparisons of assessed values per acre. These results are the levels of assessment provided to the

counties as benchmarks for their assessment work in 1981. County-level results are derived using a 7.5 percent capitalization rate, which is one percentage point lower than the capitalization rate used in development and refinement of the model. The lower capitalization rate is the discount rate adopted by the North Dakota Legislative to implement the model in 1981 at the county level.

State-Level Results

The correspondence between productivity value and the USDA real estate market estimate at the state level is illustrated in Figure 4. The productivity value estimate exceeded the market value for North Dakota prior to 1972. This occurred for two reasons. First, the capitalization rate was lower prior to 1972 than it was in the post-1972 period. Second, the USDA market value is a conservative estimate of market value. Market value of farmland increased dramatically in most areas of the state during the 1973-79 period, as illustrated in the graph.

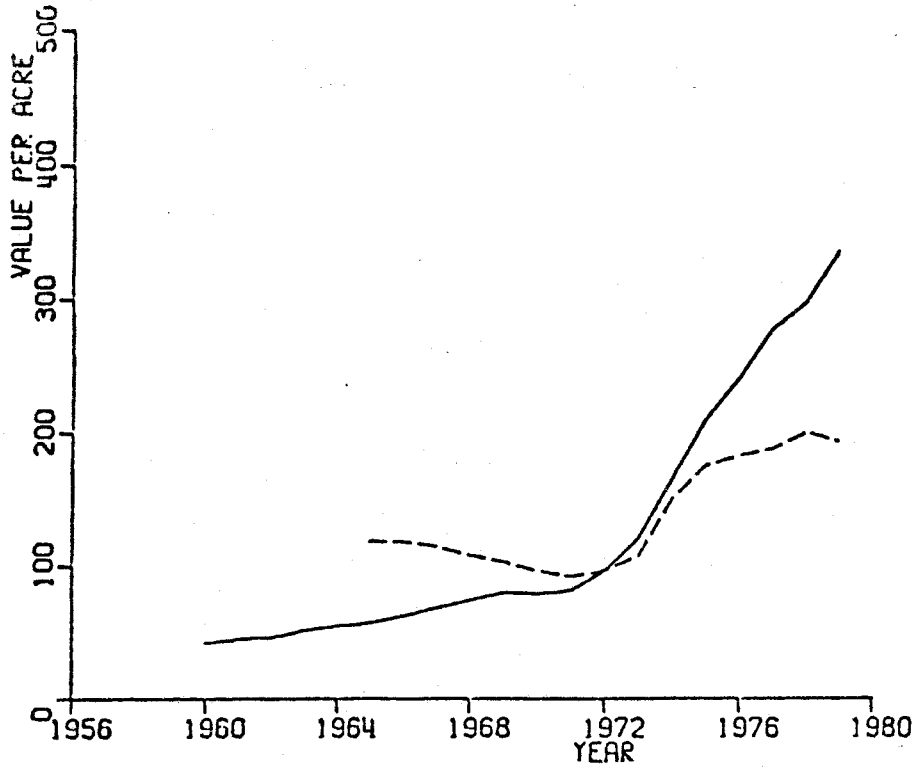

Figure 4. Estimated Average Capitalized Value (broken line), and USDA Average Market Value (solid line) for Farmland in North Dakota, 1960-1979

Figure 5 illustrates the relationship between the estimated average county assessed value per acre and the actual assessed value per acre for the entire state. The relationship was relatively poor prior to 1976, yet the post-1976 period provided estimates of assessed value per acre which were close to actual assessment levels.

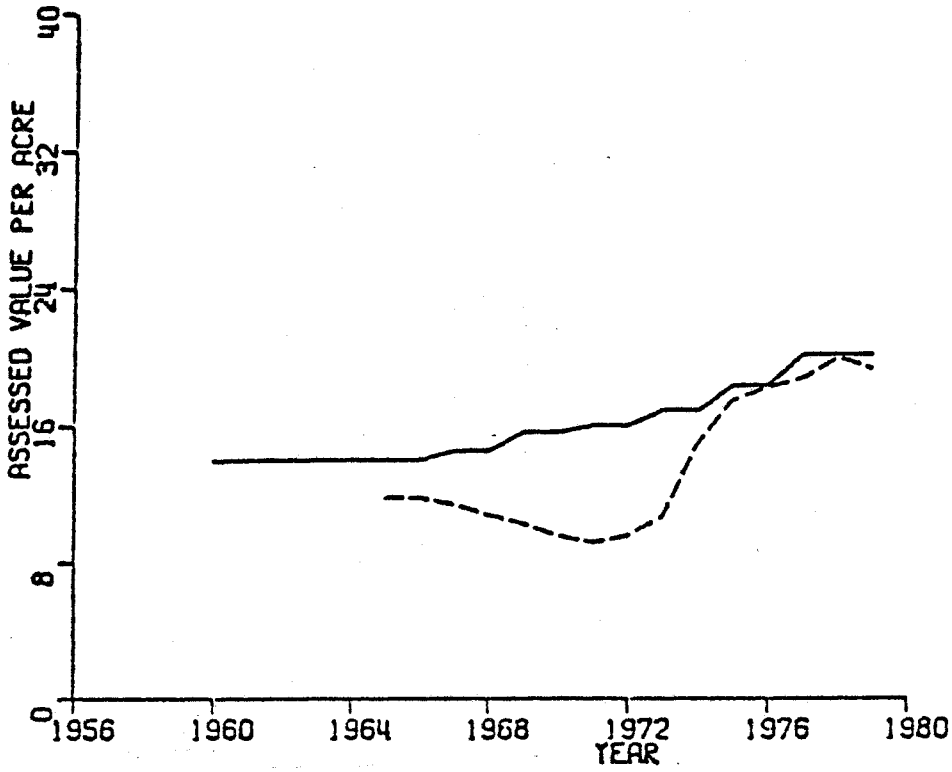

Figure 5. Estimated Average Assessed Value Per Acre of Farmland (broken line), and Actual Average Assessed Value (solid line) for North Dakota, 1960-1979

Generally, the land valuation model generates estimates of capitalized value per acre of farmland which; 1) capture significant regional differences in productivity of farmland, 2) illustrate some year-to-year variability due to change in returns per acre and movement of interest rates, and 3) indicate a gradual trend in productivity vlaue of farmland for the period 1964-79.

County-Level Results

Estimates of the productivity value of cropland and noncropland for the 53 counties are provided in Table 4 for 1979. Capitalized and assessed values generated by the model for each county in the state can be readily compared with the state value and with other adjacent counties in a substate region for 1979. Capitalized value per acre generally illustrates an expected regional

TABLE 4. ACREAGE, RETURNS, LANDOWNER'S SHARE, CAPITALIZED VALUE, ESTIMATED AVERAGE ASSESSED VALUE, AND ACTUAL AVERAGE ASSESSED VALUE BY COUNTY, 1979

COUNTY	TOTAL AGRIC ACRES CROP	TOTAL AGRIC ACRES NONCROP	TOTAL GROSS RETURNS PLUS GOVT PAYMENTS	GROSS RETURNS PLUS GOVT PMTS PER ACRE	LANDOWNERS SHARE OF GROSS RETURNS PLUS GOVT PMTS PER ACRE	AVERAGE CAPITALIZED VALUE OF FARM AND RANCHLAND PER ACRE*	ESTIMATED AVERAGE ASSESSED VALUE PER ACRE**	ACTUAL AVERAGE ASSESSED VALUE PER ACRE***
ADAMS	354860.	251377.	19034698.	31.40	10.64	141.93	14.19	18.19
BARNES	759030.	82290.	64945835.	77.20	23.57	314.21	31.42	31.20
BENSON	650400.	138011.	44409484.	56.33	17.52	233.63	23.36	20.07
BILLINGS	122280.	245219.	8090458.	22.01	8.45	112.65	11.27	10.11
BOTTINEAU	841010.	81987.	50142006.	54.33	16.61	221.44	22.14	17.66
BOWMAN	353800.	368723.	19237380.	26.63	9.23	123.01	12.30	12.40
BURKE	437860.	134608.	22502428.	39.31	12.55	167.33	16.73	15.34
BURLEIGH	485100.	415029.	31445162.	34.93	11.97	159.62	15.96	16.58
CASS	994690.	33332.	112660626.	109.59	33.01	440.18	44.02	45.01
CAVALIER	799310.	72522.	57377407.	65.81	20.04	267.20	26.72	23.06
DICKEY	464270.	156628.	36826774.	59.31	18.82	250.91	25.09	22.71
DIVIDE	549170.	199724.	30024707.	40.09	12.89	171.82	17.18	15.96
DUNN	416960.	786390.	30433435.	25.29	9.52	126.88	12.69	11.15
EDDY	269830.	60436.	17067787.	51.68	16.18	215.70	21.57	17.34
EMMONS	509820.	307729.	30732418.	37.59	12.49	166.50	16.65	16.27
FOSTER	334430.	57069.	24476177.	62.52	19.28	257.03	25.70	24.64
G VALLEY	222510.	298035.	15007264.	28.83	10.04	133.81	13.38	14.97
G FORKS	737330.	57848.	86699250.	109.03	33.01	440.15	44.01	35.05
GRANT	446570.	547011.	28528170.	28.71	10.24	136.52	13.65	10.95
GRIGGS	335520.	59165.	25885777.	65.59	20.21	269.40	26.94	23.87
HETTINGER	573600.	153036.	28680560.	39.47	12.47	166.26	16.63	16.93
KIDDER	413660.	365363.	26475837.	33.99	11.73	156.36	15.64	12.44
LAMOURE	551930.	87854.	42408156.	66.29	20.47	272.95	27.29	26.41
LOGAN	348650.	231744.	22801083.	39.29	13.08	174.36	17.44	14.15
MCHENRY	719410.	413469.	42335085.	37.37	12.49	166.50	16.65	13.45
MCINTOSH	394630.	173510.	24833335.	43.71	14.09	187.93	18.79	14.63
MCKENZIE	487340.	653778.	34884147.	30.57	10.86	144.75	14.47	13.47
MCLEAN	881920.	344823.	53154284.	43.33	13.90	185.39	18.54	19.77
MERCER	278320.	304467.	17803163.	30.55	10.70	142.70	14.27	16.38
MORTON	502330.	634693.	34766810.	30.58	10.81	144.20	14.42	13.84
MOUNTRAIL	647980.	536563.	40615591.	34.29	11.74	156.53	15.65	11.86
NELSON	504800.	96877.	35821969.	59.54	18.43	245.68	24.57	20.51
OLIVER	192280.	251147.	14581586.	32.88	11.54	153.88	15.39	14.04
PEMBINA	585050.	14976.	75744994.	126.24	37.98	506.35	50.64	32.38
PIERCE	491160.	147861.	28726081.	44.95	14.30	190.71	19.07	16.07
RAMSEY	648060.	52092.	44375433.	63.38	19.29	257.16	25.72	25.02
RANSOM	355020.	62941.	32212387.	77.07	23.73	316.39	31.64	25.05
RENVILLE	443460.	72030.	26079591.	50.59	15.67	208.92	20.89	19.80
RICHLAND	748100.	124063.	91608860.	105.04	32.11	428.12	42.81	36.16
ROLETTE	370700.	66629.	23210262.	53.07	16.46	219.42	21.94	18.27
SARGENT	356590.	107172.	31861147.	68.70	21.57	287.60	28.76	22.96
SHERIDAN	364690.	236605.	23347448.	38.83	12.91	172.09	17.21	13.73
SIOUX	144350.	546012.	14125395.	20.46	8.47	112.97	11.30	12.18
SLOPE	275460.	313489.	16942026.	28.77	10.08	134.45	13.44	11.27
STARK	511450.	284925.	28401454.	35.66	11.76	156.77	15.68	18.99
STEELE	385490.	32331.	36228307.	86.71	26.29	350.47	35.05	30.85
STUTSMAN	947780.	347944.	72092276.	55.64	17.77	236.99	23.70	22.09
TOWNER	559480.	47899.	39591440.	65.18	19.84	264.57	26.46	20.09
TRAILL	484960.	12775.	61462261.	123.48	37.15	495.37	49.54	41.85
WALSH	724580.	40407.	94082803.	122.99	37.10	494.65	49.47	35.14
WARD	897790.	297375.	58148709.	48.65	15.39	205.24	20.52	20.50
WELLS	659820.	127568.	45857097.	58.24	18.04	240.58	24.06	23.84
WILLIAMS	796680.	421158.	45918186.	37.70	12.43	165.70	16.57	16.36
STATE	27319740.	11953583.	2066530662.	52.62	16.75	223.36	22.34	20.17

* THE CAPITALIZATION RATE IS 7.50%
** ASSESSMENT RATE IS 10% FOR FARMLAND
*** ND TAX DEPT, ANNUAL STATISTICAL REPORT 1979

pattern. Land values are generally higher in the eastern Red River Valley region and gradually decline as one moves west in the state.

Since the estimated assessed value per acre is simply 10 percent of the capitalized value per acre, the substate regional pattern of land values can be reflected in a surface map (see Figure 6). The estimated average assessed value per acre for each county is plotted on the state map to coincide with the location of the county. The height of the surface indicates the dollar magnitude of the estimated assessed value per acre (see Table 4 for dollar values). Visual comparison of eastern, central and western counties indicates that land productivity declines dramatically on a county-wide basis as one leaves the Red River Valley region in the east.

The impact of the 1981 assessments law on average assessed value of agricultural land at the county level can be estimated via a comparison of the actual average assessed value per acre in 1979 and the estimated average assessed value per acre. The last two columns of Table 4 provide such a comparison in dollar terms.

Figure 7 illustrates the expected change in assessed value per acre. The greatest increases in average assessed value of farmland occur in the northern Red River Valley region. Decreases in average assessed value per acre occur in selected central and western counties in the state. A majority of the counties show an increase in the average county assessed value per acre. Twenty-four of the 53 counties in the state show an increase of 10 percent or more per agriculturally assessed acre. Four counties exhibit decreases exceeding 10 percent per assessed acre. Certain counties illustrate a relatively high percentage increase in assessed value per acre, yet in dollar terms experience only a small increase in assessed value.

A uniform pattern of increase (or decrease) does not occur in this comparison of county average assessed values for 1979. Two major factors contribute to this result. First, estimated productivity value is expected to be lo er than cash market value. It is generally the case that higher-valued land is under-valued relative to other land. Therefore, the relationship between market value of highly productive land and productivity value (as estimated in tne model) is subject to error and the est mate is biased downward. Second, tne assessment rate used in model estimation is uniformly 10 percent. It has been observed that tne assessment rates vary considerably between counties. The assessment rate averaged nearly 6.2 percent for farmland in 1979. The assessment rate differential between counties may be

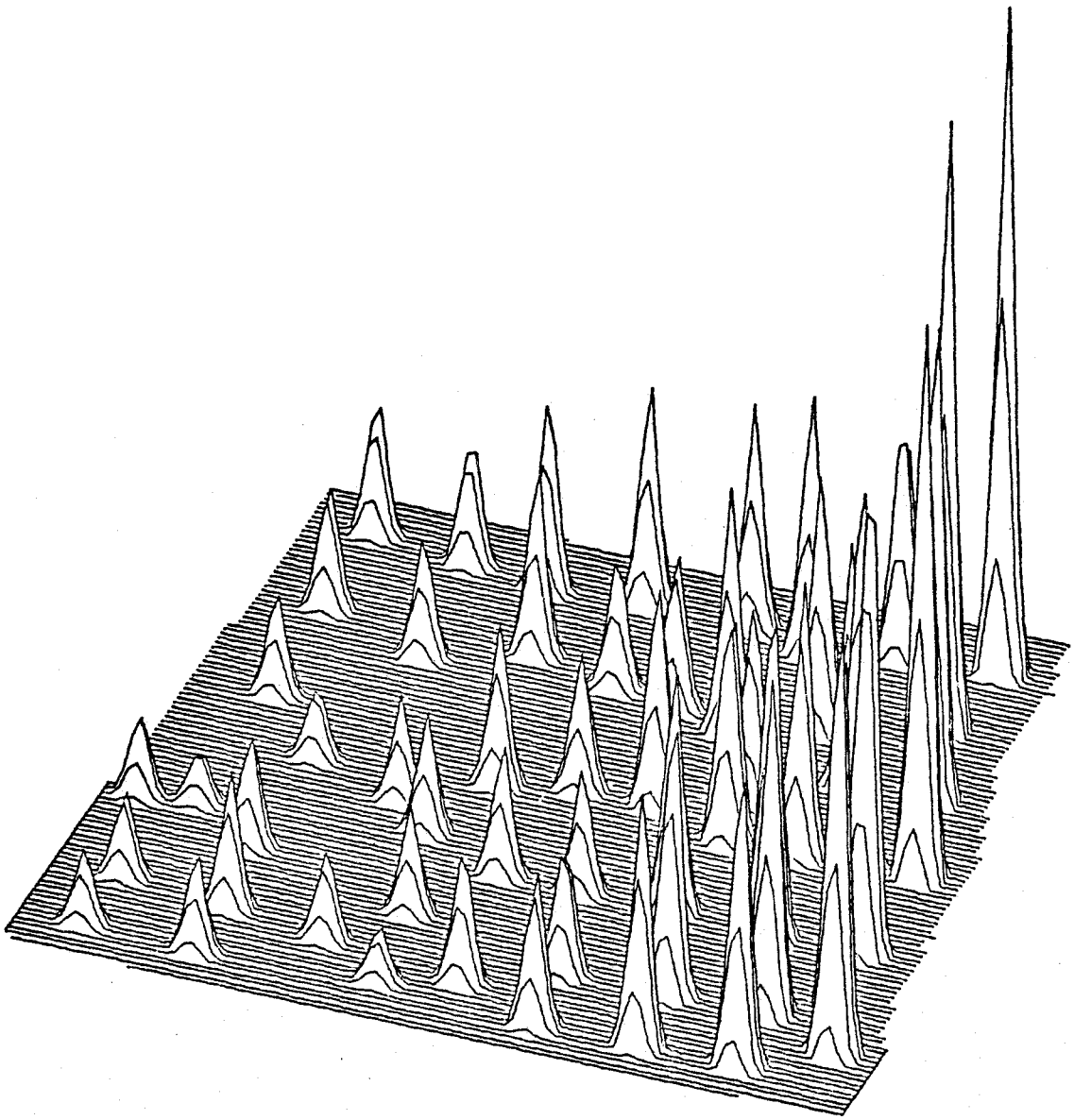

Figure 6. Surface Map of Estimated Average County Assessed Values Per Acre of Farmland for 53 Counties in North Dakota

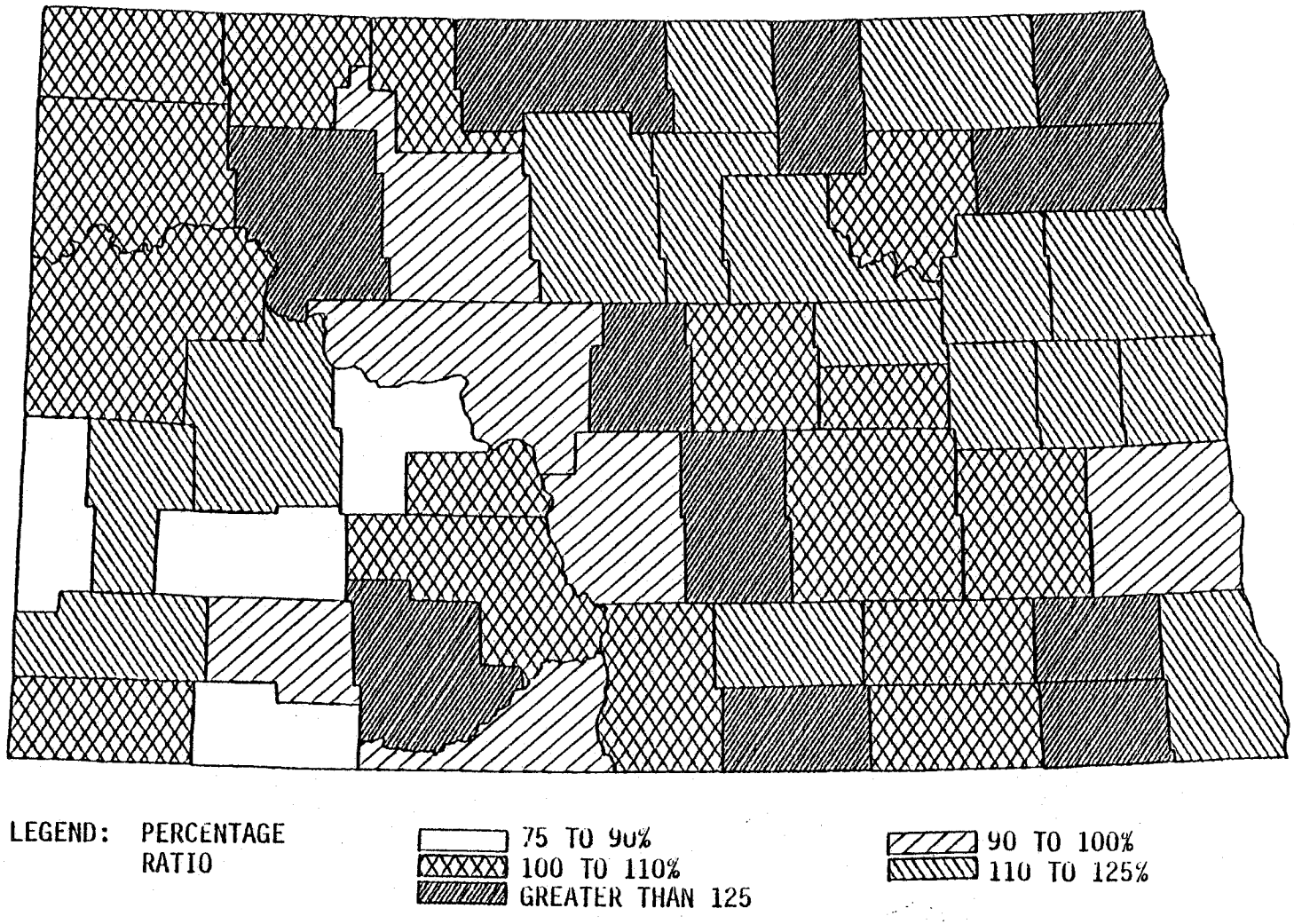

Figure 7. Ratio of County Average Estimated Assessed Value Per Acre to County Average Actual Assessed Value Per Acre for 53 Counties in North Dakota

significant in some areas of the state. In the following section, model estimates of the capitalized value of farmland are used to determine the degree of property tax shift which would occur between the major categories of real property in the state.

Tax Shift Analysis

Implementation of the 1981 North Dakota farmland assessment law is anticipated to result in certain shifts in the property tax burden. These shifts are related to several factors at the county level. The effective rate of taxation changes when use-value assessment is adopted for farmland. A change in the effective rate for a particular category of property, say farmland, is a function of local governmental unit revenue needs, the nominal tax rate (in mills), the assessment ratio for the subject class of property, and the magnitude and underlying distribution of market values for all property classes. Property tax shifts can be illustrated by holding county revenue needs, total property values, and the mix of property values constant within a given year for two hypothetical counties, while the assessment ratios and tax rates are allowed to change. Changes in the tax burden can then be compared within and between property classes in a given county, as well as between counties.

Assume two counties, county A and county B (as shown in Table 5), with 1) equal nominal tax rates prior to the introduction of use-value assessment of farmland, 2) equal total revenue requirements, 3) equal total taxable valuations and 4) constant, uniform assessment rates. The total tax burden to farmland owners will vary inversely in the two counties with respect to the ratio of farm property values to total county real property in each county. Once use-value assessment has been adopted, the nominal tax rates in the two counties must adjust to yield the same constant revenue. If county A has a high ratio of farm property value to total property value, the shift of property tax burden from farmland to other property categories would be small ($24). Farmland in county A would continue to pay the largest share of the total property tax levy ($1,776). In county B where farmland comprises a low proportion of total property and taxable valuation, a shift of the tax burden away from farm property to other property classes would occur ($400 is reduced to $224). In county B the effective tax rate on farmland would decline by a greater percentage, and farmland would experience a reduction in its tax burden as the nominal tax rate is increased to maintain total tax revenues.

TABLE 5. ILLUSTRATION OF A PROPERTY TAX SHIFT FOR TWO HYPOTHETICAL COUNTIES ADJUSTING TO USE-VALUATION OF AGRICULTURAL LAND

	County A		County B	
	Before Use-Valuation	After Use-Valuation	Before Use-Valuation	After Use-Valuation
Nominal Tax Rate	2.00%	2.22%	2.00%	2.22%
Total Taxable Valuation	$100,000	$90,000	$100,000	$90,000
Taxable Valuation (farm)	$ 90,000	$80,000	$ 20,000	$10,000
Taxable Valuation (nonfarm)	$ 10,000	$10,000	$ 80,000	$80,000
Total Revenue Needs	$ 2,000	$ 2,000	$ 2,000	$ 2,000
Effective Tax Rate (farm)	2.00%	1.97%	2.00%	1.10%
Tax (farm)	$ 1,800	$ 1,776	$ 400	$ 224
Effective Tax Rate (nonfarm)	2.00%	2.22%	2.00%	2.22%
Tax (nonfarm)	$ 200	$ 224	$ 1,600	$ 1,776

In North Dakota the relative tax shifts are slightly more complex than the above two-county example, yet the same principles apply. The 1981 assessments law reduces the taxable valuation for farmland by adopting productivity valuation, but additionally creates a uniform assessment ratio for most property classes with the exception of utility and residential property where uniformity had not existed between counties. The effective tax rate on farmland in a given county is reduced by the productivity value provision, but is increased by raising the rate of assessment on farmland to a 10 percent uniform rate. The reduction (or increase) in the effective tax rate on farmland in a particular county depends upon all of the factors listed above plus an additional factor. The additional factor is the spread which existed between the prior level of assessment on farmland and the new uni rate. If a county had been under-assessing relative to the state average assessment rate, then the alignment of assessment rates for the various property classes would have a greater impact in raising the effective tax rate, other things held constant The magnitude of the tax shift which would occur in a given county in North Dakota due to the change in level of assessment and redefinition of the value

of farmland will depend upon the same basic set of factors which affect the effective tax rate, plus the size of the county's revenue needs.

Within county shifts of the tax burden between property categories are difficult to ascertain in advance. One method which can provide estimates of the shifts which would occur involves holding each of the county tax collections at their 1979 level and then re-estimating the effective millage rates which would have to be applied to each of the property classes to collect the equivalent amount of total revenue. Figure 8 illustrates the percentage increase (decrease) in the 1979 farmland tax levy that would have occurred had the 1981 assessment law been in effect in 1979. Four counties (Pembina, Grand Forks, Rolette, and Morton) experience an increase in farm real estate taxes in excess of 10 percent. Five counties (Cass, Bowman, Stark, McLean, and Mercer) show a reduction of farm real estate taxes exceeding 10 percent. The remaining 44 counties experience a reduction or increase in real estate taxes of less than 10 percent. No clear regional pattern emerges with regard to increases or decreases in the state.

Numerical estimates indicate that considerable variability in tax shifts can be expected between property classes among counties. Two measures of the tax shift could be considered; 1) the dollar value of the tax reduction or increase for each category, or 2) the anticipated percentage change. While the percentage change figures illustrate the relative burden of the tax, it could be argued that actual dollar changes more accurately reflect the tax burden which is being reallocated. Percentage figures may obscure the size of the shift from utilities (which actually may account for a quite small proportion of the total county levy) to farm or residential property as compared with a relatively large shift from commercial property to the residential or farm property categories (dollar shift estimates are shown in Appendix E).

Figures 9 and 10 illustrate the estimated tax shifts which would occur for residential and commercial real estate at the county level holding total revenue needs constant.

A Statistical Model of Tax Shifts

Shifts in the property tax between the various classes of property at the county level can be statistically analyzed with the following model:

$$TXSH = f(ETXR, TVAL, PTVL, ITAX)$$

where, TXSH = change in taxes levied on the farm property class, in dollars

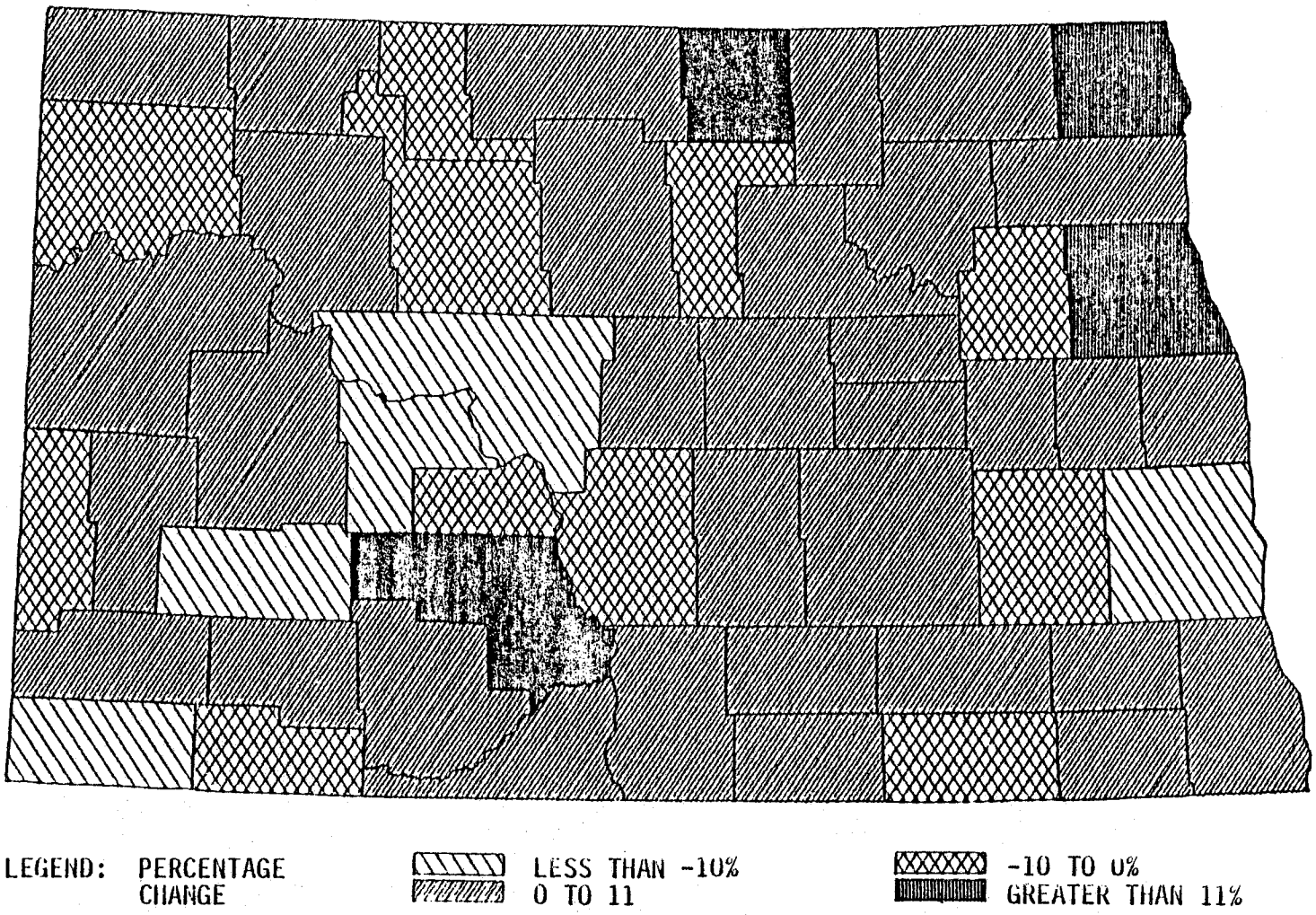

Figure 8. Anticipated Percentage Changes of Total Real Estate Taxes Levied on Farm Real Estate by County in North Dakota

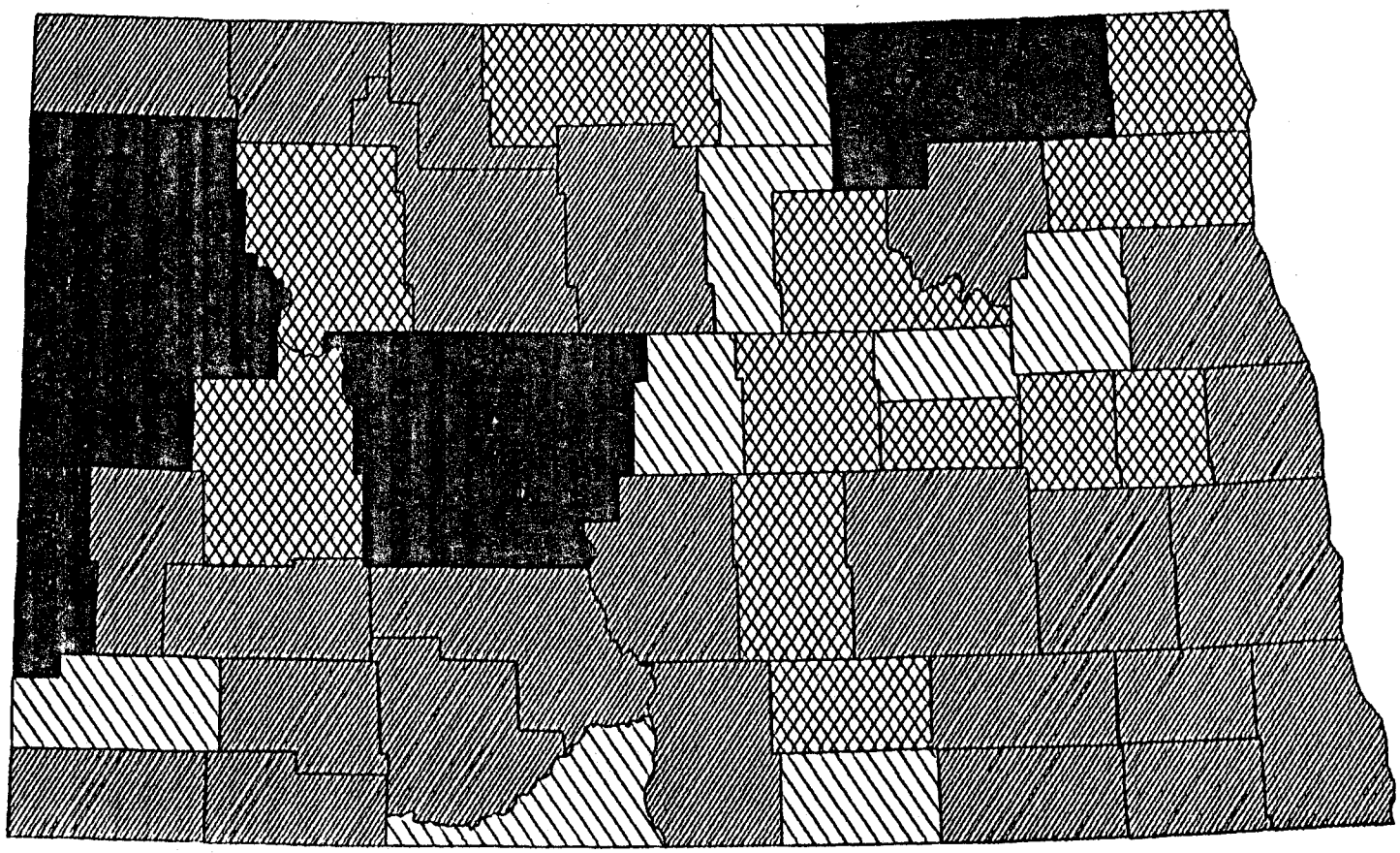

Figure 9. Anticipated Percentage Changes of Total Real Estate Taxes Levied on Residential Real Estate by County in North Dakota

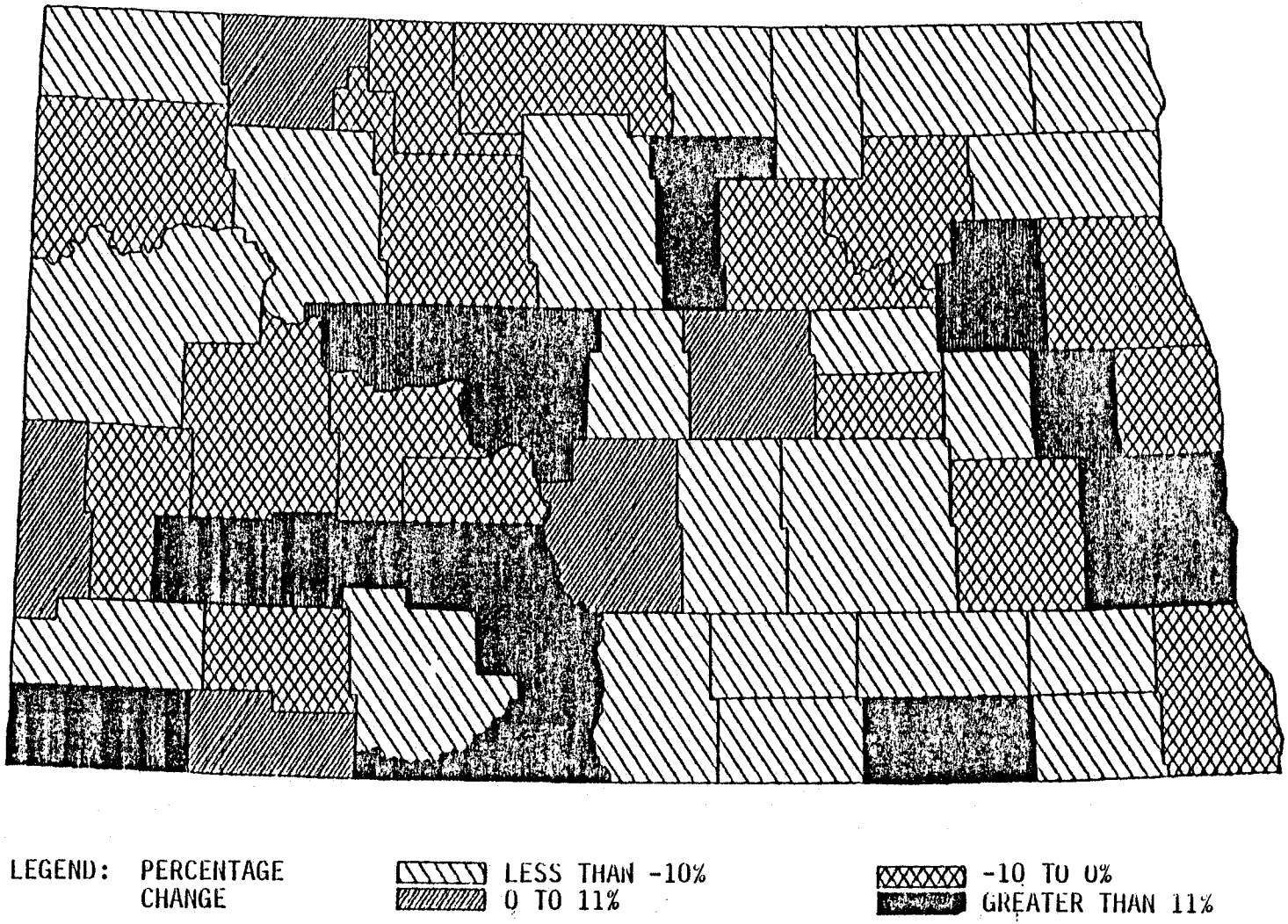

Figure 10. Anticipated Percentage Changes of Total Real Estate Taxes Levied on Commercial Real Estate by County in North Dakota

ETXR = effective tax rate on the farm property class, in mills
TVAL = total valuation of the farm property class, in dollars
PTVL = total valuation of the farm property class as a percent of the total real estate valuation for the county
ITAX = initial taxes levied on the farm property class, in dollars

The above variables were selected due to the implied relationship with the county tax base or level of revenue needs. These variables also coincide with the factors identified above in the hypothetical two-county example of tax shifts.

The above equation, estimated for the farm class of real property, provided the following results;

$$TXSH = \underset{(-1.73)}{-310{,}002^{*}} + \underset{(1.25)}{36{,}086{,}306}\ ETXR + \underset{(1.75)}{.0008^{*}}\ TVAL + \underset{(1.64)}{223{,}193}\ PTVL - \underset{(-1.88)}{.1916^{*}}\ ITAX$$

$R^2 = .22 \quad F = 3.5$

The figures in parenthesis are t-values associated with the estimated coefficients. Total valuation of farm real estate and the initial level of taxes levied on farmland were significant in explaining the tax shift.[6/]

The estimated regression coefficients provide an indication of the direction of impact of each variable on farm real estate taxes. The effective tax rate on farm real estate, computed as the adjusted tax levy on farmland divided by the total taxable valuation of farm real estate, is an indicator of the level of taxation. Effective tax rate was not found to be a significant factor in explaining the incidence of the tax shift for farmland. Several variables are used to compute the effective tax rate. The resulting measure of the effective tax rate was not highly correlated with the tax shift on farm real estate.

The initial level of taxes levied on farmland was significant as an indicator of level of taxation. It, however, was measured in dollar terms and does not reflect a rate of taxation. Logically, counties where farm real estate taxes are initially high relative to the average of all counties could

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[6]Both coefficients were found to be significantly different from zero at the 10 percent level. Asterisks on the estimated coefficients indicate those which were statistically significant.

expect that adoption of a productivity value concept would reduce the level of taxes on farm real estate, other factors held constant. The negative coefficient indicates that the relationship does occur.

Two variables were included to capture size and mix of the county tax base--the total taxable valuation of farm real estate and the percentage of taxable valuation which farm real estate comprises, respectively. Total taxable valuation is directly related to the magnitude of the tax shift to farm real property. In those counties where the taxable valuation is greater than the average valuation of all counties, the tax shift is toward farm real estate. Percentage of total taxable valuation comprised of farm real estate is not significant in the estimated equation. It was hypothetized above that the higher the percentage of farm real estate in the total tax base of a county, the smaller the tax shift away from farmland and into other property classes (consequently, the smaller the tax reduction for farmland). The positive coefficient on the percentage of taxable valuation variable is not significantly different from zero, yet indicates that the expected negative relationship does not hold.

Overall, the reported equation did not predict well and variables were not highly significant or carried a sign which was not expected. An underlying problem with the regression model is the manner in which the tax shift for farm real estate was measured. Refinement of the tax shift measure would be expected to yield more reliable and consistent results.

Implications

The ad valorem property tax will continue to be an important source of revenue for local units of government in North Dakota. Property tax reform will also continue to be an important political and economic issue in the state. Reform in the general area of property tax administration has focused on quality of property assessment. Quality of assessment improves only gradually since local units of government employ a large number of part-time assessors. Increasing use of computer data processing capabilities provides one avenue by which the rate of change in quality of assessment can be accelerated.

There are actually two processes by which real property becomes subject to the property tax. First, actual assessment of property requires that a value be established. Second, assessments are equalized to improve uniformity

across comparable parcels of property. This report focuses upon the traditional capitalization method of valuation to provide benchmark estimates of value of farm and rangeland which are useful in equalization across counties.

Changes in assessment laws are anticipated to create tax impacts now and in the future. Two changes in the North Dakota property tax were recently legislated. First, land used for agricultural purposes is to be valued on the basis of its contribution to current farm income, not its market value. Second, most classes are to be assessed at a uniform percentage of true and full value.

In this report, the traditional method by which the income stream from land could be used to provide an estimate of the value of the land resource at a point in time was reviewed. The resulting estimates were found to be significantly less than current market values of farmland, due primarily to market value appreciation of land in recent years.

A primary motivation for the above redefinition of value of farmland was the need to either assess all classes of real property at the same percentage of true and full value or to adopt a classification system in statutory form. The informal de facto classification system which had evolved in the state was ruled unconstitutional to comply with a State Supreme Court ruling. The assessment rate on farmland was necessarily raised while utility and railroad property rates were reduced to accomplish greater uniformity of assessment rates. Commercial property assessment rates remained at the state average of 10 percent. Residential property assessment rates were set at the state average level of 9 percent.

The joint tax shift impact of the two changes in property assessment practices (redefinition of true and full value of agricultural land and realignment of the assessment rates) were estimated for each county and the state. The general direction of the shift was away from railroad and utility properties toward farm, residential, and commercial properties. The extent of the shift for a particular property class and county depends upon several factors. The tax shift analysis (using 1979 revenue and tax base data) indicates that no single factor alone best describes the anticipated tax shifts which would occur. Characteristics of the local tax base tend to be somewhat better explanatory variables of the shift than are the associated levels of revenue needs and size of the initial tax burden.

Two conceptual issues have been raised in this report concerning the relationship between the property tax and farmland values. The first issue was illustrated by including the property tax rate as an additional variable in the formula for using the capitalization method of valuation. The value of farmland should decline over time if the tax rate is sufficiently increased. The second issue relates to the introduction of a productivity concept (use valuation) into the farmland assessment process. If use value is introduced, the effective tax rate will change depending upon factors related to local tax base, tax needs, and past assessment practices. Use valuation alone is expected to lower the effective tax rate on farmland, all other factors held constant.

These two issues are consistent in their implications for land values. Land values would rise if use valuation leads to a reduction of the effective rate of property taxation and the lower effective rate is used in the valuation formula. Changes in the effective tax rate and redistribution of the tax burden within a county are related to the proportion of farmland value to the total taxable valuation. It could be reasoned that in counties where agricultural land is a high proportion of the total tax base, the impact of use valuation upon land values will be small since the tax shift and change in effective tax rate will be small. Conversely, the impact upon land values in counties where farmland is a relatively smaller proportion of total taxable valuation is expected to be somewhat greater, all other factors equal.

This discussion remains somewhat conjectural since adequate current farmland market data do not exist in the state. Moreover, even if such data existed, the full impact of a change in the property tax could take several years to be reflected in land values. Immediate impacts of the new assessments law would be small and, therefore, tend to understate the overall impacts upon land values. Fortunately, the law requires that the sale price of all land bought after 1980 must be reported when the deed is registered.

The valuation model is useful as a first step in bringing about greater uniformity in the assessment of agricultural land. But the approach being used is necessarily limited in application to the county level due to the constraints which exist on the underlying data set.

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APPENDIX A
Discussion of Model Refinement Procedures

North Dakota crop prices show large year-to-year variation, especially since 1972. A first attempt at smoothing the returns per acre involved averaging crop prices. Eight price moving average techniques were evaluated:

1) a three-year weighted average using a declining-weight scheme,
2) an exponential weighting scheme,
3) a five-year average dropping out the high and low prices,
4) a six-year average dropping the high and low prices,
5) a seven-year average dropping out the high and low prices,
6) a five-year average dropping out the high and low prices but retaining the most recent year's price,
7) a six-year average dropping the high and low prices but retaining the last year's price, and
8) a seven-year average dropping the high and low prices and retaining the most recent year's price.

Due to large price swings, the shorter period averages fail to clearly capture the price trend. Longer period averages tend to portray the trend most clearly but elimination of the high and low prices from the moving average produce overly-conservative estimates of gross returns. The reason for this conservative bias in the 1972-79 period is that the highs are further above the average price than the lows are below the average price. Averaging prices alone and multiplying the averaged price series times production fails to satisfactorily smooth the estimate of gross returns. The primary reason is that yield per acre and the number of acres are also highly variable.

Both the six- and seven-year averages (dropping the high and low prices but retaining the most recent year's price) are effective techniques. These two techniques have been applied to several combinations of yield, prices and averages to derive smooth-trend estimates of gross returns. The smoothest average results when all three variables are averaged. The "cost" of using

the six- and seven-year average techniques is that both averages are somewhat conservative and several observations are lost (1960-64). Moving averages of each of the three variables (prices, yields, and acres) proves to be a cumbersome and costly approach. Consequently, it is beneficial to average total revenues (the product of yields, acreages, and prices).

Both the six- and seven-year techniques described produce estimates of average gross returns which are not able to "keep-up" with the annual gross returns estimates; therefore, a new weighted moving average routine was devised. The weights applied to individual year gross returns follow a sum-of-the-year's-digits (SYD) scheme. This scheme is commonly used by farmers and others to schedule machinery depreciation allowances. The formula for computing an SYD moving average for four years is:

$$SYD_4 = \frac{4R_t + 3R_{t-1} + 2R_{t-2} + R_{t-3}}{10}$$

Where, R_t = gross return for the year with the largest gross returns

R_{t-1} = gross return for the year with the second largest gross returns

R_{t-2} = gross return for the year with the third largest gross returns

R_{t-3} = gross return for the year with the lowest gross returns

Averages using a combination of weights and means of eliminating high and low year values produce the most satisfactory series for gross returns. Combinations which yield good results are: 1) a six-year SYD moving average of the remaining four years once the high and low gross retunrs have been dropped out, and 2) a similar seven-year moving average using the remaining five years. The six-year SYD moving average of the remaining four years' gross returns produces the best series for average annual gross returns (Technique I in Figure 3). This weighted-average technique is used to estimate the numerator of the capitalization formula.

APPENDIX B

Seventh District Federal Land Bank Farm Loan Interest Rates Expressed on a Twelve-Month Basis, 1960-1980[a/]

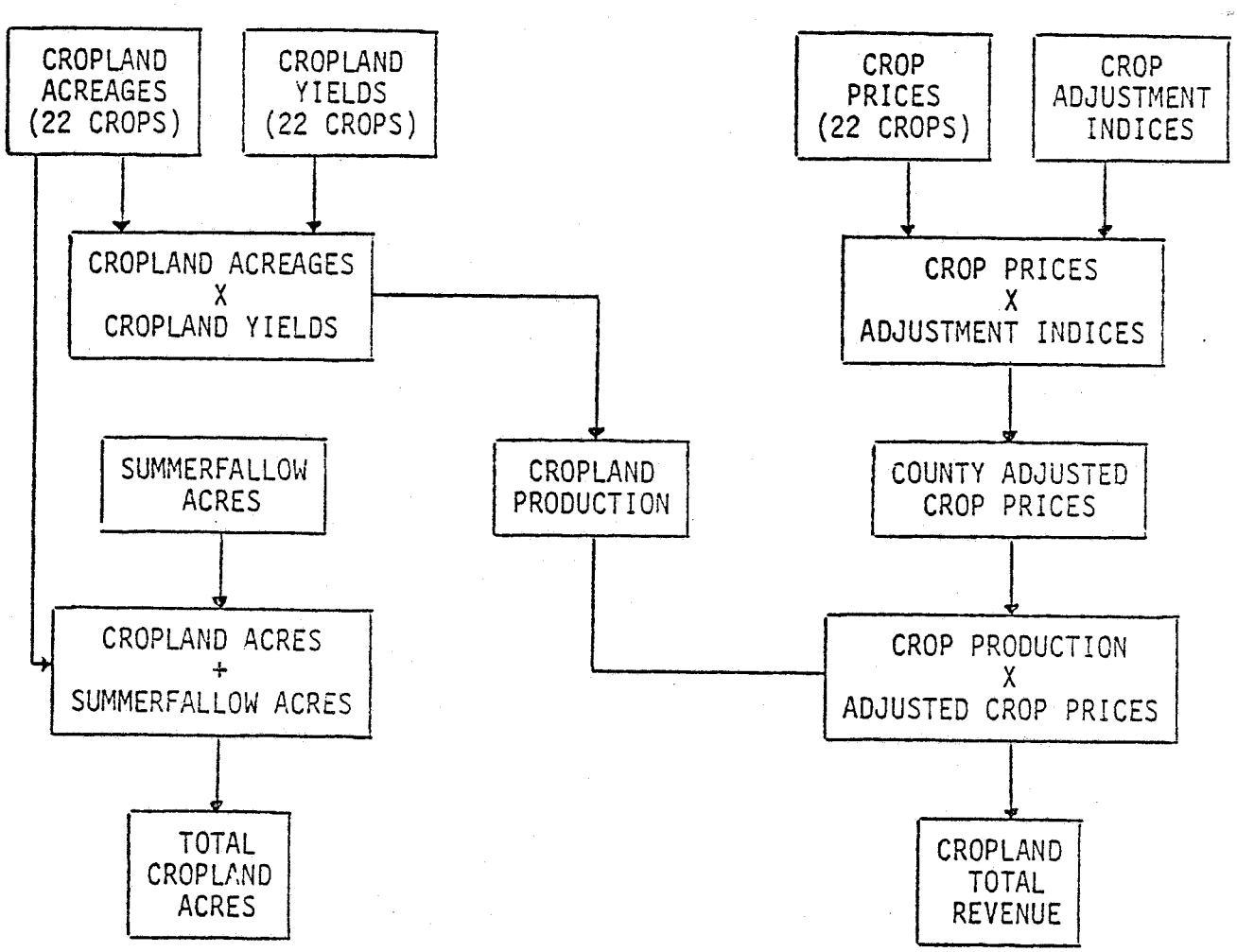
Year	Billing Rate(%)	Year	Billing Rate(%)
1960	6.00	1970	7.82
1961	5.50	1971	7.79
1962	5.50	1972	7.08
1963	5.50	1973	7.17
1964	5.50	1974	7.79
1965	5.50	1975	8.50
1966	5.76	1976	8.50
1967	6.02	1977	8.25
1968	6.80	1978	8.25
1969	7.67	1979	9.04
		1980	10.17

[a/] The billing rate changes at various times during the year as outstanding debt is retired and new debt is issued. To derive a uniform annual series of these interest rates a weighted average of the actual billing rate is computed. The actual billing rate is weighted by the number of months during the given year that the rate is in effect, the sum is for each year then divided by twelve.

SOURCE: G. D. Grinager, The Federal Land Bank of St. Paul Loan Interest Rates, March, 1981.

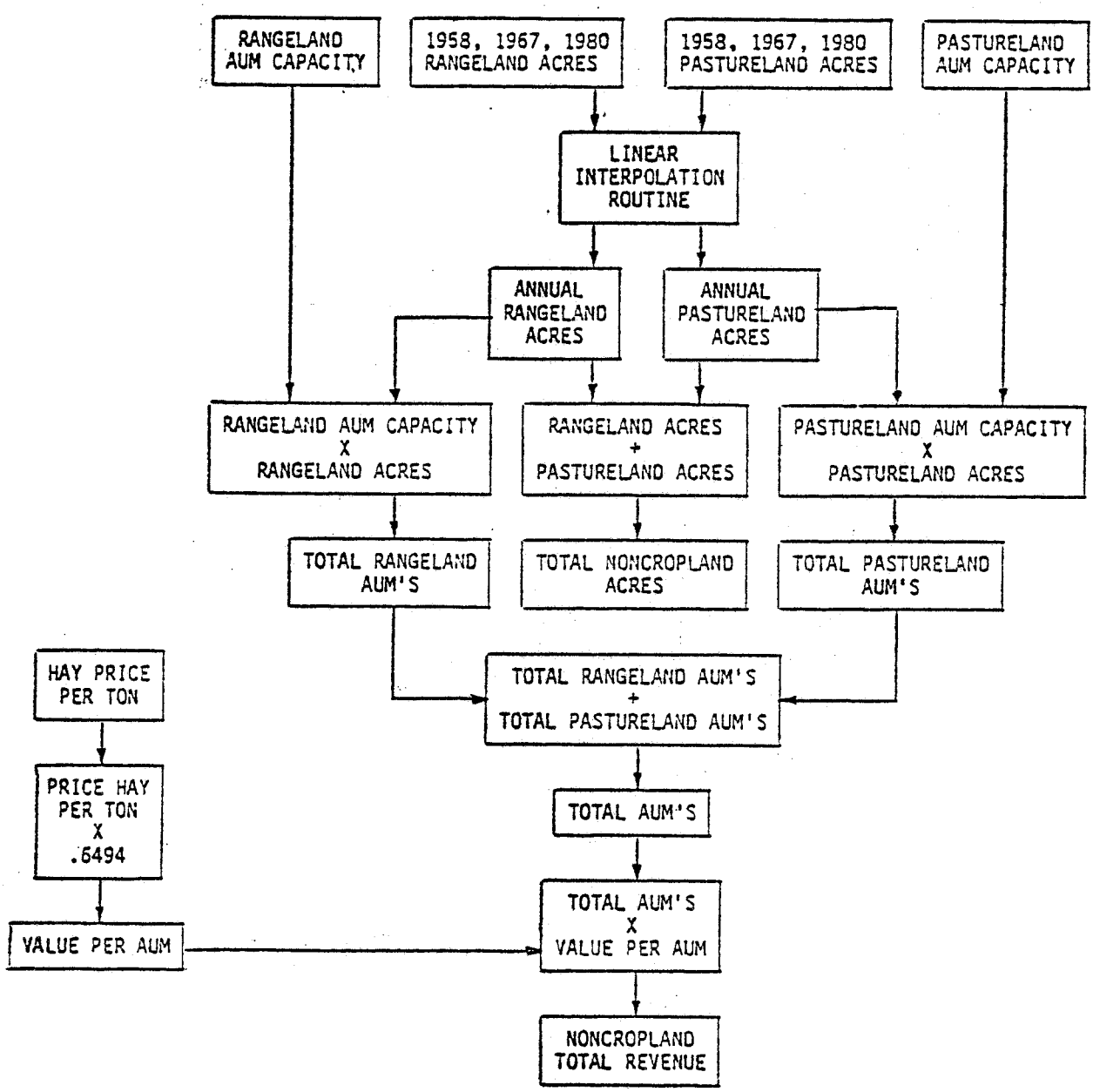
APPENDIX C

The Cropland Submodel



APPENDIX D

The Noncropland Submodel



APPENDIX E. NORTH DAKOTA REAL ESTATE TAX SHIFT ANALYSIS*

COUNTY	FARM PROPERTY	COMMERCIAL PROPERTY	RESIDENTIAL PROPERTY	RAILROAD PROPERTY	UTILITIES PROPERTY	TOTAL
ADAMS:						
1979 TAX PAID	761118.	101645.	208226.	10392.	27083.	1108464.
1979 ADJUSTED TAX	760577.	109692.	195659.	9785.	30676.	1106390.
PERCENT CHANGE	-0.07	7.92	-6.04	-5.84	13.27	-0.19
BARNES:						
1979 TAX PAID	2407098.	444726.	857315.	127128.	218979.	4055246.
1979 ADJUSTED TAX	2444808.	438352.	871624.	96357.	199231.	4050372.
PERCENT CHANGE	1.57	-1.43	1.67	-24.20	-9.02	-0.12
BENSON:						
1979 TAX PAID	1311523.	92653.	136883.	62062.	127218.	1730339.
1979 ADJUSTED TAX	1380383.	85399.	121542.	40467.	100150.	1727942.
PERCENT CHANGE	5.25	-7.83	-11.21	-34.80	-21.28	-0.14
BILLINGS:						
1979 TAX PAID	123920.	56632.	4213.	15266.	23961.	223992.
1979 ADJUSTED TAX	130952.	55897.	4005.	10824.	20390.	222067.
PERCENT CHANGE	5.67	-1.30	-4.96	-29.10	-14.90	-0.86
BOTTINEAU:						
1979 TAX PAID	1744778.	219068.	504083.	39556.	165103.	2672588.
1979 ADJUSTED TAX	1839967.	223630.	456175.	24803.	124977.	2669552.
PERCENT CHANGE	5.46	2.08	-9.50	-37.30	-24.30	-0.11
BOWMAN:						
1979 TAX PAID	582508.	124549.	223212.	10748.	49836.	990853.
1979 ADJUSTED TAX	517879.	203227.	222834.	7134.	39152.	990227.
PERCENT CHANGE	-11.09	63.17	-0.17	-33.63	-21.44	-0.06
BURKE:						
1979 TAX PAID	770031.	98768.	111833.	40232.	32673.	1053537.
1979 ADJUSTED TAX	783391.	104815.	108415.	28972.	28248.	1053840.
PERCENT CHANGE	1.73	6.12	-3.06	-27.99	-13.54	0.03
BURLEIGH:						
1979 TAX PAID	1533189.	4741828.	7776382.	84499.	895672.	15031570.
1979 ADJUSTED TAX	1553540.	5131148.	7421564.	67464.	857186.	15030902.
PERCENT CHANGE	1.33	8.21	-4.56	-20.16	-4.30	0.
CASS:						
1979 TAX PAID	4872258.	7802002.	9923410.	263001.	1947376.	24808046.
1979 ADJUSTED TAX	4383380.	9089543.	9545917.	183381.	1602361.	24804581.
PERCENT CHANGE	-10.03	16.50	-3.80	-30.27	-17.72	-0.01
CAVALIER:						
1979 TAX PAID	1725481.	199444.	308783.	30449.	62600.	2326756.
1979 ADJUSTED TAX	1819849.	97543.	334891.	21441.	53730.	2327454.
PERCENT CHANGE	5.47	-51.09	8.46	-29.58	-14.17	0.03
DICKEY:						
1979 TAX PAID	1135038.	180459.	329991.	15654.	120819.	1781961.
1979 ADJUSTED TAX	1135669.	208411.	326303.	10833.	99924.	1781139.
PERCENT CHANGE	0.06	15.49	-1.12	-30.79	-17.29	-0.05
DIVIDE:						
1979 TAX PAID	1097508.	104979.	176245.	11060.	38030.	1427822.
1979 ADJUSTED TAX	1147842.	66539.	172305.	7894.	33340.	1427920.
PERCENT CHANGE	4.59	-36.62	-2.24	-28.62	-12.33	0.01
DUNN:						
1979 TAX PAID	786469.	41936.	80442.	9712.	75299.	993858.
1979 ADJUSTED TAX	808923.	41436.	73989.	6734.	62592.	993674.
PERCENT CHANGE	2.86	-1.19	-8.02	-30.67	-16.88	-0.02
EDDY:						
1979 TAX PAID	577266.	98226.	184078.	31030.	51047.	941648.
1979 ADJUSTED TAX	634506.	90664.	151769.	21261.	43046.	941247.
PERCENT CHANGE	9.92	-7.70	-17.55	-31.48	-15.67	-0.04

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APPENDIX E. NORTH DAKOTA REAL ESTATE TAX SHIFT ANALYSIS* (CONTINUED)

COUNTY	FARM PROPERTY	COMMERCIAL PROPERTY	RESIDENTIAL PROPERTY	RAILROAD PROPERTY	UTILITIES PROPERTY	TOTAL
EMMONS:						
1979 TAX PAID	1150417.	54445.	178944.	11098.	44336.	1439241.
1979 ADJUSTED TAX	1170432.	44793.	173475.	8357.	40433.	1437490.
PERCENT CHANGE	1.74	-17.73	-3.06	-24.70	-8.80	-0.12
FOSTER:						
1979 TAX PAID	798721.	190967.	274829.	49797.	83045.	1397358.
1979 ADJUSTED TAX	848282.	186672.	244660.	37805.	76745.	1394165.
PERCENT CHANGE	6.21	-2.25	-10.98	-24.08	-7.59	-0.23
GOLDEN VALLEY:						
1979 TAX PAID	502005.	35436.	107914.	30284.	47914.	723554.
1979 ADJUSTED TAX	495687.	38353.	115514.	25148.	47637.	722339.
PERCENT CHANGE	-1.26	8.23	7.04	-16.96	-0.58	-0.17
GRAND FORKS:						
1979 TAX PAID	2980620.	4166146.	6105803.	144067.	1000367.	14397003.
1979 ADJUSTED TAX	3496060.	4021545.	5880823.	103883.	884574.	14386885.
PERCENT CHANGE	17.29	-3.47	-3.68	-27.89	-11.58	-0.07
GRANT:						
1979 TAX PAID	874875.	45102.	106504.	8549.	79141.	1114171.
1979 ADJUSTED TAX	912925.	32530.	101460.	5519.	61648.	1114081.
PERCENT CHANGE	4.35	-27.88	-4.74	-35.45	-22.10	-0.01
GRIGGS:						
1979 TAX PAID	868221.	84387.	140619.	37926.	17041.	1148195.
1979 ADJUSTED TAX	904396.	73645.	127568.	26897.	15021.	1147527.
PERCENT CHANGE	4.17	-12.73	-9.28	-29.08	-11.86	-0.06
HETTINGER:						
1979 TAX PAID	839198.	85017.	166102.	3929.	76717.	1170962.
1979 ADJUSTED TAX	849384.	86877.	159042.	3006.	70687.	1168995.
PERCENT CHANGE	1.21	2.19	-4.25	-23.49	-7.86	-0.17
KIDDER:						
1979 TAX PAID	750713.	42163.	92745.	43123.	46752.	975496.
1979 ADJUSTED TAX	792756.	33575.	83930.	28032.	36683.	974977.
PERCENT CHANGE	5.60	-20.37	-9.50	-34.99	-21.54	-0.05
LAMOURE:						
1979 TAX PAID	1279574.	95064.	190881.	30819.	65398.	1661736.
1979 ADJUSTED TAX	1314506.	82691.	179599.	22932.	59372.	1659101.
PERCENT CHANGE	2.73	-13.02	-5.91	-25.59	-9.21	-0.16
LOGAN:						
1979 TAX PAID	638047.	42011.	118938.	7376.	50740.	857112.
1979 ADJUSTED TAX	670656.	31011.	110152.	4900.	40817.	857536.
PERCENT CHANGE	5.11	-26.18	-7.39	-33.57	-19.56	0.05
MCHENRY:						
1979 TAX PAID	1170277.	110146.	220805.	128412.	119940.	1749580.
1979 ADJUSTED TAX	1264310.	83816.	213371.	84624.	95633.	1741755.
PERCENT CHANGE	8.04	-23.90	-3.37	-34.10	-20.27	-0.45
MCINTOSH:						
1979 TAX PAID	645112.	76262.	247302.	4349.	74992.	1048018.
1979 ADJUSTED TAX	713171.	68209.	205417.	2780.	58507.	1048084.
PERCENT CHANGE	10.55	-10.56	-16.94	-36.08	-21.98	0.01
MCKENZIE:						
1979 TAX PAID	976531.	114898.	155933.	6284.	112531.	1366177.
1979 ADJUSTED TAX	1001324.	74283.	187199.	4479.	96211.	1363496.
PERCENT CHANGE	2.54	-35.35	20.05	-28.72	-14.50	-0.20
MCLEAN:						
1979 TAX PAID	1787326.	246950.	498089.	15416.	122995.	2670776.
1979 ADJUSTED TAX	1636132.	308973.	607112.	11191.	105281.	2668689.
PERCENT CHANGE	-8.46	25.12	21.89	-27.41	-14.40	-0.08
MERCER:						
1979 TAX PAID	717848.	260283.	491651.	18357.	680719.	2168858.
1979 ADJUSTED TAX	623076.	252632.	667347.	13410.	598458.	2154922.
PERCENT CHANGE	-13.20	-2.94	35.74	-26.95	-12.08	-0.64

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APPENDIX E. NORTH DAKOTA REAL ESTATE TAX SHIFT ANALYSIS* (CONTINUED)

COUNTY	FARM PROPERTY	COMMERCIAL PROPERTY	RESIDENTIAL PROPERTY	RAILROAD PROPERTY	UTILITIES PROPERTY	TOTAL
MORTON:						
1979 TAX PAID	2028005.	860919.	1791835.	115224.	611613.	5407597.
1979 ADJUSTED TAX	1588576.	1293860.	1830561.	92215.	582305.	5387517.
PERCENT CHANGE	-21.67	50.29	2.16	-19.97	-4.79	-0.37
MOUNTRAIL:						
1979 TAX PAID	1065142.	151280.	306256.	87478.	77077.	1687232.
1979 ADJUSTED TAX	1178890.	105565.	285312.	55605.	59911.	1685284.
PERCENT CHANGE	10.68	-30.22	-6.84	-36.44	-22.27	-0.12
NELSON:						
1979 TAX PAID	1095141.	141877.	216698.	51851.	70561.	1576128.
1979 ADJUSTED TAX	1099700.	211278.	176536.	33180.	54061.	1574754.
PERCENT CHANGE	0.42	48.92	-18.53	-36.01	-23.38	-0.09
OLIVER:						
1979 TAX PAID	438895.	23645.	46458.	9983.	22003.	540983.
1979 ADJUSTED TAX	435493.	21781.	58514.	6827.	18012.	540626.
PERCENT CHANGE	-0.78	-7.88	25.95	-31.62	-18.14	-0.07
PEMBINA:						
1979 TAX PAID	1812671.	663964.	505835.	43408.	129472.	3155351.
1979 ADJUSTED TAX	2069241.	513726.	460059.	25251.	91397.	3159674.
PERCENT CHANGE	14.15	-22.63	-9.05	-41.83	-29.41	0.14
PIERCE:						
1979 TAX PAID	828423.	156720.	307729.	51432.	122845.	1467149.
1979 ADJUSTED TAX	838653.	246853.	251091.	33468.	95504.	1465570.
PERCENT CHANGE	1.23	57.51	-18.41	-34.93	-22.26	-0.11
RAMSEY:						
1979 TAX PAID	1722955.	786735.	970442.	84629.	257085.	3821846.
1979 ADJUSTED TAX	1807142.	751793.	954234.	65143.	239777.	3818089.
PERCENT CHANGE	4.89	-4.44	-1.67	-23.03	-6.73	-0.10
RANSOM:						
1979 TAX PAID	1194102.	117559.	298825.	39067.	88284.	1737837.
1979 ADJUSTED TAX	1259414.	89719.	291805.	25776.	70625.	1737340.
PERCENT CHANGE	5.47	-23.68	-2.35	-34.02	-20.00	-0.03
RENVILLE:						
1979 TAX PAID	797171.	47947.	119866.	15506.	23727.	1004217.
1979 ADJUSTED TAX	802572.	46716.	122621.	11117.	20417.	1003444.
PERCENT CHANGE	0.68	-2.57	2.30	-28.31	-13.95	-0.08
RICHLAND:						
1979 TAX PAID	2833725.	570892.	924313.	79132.	356528.	4764590.
1979 ADJUSTED TAX	2914260.	552915.	948499.	53189.	289087.	4757951.
PERCENT CHANGE	2.84	-3.15	2.62	-32.78	-18.92	-0.14
ROLETTE:						
1979 TAX PAID	726992.	168333.	325047.	13100.	96433.	1329906.
1979 ADJUSTED TAX	826667.	145202.	262065.	9541.	86617.	1330091.
PERCENT CHANGE	13.71	-13.74	-19.38	-27.17	-10.18	0.01
SARGENT:						
1979 TAX PAID	999194.	107312.	145133.	23348.	93618.	1368605.
1979 ADJUSTED TAX	1061767.	76320.	140933.	15031.	73176.	1367226.
PERCENT CHANGE	6.26	-28.88	-2.89	-35.62	-21.84	-0.10
SHERIDAN:						
1979 TAX PAID	611455.	29937.	49413.	8864.	44107.	743777.
1979 ADJUSTED TAX	641825.	24671.	35643.	5736.	35150.	743025.
PERCENT CHANGE	4.97	-17.59	-27.87	-35.29	-20.31	-0.10
SIOUX:						
1979 TAX PAID	312387.	8276.	19034.	1091.	6034.	346822.
1979 ADJUSTED TAX	315140.	11411.	13309.	891.	5918.	346670.
PERCENT CHANGE	0.88	37.88	-30.08	-18.33	-1.92	-0.04

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NDIX E. NORTH DAKOTA REAL ESTATE TAX SHIFT ANALYSIS* (CONTINUED)

TY	FARM PROPERTY	COMMERCIAL PROPERTY	RESIDENTIAL PROPERTY	RAILROAD PROPERTY	UTILITIES PROPERTY	TOTAL
SLOPE:						
979 TAX PAID	446240.	1454.	6258.	2435.	6970.	463356.
979 ADJUSTED TAX	451132.	979.	4253.	1813.	5705.	463881.
ERCENT CHANGE	1.10	-32.70	-32.03	-25.52	-18.15	0.11
:						
979 TAX PAID	1273521.	1744022.	1279259.	84987.	337672.	4719460.
979 ADJUSTED TAX	1094749.	2015617.	1229977.	66514.	310214.	4717072.
ERCENT CHANGE	-14.04	15.57	-3.85	-21.74	-8.13	-0.05
LE:						
1979 TAX PAID	1094165.	70798.	86765.	15346.	57660.	1324734.
1979 ADJUSTED TAX	1107176.	82292.	77658.	10431.	47077.	1324634.
PERCENT CHANGE	1.19	16.23	-10.50	-32.03	-18.35	-0.01
MAN:						
979 TAX PAID	2162010.	1192244.	1892830.	107210.	481002.	5835296.
979 ADJUSTED TAX	2288228.	1085993.	1940431.	79352.	432230.	5824235.
ERCENT CHANGE	5.84	-8.91	2.51	-25.98	-10.14	-0.16
:						
979 TAX PAID	1146731.	95930.	154728.	21848.	39607.	1458033.
979 ADJUSTED TAX	1186642.	63882.	166671.	13005.	28526.	1458725.
ERCENT CHANGE	3.48	-33.41	7.72	-40.47	-27.98	-0.01
AIL:						
1979 TAX PAID	1893784.	397099.	503011.	49138.	125321.	2968353.
979 ADJUSTED TAX	1989378.	367168.	470665.	32705.	101564.	2961478.
RCENT CHANGE	5.05	-7.54	-6.43	-33.45	-18.96	-0.23
979 TAX PAID	2646882.	583903.	885732.	64675.	169985.	4351178.
979 ADJUSTED TAX	2871494.	520624.	797241.	39753.	125833.	4354946.
ERCENT CHANGE	8.49	-10.84	-9.99	-38.53	-25.97	0.09
979 TAX PAID	1989812.	2590213.	5293676.	153191.	689689.	10716582.
979 ADJUSTED TAX	1959078.	2667481.	5356846.	115256.	618409.	10717069.
ERCENT CHANGE	-1.54	2.98	1.19	-24.76	-10.34	0.
LS:						
979 TAX PAID	1373781.	133505.	286887.	59555.	100872.	1954599.
979 ADJUSTED TAX	1412155.	139137.	259443.	46576.	95435.	1952746.
ERCENT CHANGE	2.79	4.22	-9.57	-21.79	-5.39	-0.09
AME:						
979 TAX PAID	1699688.	880737.	1667431.	121154.	357534.	4726544.
979 ADJUSTED TAX	1635238.	919376.	1775346.	88495.	309994.	4728449.
ERCENT CHANGE	-3.79	4.39	6.47	-26.96	-13.30	0.04
DAKOTA:						
1979 TAX PAID	67600514.	31481486.	48005612.	2594227.	10824020.	160505858.
1979 ADJUSTED TAX	68869373.	33320261.	46973373.	1847182.	9379655.	160389846.
PERCENT CHANGE	1.88	5.84	-2.15	-28.80	-13.34	-0.07

SHIFTS WHICH WOULD OCCUR FOR 1979 UNDER SB2323.
CAPITALIZATION RATE USED FOR FARMLAND IS 7.50%.
ASSESSMENT RATES ARE 10% FOR FARMLAND, 9% FOR RESIDENTIAL,
FOR COMMERCIAL, 10% FOR RAILROADS, AND 14% FOR UTILITIES.