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REQUIREMENTS FOR CONTRIBUTIONS

Articles in the field of agricultural economics, suitable for publication in the journal, will be welcomed.

Articles should have a maximum length of 10 folio pages (including tables, graphs, etc.), typed in double spacing. Contributions, in the language preferred by the writer, should be submitted in triplicate to the Editor, c/o Department of Agricultural Economics and Marketing, Pretoria, and should reach him at least one month prior to date of publication.

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Contents

	<u>Page</u>
I. TRENDS IN THE AGRICULTURAL SECTOR*	1
INTRODUCTION	1
<u>Economic review</u>	1
Gross value of agricultural production	1
Net income of farmers	2
Agriculture's contribution to the gross domestic product	2
Expenditure on intermediate goods	2
Investment	2
Producer prices	3
Prices of farming requisites	3
Consumer prices of food	3
Consumer expenditure on food	4
BRANCHES OF INDUSTRY	
<u>Field crops</u>	4
Summary	4
Maize	4
Kaffircorn	5
Buckwheat	6
Wheat	6
Groundnuts	7
Sunflower seed	7
Dry beans	8
Tobacco	8
Cotton	9
Lucerne hay	9
Chicory	10
Sugar	10
<u>Horticulture</u>	10
Summary	10
Citrus fruit	11
Deciduous fruit	12
Bananas	12
Dried fruit	13
Viticulture	14
Vegetables	14
Potatoes	15
Rooibos tea	16
<u>Livestock</u>	17
Summary	17
Weather conditions	17
Stock numbers	18
Meat	19
Wool	21
Mohair	22
Karakul pelts	23
Industrial milk	23
Fresh milk	24
Eggs	25

* Compiled at the beginning of August 1970. Latest figures contained herein are provisional.

II. ARTICLES

1. Application and utilisation of agricultural sector accounts	27
- J.P.F. du Toit, University of Pretoria	
2. Farmland prices in South Africa, 1939-1966	33
- H.I. Behrmann, University of Natal	
B.H. Collett, Division of Agricultural Production Economics,
Economics, Pretoria	

III. STATISTICS	40
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Farmland prices in South Africa 1939-1966*

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INTRODUCTION

The price of farmland in South Africa has risen considerably since the great depression of 1933. This land price rise has been accompanied by occasional short downward trends, but since 1963 the increase has been phenomenal. The degree to which the land price has outstripped the increase in the prices of consumer goods, agricultural requisites, is shown in Figure 1.

Various authorities in South Africa have deemed the high price paid for farmland "unjustified". The questions that are commonly raised concerning land prices and the land price trend are: Is the price paid for farmland too high? Why are land prices rising and how long will the increasing trend last? An attempt has been made to explain the land price trend in South Africa and hence to provide answers to these questions. A theoretical model has been constructed for this purpose and then tested empirically by means of multiple linear regression.

THEORETICAL FORMULATION

The land price, which is the dependent variable, is derived from the records of rural property transfers.¹⁾ Land prices, therefore, comprise land with its complement of fixed improvements. The non-farm factors which affect land prices such as mineral rights and industrial development are assumed to have a negligible effect on the average rural land price at a national aggregate level. Rural immovable property is valued according to its rent-earning capabilities in the farm business, in other words, according to income capitalisation, the exact form of which is expressed as follows:

$$V = \frac{I_1}{(1+r)} + \frac{I_2}{(1+r)^2} + \frac{I_3}{(1+r)^3} + \dots + \frac{I_n}{(1+r)^n}$$

* Based on M.Sc Agric. thesis, University of Natal: Collett, B.H. 1969. "Time series analysis of factors affecting farmland prices in South Africa, 1939-1966".

1) Bureau of Statistics 1940-1967: Transfers of Rural Immovable Property, Government Printer, Pretoria.

where V = current value of land and fixed improvements.

I_1 to I_n = future conventional and non-conventional returns to land and fixed improvements for the years 1 to n after the time of valuation respectively.
r = rate of capitalisation corresponding to the year of the income return.

Non-conventional returns to land, which arise from land price changes, complicate the application of the above formula over and above the difficulty involved in estimating appropriate conventional returns and capitalisation rates. The object of this study, however, is not to estimate the exact value of property, but to isolate the factors that determine the value of land. The equation is, therefore, expressed in the following functional form:

$$V = f(I, r)$$

In the model, the total returns to land and fixed improvements (I), are evaluated in terms of the present conventional income and the expected changes in future returns. The latter are realised in terms of non-conventional income changes in the short-run as these future expectations are capitalised into the value of land.

The rate of capitalisation (r) is governed by two separate phenomena. Firstly, the general rates of return on long term investment will affect capitalisation rates as this is the rate of return that would have to be earned on borrowed capital. There is also a tendency to equalise rates of return in all spheres by altering the values placed on capital goods accordingly. Secondly, the rate of return from land is affected by the demand for land. Since the supply of land is fixed, the ownership falls to those who are prepared to accept the lowest rates of return, i.e. use the lowest capitalisation rates in deriving values.

The aggregate value of land and fixed improvements is now expressed as follows:

$$V = f(CI, NI, i, DL)$$

where V = value of land and fixed improvements.
CI = current conventional returns.
NI = expected changes in future returns to land.
i = rate of interest yielded on long term investments.
DL = demand for land.

FIG. 1 - Index numbers of trends in prices of rural immovable property, farm produce, farm requisites and consumer goods in South Africa

Since the price paid for land, rather than the actual value of land is analysed, distinction between value and price is drawn into the model by means of the availability of finances. The harder buyers and sellers are pressed for finance, the lower will be the price paid in relation to the values estimated by both parties and vice versa.

The land price is now expressed as follows:

$$LP = f(CI, NI, i, DL, FA)$$

where LP = price paid for land and fixed improvements.

FA = level of financial availability, and CI, NI, i and DL are as defined above.

Since the analysis is conducted on a time series basis, the price variations arising from changes in the units of price measurements must also be included in the model, i.e. the inflationary trend.

The factors that affect the price of land are measured in the statistical analysis as follows:

1. Inflationary trends are corrected in the land price data by deflating the land price by the consumer price index. The corresponding net farm income, which causes inflation of the land price, is itself deflated in the manner in which it is measured in the analysis.

2. Current conventional returns to land are evaluated on a residual income basis which is highly sensitive to prices received for agricultural products, prices paid for requisites and the quantities of input and output. Agricultural output, and hence the return to land, is determined by the weather and lack of judgement of the market by producers in the short-term, and by the level of technology in the long-term.

- (a) Net farm income is measured by Hoover's proxy method²⁾ in terms of the ratio of the agricultural product price index to the price index of requisites other than fertilizer (X_1).
- (b) Fertilizer is considered separately from the other requisites as it is a good substitute for land and it is a short-term requisite which can easily be varied in accordance with product prices. This relationship is measured by the ratio of the fertilizer price index to the agricultural product price index (X_2).
- (c) The major changes in output over time are assumed to result from technological advance by way of phenomena such as mechanisation, plant and animal breeding, pest control and the creation of irrigation settlements. Technology has been interpreted as a change in

2) Hoover, D.M. 1961, A study of land prices in the U.S. Unpublished Ph.D. Thesis, University of Chicago.

output per unit of total input over a given period of time. In this case the concern is technological change in relation to the input of land. The total land input is regarded as fixed, as the total area of farmland in South Africa has varied a mere 7.36 per cent at the mean between the recorded lows and highs of 100.7 million morgen in 1939 and 108.4 million morgen in 1959 respectively, over the 27 year period³⁾. The change in output alone is therefore used as a measure of technology, i.e. the index of the volume of agricultural production (X_3).

3. Expected changes in the returns to land are introduced into the statistical analysis by means of the Nerlove-type distributed lag which is expressed as follows:

$$P_t - P_{t-1} = B(P_t^* - P_{t-1})$$

$$\text{or } P_t = (1-B)P_{t-1} + B.P_t^*$$

where P_t = actual land price in the current year (deflated)

P_{t-1} = actual land price in the previous year (deflated)

P_t^* = expected land price in the current period which is evaluated by the current land price determinants in model, and

B = coefficient of expectations where $0 \leq B \leq 1$.

The land price, which is the dependent variable in the multiple regression equation, is thus lagged and re-entered into the equation as an independent variable, (X_4).

4. Interest rate on long term investment and financial availability are measured jointly by the average interest rate paid on first mortgage bonds (X_5). Financial availability is considered to be represented by this measure as well, as it is the price paid for finances.

5. The population effect is measured by the population pressure on land which is considered in two ways.

Firstly, there is the total demand for land which is measured in terms of the total population density per square mile (X_6). In this way the demand for land for urban and Bantu homeland expansion, the potential and effective demands for farmland from the European urban and rural sectors, respectively, and the demand for farm produce, are accounted for. The effect of urbanisation is expected to relieve the demand for farmland as attractive urban employment opportunities would tend to counteract the desire to farm. This effect is measured by the actual distribution of the European population in terms of the percentage of the European population resident in urban areas, a measure which allows for the restriction of the effect by labour immobility (X_7).

3) Bureau of Statistics. 1938-1967. Reports on Agricultural and Pastoral Production 1936-37, to 1938-39 and 1945-46 to 1962-63. Agricultural Census Reports Nos. 17 to 37. Government Printer, Pretoria.

Secondly, only the effective demand for farmland is measured, i.e. the rural European population pressure which is expressed in 1 000 (X_8). This variable has limitations in that it does not represent the true demand for farmland but, on the other hand, it does not include the demand for farm products.

The data used in the multiple regression equations are listed in Table 1.

The three equations used in the analysis are as follows:

Equation No. 1: $Y = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + b_7X_7$

Equation No. 2: $Y = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_8X_8$

Equation No. 3: $Y = a + b_1X_1 + b_2X_2 + b_4X_4 + b_5X_5 + b_6X_6 + b_7X_7$

where a = constant term

b_1 to b_8 = estimated partial regression coefficients.

STATISTICAL RESULTS

The regression equations yielded by the three versions of the land price model are given in Table 2. All equations fit theoretical expectations despite the different values assigned to the volume of agricultural production, (X_3). Equations No. 1 and No. 3 are considered statistically superior to Equation No. 2 by way of the significance of the individual variables, the multiple correlation coefficient (R^2), the error mean square and the magnitude of the coefficient for the lagged dependent variable. The high value assigned to the lagged dependent variable in Equation No. 2 implies that bias has been incorporated in the estimation of this coefficient. This phenomenon would explain the absence of serial correlation in the residuals as shown by the Durbin-Watson statistic.

The actual and estimated land prices portrayed in Figure 2 and the expectation coefficient and the elasticities used in the interpretation of the results, are derived from Equation No. 1.

An examination of Table 3 reveals a high correlation between the measures of the demand for land (X_6 , X_7 , X_8) and the volume of production (X_3). The analysis of the coefficients assigned to these variables, therefore, warrants joint consideration in the interpretation of the results. The remaining independent variables are discussed separately.

The coefficient of expectations which is derived from the lagged dependent variable, has been estimated as 0.619. The high value of this coefficient shows that land owners base their future expectations only on the immediate past. The tendency to cling to past land prices is thus small.

The product/requisite price index ratio is positively related to the land price. The short-run elasticity of this ratio in relation to the land price

TABLE 1 - Data used in the estimation of the final aggregate South African short-run rural land price model.

Year	Y	X ₁	X ₂	X ₃	X ₅	X ₆	X ₇	X ₈
1938/39	5.89							
1939/40	5.55	77.7	141.7	84	5.83	21.6	70.4	637
1940/41	5.82	72.5	169.3	84	5.85	22.0	71.2	629
1941/42	5.81	74.8	161.3	84	5.51	22.3	71.9	622
1942/43	6.41	80.1	138.2	86	5.26	22.7	72.6	616
1943/44	7.90	79.2	139.2	89	4.94	23.1	73.4	610
1944/45	8.52	79.5	146.5	86	4.83	23.5	74.1	604
1945/46	9.79	84.0	147.6	84	4.81	23.9	74.9	595
1946/47	10.88	98.2	126.3	88	4.79	24.3	75.6	588
1947/48	11.79	116.4	102.5	102	4.85	24.8	76.3	577
1948/49	12.35	113.5	100.4	95	4.94	25.4	77.0	575
1949/50	11.08	112.6	97.4	103	5.09	25.9	77.7	571
1950/51	11.59	128.9	77.5	111	5.16	26.4	78.4	563
1951/52	11.45	112.2	101.3	104	5.17	26.9	79.1	554
1952/53	12.64	117.7	93.1	118	5.60	27.7	79.7	547
1953/54	12.91	118.2	82.9	125	5.99	28.4	80.3	540
1954/55	13.97	115.1	84.5	128	6.05	29.1	80.9	533
1955/56	15.28	114.2	92.4	136	6.06	29.8	81.4	527
1956/57	14.72	115.7	93.1	143	6.40	30.6	82.0	520
1957/58	16.35	112.5	89.9	138	6.51	31.4	82.4	515
1958/59	15.85	107.1	90.1	145	6.52	32.2	82.9	511
1959/60	15.31	107.4	88.0	151	6.48	33.0	83.3	508
1960/61	16.52	104.5	87.4	161	6.54	33.8	83.6	503
1961/62	16.81	103.5	89.4	174	6.67	34.5	83.9	501
1962/63	16.98	103.5	89.3	176	6.84	35.3	84.2	502
1963/64	20.33	109.4	84.4	170	6.47	36.1	84.4	506
1964/65	23.93	113.9	80.2	178	6.44	37.0	84.5	515
1965/66	15.12	113.7	81.7	178	6.77	37.9	84.6	524

Y = deflated average price paid for land (dependent variable) 4)5)6)

X₁ = product/requisite price index ratio 5)6)

X₂ = fertilizer/product price index ratio 5)6)

X₃ = index of the volume of agricultural production 5)6)

X₄ = lagged dependent variable, which is the same as Y, lagged one year $b_4 = (1 - B)$

X₅ = interest rate 6)7)

X₆ = total population density per square mile 5)6)

X₇ = percentage of European population resident in urban areas 5)7)

X₈ = rural European population (1 000) 5)7)

Source: Calculated from 4)5)6) and 7)

4) Bureau of Statistics, 1940 - 1967 *op cit.*

5) Department of Agricultural Economics and Marketing. 1967. Supplementary data to the Abstract of Agricultural Statistics of the Republic of South Africa, Government Printer, Pretoria.

6) Bureau of Statistics, 1960, Union Statistics for fifty years.

7) Bureau of Statistics, Statistical Year Book, 1966.

TABLE 2 - Estimated partial regression coefficients for the three versions of the South African land price equation ^(a)

	Equation No. 1	Equation No. 2	Equation No. 3
X ₁ Product/Requisite price index ratio	0.104 (0.046)	0.031 (0.052)	0.102 (0.057)
X ₂ Fertilizer/product price index ratio	0.041 (0.030)	0.028 (0.038)	0.048 (0.037)
X ₃ Volume of agricultural production	- 0.051 (0.042)	0.077 (0.033)	
X ₄ Lagged dependent variable	0.381 (0.183)	0.882 (0.147)	0.463 (0.212)
X ₅ Interest rate	- 1.075 (0.549)	- 1.466 (0.680)	- 1.435 (0.576)
X ₆ Total population density	1.571 (0.417)		1.183 (0.334)
X ₇ Urban European population percentage	- 0.568 (0.213)		- 0.512 (0.260)
X ₈ Rural European population		0.014 (0.017)	
Constant	5.801	-12.589	6.843
Error mean square	0.642	1.035	0.657
R ²	.991	.984	0.990
F - Value	146.049	104.377	166.303
Durbin-Watson statistic	1.423(*)	2.092(**)	1.544(*)

(a) The standard errors are shown in parenthesis

(x) Inconclusive test

(xx) No serial correlation in the residuals

FIG. 2 - Estimated and actual land prices in South Africa, at a constant consumer price level, 1947/49 to 1949/50 = 100

was estimated as 0.818 at the mean, i.e. a 1 per cent increase in the measure is associated with a 0.818 per cent increase in the price of land. This indicates the tendency for net farm income increases to be capitalised into land values.

The fertilizer/product price index ratio is positively associated with the land price which verifies the substitution relationship between land and fertilizer. If fertilizer prices increase relative to agricultural product prices, the demand for and the price of land tends to increase. The short-run elasticity of 0.335 at the mean indicates that a 1 per cent rise in the fertilizer/product price index ratio causes a 0.3 per cent rise in the price of land.

The interest rate on long term investments is negatively associated with the price paid for land. The short-run elasticity of the interest rate in relation to the land price was estimated as -0.473 at the mean, i.e. a 1 per cent rise in the interest rate depresses the land price by 0.5 per cent.

Population pressure and volume of production are closely related in their effect on the land price. The relationship of the volume of production to the land price is dependent on the measure of population pressure used. Where total population density is held constant as in Equation No. 1, the volume of agricultural production has a slight negative effect on the land price. In Equation No. 2, where total population density is not held constant, the volume of production is positively associated with an increase in the land price.

Under the assumption of a static population and no increase in consumption, an inelastic demand, the effect of volume of production on the average land price must surely be negative. Technological development gives rise to an increase in the production per unit area of land. The consumption of agricultural products, on the other hand, will not rise at a rate in proportion to the present rate of technological advance when the population is static. The surplus production will result in the withdrawal of land from intensive use, either naturally where prices are not interfered with, or the withdrawal will be forced where prices are artificially maintained as in the United States. The natural withdrawal process will result in a decline in the general land price. Only where the increase in production, that stems from technological development and consequent cost savings, is suffi-

cient to outweigh the product price decline, will properties increase in value. Where product prices are maintained artificially, the average land price will increase.

The assumption of a static population is far removed from the total population trend in South Africa. The expositions of the land price analysis given in this paper comprise two forms of population pressure measurement, i.e. the total population density coupled with the percentage European population in urban areas and the rural European population. The major difference between these two measures lies in the incorporation of the demand for agricultural products in the former and not in the latter. The measure of population pressure by the total population density, therefore accounts for the increased consumption of agricultural output. The residual effect of volume of production on the land price is then negative, which is what would be expected. Where the increased demand for products is not accounted for in the measure of population pressure, the effect of the increased output is measured by volume of production which is then positively related to the price of land.

The initial effect of the increase in the volume of production on the price of land is essentially positive owing to the increased output under a stable price structure. The maintenance of this effect requires the increase in the demand for farm products, and, on an aggregate basis, it is this increased demand that has the effect of increasing the price of land. The increased demand for products would have the effect of increasing the land value to an even greater extent if there was no increase in the corresponding supply resulting from technology. The effect of volume of production on the land price is, therefore, negative on an aggregate basis when the increase in the demand for farm products is accounted for in the analysis.

Urban development has the effect of depressing the price paid for rural land. The high degree of correlation between this variable and the total population density and the volume of production variable, renders the magnitude of the weight attached to urban development unreliable. Nevertheless, the process of European urbanisation has the effect of decreasing the price of rural land, assuming that the effect of the increased demand for agricultural produce by the urban population increase is removed.

TABLE 3 - Simple correlation coefficients between variables used in the analysis

	Y	X ₁	X ₂	X ₃	X ₄	X ₅	X ₆	X ₇	X ₈
Y Land price (dependent variable)	1.00	.64	-.80	.92	.98	.70	.96	.92	-.87
X ₁ Product requisite price index ratio		1.00	-.93	.54	.68	.28	.57	.73	-.71
X ₂ Fertilizer product price index ratio			1.00	-.77	-.83	-.54	-.78	-.89	.88
X ₃ Volume of production				1.00	.93	.87	.99	.94	-.92
X ₄ Lagged dependent variable					1.00	.73	.96	.94	-.89
X ₅ Interest rate						1.00	.83	.75	-.76
X ₆ Total population density							1.00	.96	-
X ₇ Urban European population percentage								1.00	-
X ₈ Rural European population									1.00

CONCLUSION

Exact land price predictions for the future cannot be made by the direct application of the estimated land price equation. This would entail extrapolation which is subject to severe statistical limitations. The analysis of the past, however, does provide a basis for intuitive outlook work.

The recent rural land price trends have given rise to concern. The phenomenal land price rise during the last 3 years covered in the study period appear to have been stimulated by a number of factors including (i) a sharp drop in interest rate from 1962-63 to 1963-64; (ii) an increase in the product/requisite price index ratio; (iii) the onset of inflation in 1963; and (iv) the subsequent maintenance of expected future prospects. A drastic consequential fall in the rural land price, is not anticipated in the absence of a depression. This fall would be prevented by the increasing population pressure on land in South Africa. The present rate of land price increase may be expected to be curbed if inflationary trends and hence future expectations are dampened.

The model applied in this analysis does not test whether the price for farmland is in excess of its earning capacity, but the analysis does show that increases in the net farm income are capitalised into land values. Artificial support of net farm incomes to alleviate the burden of high farm

capital requirements, will therefore, have a short-lived effect. The presence of low rates of return in farming arise from a large number of people who are prepared to accept these low rates of remuneration, either by choice or by necessity. The position could be alleviated by equipping rural people for non-farm employment where shortages of skilled labour prevail and remunerations are attractive. At the same time, with the ever-increasing demands for farm products, producers remaining on the land will face a greater challenge in being called upon to supply the needs of a much larger population.

However, the conclusion in respect of the land price increase, drawn from the popular saying "God has stopped making land but has kept right on making people" has its limitations. The evidence of technology serving as a substitute for land is small at present but what holds for the future? Agricultural policy makers and land purchasers, who bank on a high future land price, should consider the possibility of technological substitution for land, increasing at a higher rate than the population increase, in the future.

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