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A STATISTICAL ANALYSIS OF THE DEMAND FOR MAIZE IN SOUTH AFRICA

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ABSTRACT

In a dynamic economic situation, decisions concerning price, promotion, distribution, production and product policy must be made almost continually. Ample knowledge and information, amongst others, of various demand factors are necessary for the composition and maintenance of an efficient marketing strategy. Only then is there a thorough base for business control, strategic planning and forecasting.

In this study it was endeavoured to determine some characteristics of the demand for maize in South Africa. Several important coefficients, for example price elasticity, income elasticity and cross-elasticity of the total demand for maize as well as that of individual components thereof, were calculated. These coefficients should provide useful and almost indispensable information concerning the effects of price changes, and mutual substitution and complementarity.

INTRODUCTION

In a dynamic economic situation, decisions concerning price, promotion, distribution, production and product policy must be made almost continually. Ample knowledge and information of amongst others various demand factors are necessary for the composition and maintenance of an efficient marketing strategy. Only then does a thorough base exist for business control, strategic planning and forecasting (Du Toit, 1982).

Increased production is not in itself a guarantee for increased welfare to producers. Goal-oriented marketing and more economic-scientifically justifiable marketing strategies are also indispensable particularly over the longer term (Scholtz, 1971:5).

In this study an effort was made to determine some characteristics of the demand for maize in South Africa. Several important coefficients, for example the price elasticity, income elasticity and the cross-elasticity of the total demand for maize, as well as that of individual components thereof, can thus be calculated. These coefficients should provide useful and almost indispensable information concerning the effects of price changes, and mutual substitution and complementarity.

Shepherd and Futrell (1969:8) are of the opinion that the first and most basic agricultural marketing task is "... to determine accurately in quantitative and qualitative terms just what consumer demands are in time, place and form and just what changes are taking place in those demands with the passage of time".

THEORETICAL CONSIDERATIONS IN THE ANALYSIS OF THE DEMAND FOR MAIZE

A study into the behaviour of economic phenomena over time, for example the demand for maize, can be either descriptive or logically structural in nature (Du Toit, 1982:11). Traditional time series analysis is a good example of the first, while modern applied econometrics supplies examples of the structural approach.

In the "traditional" approach, change in a variable over time is divided into four different, but logical time components, namely a trend, seasonal, cyclic and a random component each with a repetitive nature differing from those of the others. This approach therefore explains movements in economic time series by associating such movements with the underlying time patterns. Such movements which are largely self-generating, therefore explain themselves (Du Toit, 1982:12). Thus, the accent does not fall on the question why a particular trend, but merely on measuring such influences (Ferber and Verdoorn, 1967: 127-128).

The structural approach in time-series analysis represents an attempt to bridge this gap. Here the accent falls on the analysis and interpretation of the above-mentioned systematic components of time series in logical or structural terms. This basically involves that fluctuations in a certain time series (for example the quantity of maize consumed) cannot be properly explained without taking into account movements in other time series and without reference to a structural model indicating the relationship among different time series (Du Toit, 1982).

This type of research is frequently complicated in nature. A large number of assumptions must frequently be made and many technical problems may arise. Although not without dangers, this method has risen in popularity. Such results have frequently supplied the necessary answers or guide-lines in adaptation and formulation of policy in problem situations (Du Toit, 1973).

Theoretically, demand represents a relationship or curve that shows the quantity of a product that the consumer is willing and able to buy at different prices, given a carefully designed set of conditions - the so-called *ceteris paribus* assumptions that include prices of other goods, income and the distribution thereof, preferences, numbers of consumers and expectations as constant (Döckel and Groenewald,

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1970:15; Van den Bogaerde: 1979 Ch 1). This demand curve is normally associated with a downward-sloping curve.

Although price is normally regarded as an important determining factor with regard to quantity of a product demanded, it is not the only one. Other factors include for instance prices of substitutes and complements, future expectations, disposable income and many more. In a dynamic environment where these factors continually change, it is therefore unrealistic to regard them as constant. These factors are thus included in empirical demand analysis as influences that can move the demand towards the left or right.

Several problems arise with the fitting of representative demand curves. According to Du Toit (1982:15) the most important are the identification and aggregation problems.

The first-mentioned problem centres around the principle of equilibrium price which, in a price determination model, is determined by the interaction of a demand curve and supply curve. Working (1951) describes the dynamic market situation as follows: "The market is dynamic and our data extend over a period of time, consequently our data are of changing conditions and must be considered as the result of shifting demand and supply schedules". Shepherd (1966: 111) indicates that it is fairly easy to correctly identify demand if supply shifts noticeably and demand remains relatively constant. If a statistical function is thus fitted on price/quantity combinations over time, two sets of factors play a role - supply and demand. Several equilibrium points are therefore possible, depending on the relative shifts of one or both of the curves under consideration. With relatively constant slopes of both curves over time, Working (1951:102) distinguishes three cases:

- Where demand and supply move equally - in this instance regression lines represent neither demand nor supply.
- Supply moves relatively more than demand - in this instance a regression line is a reasonable approximation of the demand curve.
- Demand moves relatively more than supply - in this instance a regression line represents a reasonable approximation of the supply curve.

The degree of identification can thus be either strong or weak, depending on the extent of the relationship between the two measures of variability. Although the parameters which relate the position and slope of the function with price and quantity can be estimated on basis of actual data, there is no way to identify whether this function represents a demand or supply curve, or a mixture of both (Massy, Montgomery and Morrison, 1970:274-389). After due consideration of trends in total and per capita consumption of maize and the different components thereof, as well as the variability in maize production (Directorate Agricultural Economic Trends, 1985:7-9; Jacobs Committee 1983), it was assumed that the intersections of the relevant demand and supply curves of maize over time approximate a demand curve.

The aggregation problem centres around the aggregation of individual demand functions on which the theory of consumer behaviour is based. Time series data, however, usually describes the behaviour of the whole population. Estimated demand parameters can be viewed as representative only if the total demand function for a specific product is reconcilable with the theoretic-demand curve as derived from the behaviour of the individual consumer. The simplest way of aggregation is the horizontal summation of individual demand curves.

The number of individuals, as well as other demographic characteristics, change over time (Merril and Fox, 1970: 56-58). Large income differences between individuals are also typical in the South African situation (Wijnholds, 1970), while the non-uniform changes in per capita income over time cause further aggregation problems. However, with regard to prices of consumer goods the situation is relatively stable (Du Toit, 1982:28). Although price-differences occur from place to place and time to time for the same product because of transportation cost differences, it can be assumed that a relative constant distribution near the weighted national average holds for any point in time. Therefore there is scant reason to believe that those consumers who pay a higher or lower price than the mean for goods will react significantly differently to price changes. Because in this investigation, linear regression equations were used exclusively, further aggregation problems were avoided. Schilderinck (1977:5) writes in this regard: "A rather sober linear model, in which the parameters are estimated by means of a simple method often shows a greater sense of reality than a model with complicated non-linear equations". By way of logarithmic transformations certain constant elasticities are calculated, although these transformations still imply linear functions in logarithms.

As mentioned earlier there are in addition to price, several more factors that may influence the demand for a specific product of service. Thus, the *ceteris paribus* assumptions are seldom if ever satisfied. The quantity demanded is therefore in practice specified as a function of more than one predetermined variable. The prices of several products (possible substitutes and complements) can also be included in this demand function; any relevant factor that influences the demand for a specific product merits consideration in the choice of independent variables.

Given the above-mentioned assumptions, it is theoretically assumed that the demand curve normally has a negative slope. It is furthermore known that the demand for essential products, for example foodstuffs, is relatively inelastic, while the demand for luxury products is relatively elastic. However, there is no *a priori* basis on which it can be decided whether the relevant functions are linear or non-linear (Du Toit, 1982). Additional information from the theory of consumer behaviour is needed for this.

In the analysis of demand for foodstuffs, the Law of Engel should be taken into consideration (Sameulson, 1964: 209-211), because the income elasticity for demand of foodstuffs may change. Theoretically the demand for a product, for example maize, can be viewed as a function of relative prices of all commodities, as well as real income. For practical reasons, a demand function is more often than not specified so that the quantity demanded of a specific product is a function of the price of the article, the general price-level, the prices or availability of relevant substitute or complementary products and available income. Depending on the set hypotheses and nature of results, relevant factors can also be omitted or included by way of meaningful scientific experimentation.

DATA USED AND SELECTION OF VARIABLES

The period selected for the analysis of the demand for maize extends over a period of 28 years, from 1956/57 to 1983/84. Annual data were used.

The demand for maize in the country as a whole was analysed. However, the ideal would be to study the demand for the various uses of maize in the different market segments on either a geographical or demographical basis as the necessary data becomes available with time. In this regard the total demand for maize, as well as its two major components, namely the demand for animal and human consumption, were calculated separately. The reason for this is that the demand for maize as human food is based on other considerations than that of the demand for maize as animal feed. The demand for maize as animal feed is a derived demand which depends on the demand for the final product, for example meat (Nieuwoudt, 1974:37-40).

The total population and change in population within the boundaries of any geographical market have a great influence on the size and change in the demand for a specific product within such a market area (Du Toit, 1982:30). Thomsen and Foote (1952:287) propose: "To avoid confusing the time trend for population with one that might reflect other effects, per capita data probably should be used whenever applicable". In this analysis appropriate variables were converted to a per capita base.

An important consideration in the use of time series data centres around the question of whether the relevant data (price and income) should be deflated in order to account for the change in the purchasing power or value of money or not. According to Shepherd (1966: 12) and Vosloo (1968), the process of deflation is not always justifiable or without dangers. When time series extend over long periods wherein relative prices sometimes change a lot, deflating of data is however usually desirable (Schiffman and Kanuk, 1978). In this analysis deflated data were used; farm product prices and prices for yellow maize were deflated by the index for agricultural producer prices, prices of white maize and foodstuffs (for example bread prices) were deflated with the food price index and income variables were deflated with the consumer price index.

Econometric analysis consists of four fundamental steps (Du Toit, 1982: 32):

- Specification of functional relationships between variables that, according to expectations, generated the observed data.
- Ensuring that the specified relationships are identified for the purpose of statistical analysis.
- Selection of relevant statistical methods of analysis, followed by the analysis itself.
- The interpretation and evaluation of results.

Specification involves the building of models and consists largely of the expression of economic theory in a mathematical equation. Economically speaking, it can be argued that the quantity of any foodstuff as demanded by an individual is largely determined by the price of the product, prices of a number of competitive and/or complementary products, prices of other consumer goods and services, disposable income, fixed financial obligations and a great variety of other factors that may even include characteristics such as age, sex, occupation, etc. (Van den Bogaerde, 1979: Ch 1 & 2).

The quantity (total and per capita maize consumption) was regarded as dependent variable in this study and was thus logically included as endogenous variable (Saturnino, 1970:15) in the different demand functions.

For each consumption component of maize the prices or per capita consumption of alternative commodities were included. The price of bread was thus included in the equation concerning the human consumption, and feed prices in equations concerning animal consumption of maize. Because the demand for maize as an animal feed is derived from the demand for livestock products, prices of dairy products, redmeat and poultry products were also considered as independent variables in some selections concerning animal consumption.

In some selections time was included as variable to accommodate certain tendencies that might arise out of dynamic factors such as changes in tastes and producer preferences.

In most demand equations both absolute and log-transformed data were used. Data concerning the consumption of maize was obtained directly from the Maize Board. Prices of maize were taken from the Abstract of Agricultural Statistics (Directorate Agricultural Economic Trends, 1985). Price indexes and feedstuff prices were also obtained from the same publication. Personal disposable income and population numbers were obtained from South African Statistics, 1982 (Department of Statistics, 1984) and editions of the Quarterly Journal of the Reserve Bank (S.A. Reserve Bank, 1984). Considerable transformations of data were necessary. All prices were deflated with the corresponding relevant price index values with 1975 as base, and all income values were converted into real terms. In some selections quantities were reduced to per capita values.

The NWA-STATPACK multilinear regression program was used for the solution of the various demand equations (Northwest Analytical, 1982). In this both stepwise regression procedures and traditional multilinear regression procedures are possible. Several considerations were taken into account in the evaluation of the most successful regression fit. The economic reality of the relevant model, the signs and reliability of the estimated coefficient (F or t test), the coefficient of determination (R^2), the reliability of fit (F value), and the size of the standard error of estimation were used as criteria. The Durbin-Watson test was used to test for serial correlation in the residual. By studying the various correlation matrixes and by the elimination of certain mutual highly correlated variables, the problem of multicollinearity was restricted as far as possible.

The following functional relationships between certain variables were hypothesised and tested:

Ht = f (Pm, I, Pb, B, T, Ph, PIs, PIp, PIv)
Hd = f (Pgm, Ph, PIs, PIp, PIv, Pv, B, T)
Hm = f (Pwm, I, Pb, B, T)

where:
Ht = total consumption of maize per year
Hm = total human consumption of maize
Hd = total animal consumption of maize
Pm = real weighted mean selling price of maize (R/t)
Pwm = real selling price of white maize
Pgm = real selling price of yellow maize
I = total real income (R)
Pb = real weighted mean retail price of bread (cents)
Pv = real weighted mean farm feed mixture price
Ph = real weighted mean hay price
PIs = deflated price index for dairy products
PIp = deflated price index for poultry products
PIv = deflated price index for redmeat
B = total population (1 000)
T = time (1956/57 = year 1)

Alternatively the above hypothesised demand functions were so specified as to omit population, while including quantities and income per capita. Consequently the functions were also solved in the following form:

KHt = f (Pm, KI, Pb, T, Ph, PIs, PIp, PIv)
KHm = f (Pwm, KI, Pb, T)
KHd = f (Pgm, Ph, PIs, PIp, PIv, T)

where:
KHt = per capita consumption of maize
KHm = per capita human consumption of maize
KHd = per capita animal consumption of maize
KI = real disposable income per capita

All the above specified demand functions were solved with actual and logarithmic transformed data (natural or Naperian logarithms). Selected fits are subsequently shown. The correlations between independent variables in the selected fits appear in Table 2 of the appendix.

EMPIRICAL RESULTS

Consumption trends

Linear, exponential, logarithmic and power functions were fitted to determine consumption trends over time. Time is the independent variable in each case. The linear function consistently produced the best fit. Results shown in Table 1 refer exclusively to the linear function:

$$Y = a + bX$$

where
Y = consumption criterion
X = time (1956/57 = 1)
a = intercept
b = slope or regression coefficient

Table 1 shows that only Model 5 (KHm), did not yield a highly significant fit, while the Durbin-Watson values for serial correlation are indecisive in only two cases (Models 1 and 5) at the 1% level of significance. The high R^2 values indicate that, with the exception of Model 5 ($R^2 = 0{,}1115$), the consumption of maize is largely explained by time. From Table 1 it can be deduced that the total consumption (Ht), the human consumption (Hm) and the animal consumption (Hd) of maize increase over time. The total consumption per capita (KHt) increases slower than the per capita animal consumption of maize (KHd), while the per capita human consumption of maize (KHm) decreases significantly because of the relatively low R^2 value, but represents an unsatisfactory fit. Human consumption and animal consumption of maize as percentage of total consumption respectively decreases and increases highly significantly over time. This is indicative of the increasingly important role of animal consumption of maize relative to human consumption.

The consumption of maize was also tested for cyclical tendencies. Only the animal consumption of maize (Hd) produced a cyclical tendency namely one over four years at a 5% level of significance. It is possible that this cycle is related to the pig and poultry cycles.

TABLE 1 - Results of single linear regression with time as independent variable

Model	Y	a	b	R^2	Durbin-Watson	t value
1	Ht	2 567,07	151,11	0,9768	1,15	33,06***
2	Hm	1 906,68	46,37	0,9309	1,56	18,71***
3	Hd	554,81	102,98	0,9571	1,32	24,09***
4	KHt	117,70	2,79	0,9094	1,44	16,15***
5	KHm	123,85	-0,23	0,1115	1,24	-1,81*
6	KHd	47,38	3,04	0,9362	1,67	19,53***
7	(Hm÷Ht)x 100	67,88	-0,82	0,8779	1,38	-13,67***
8	(Hd÷Ht)x 100	28,65	0,87	0,9050	1,65	15,74***

*** = Significant at the 0,1% level
* = Significant at the 5% level

Animal consumption of maize

Only the results of a few selected fits are presented and discussed.

Actual data

$$Hd = 5148{,}41 - 82{,}99\,Pgm + 65{,}99\,Ph \quad \ldots\ldots\ldots\ldots\ 1$$
$$-5{,}35^{***} \qquad 4{,}72^{***}$$
$$F = 18{,}44^{***} \quad R^2 = 0{,}5959 \quad d = 1{,}28$$

$$Hd = 4263{,}64 - 46{,}86\,Pgm + 11{,}12\,PIv \quad \ldots\ldots\ldots\ldots\ 2$$
$$-7{,}98^{***} \qquad 16{,}03^{***}$$
$$F = 172{,}03^{***} \quad R^2 = 0{,}9323 \quad d = 1{,}25$$

$$Hd = 2206{,}64 - 38{,}62\,Pgm + 11{,}08\,Ph + 14{,}09\,PIv + 8{,}53\,PIp \ldots 3$$
$$-3{,}91^{***} \qquad 1{,}41^{a} \qquad 1{,}64^{a} \qquad 5{,}59^{***}$$
$$F = 92{,}47^{***} \quad R^2 = 0{,}9415 \quad d = 1{,}18$$

Student's values according to the one-sided probability of exceedance table: * = 0,1%; ** = 1,0%; * = 5,0%; a = 10% and b = 15%. Significance of F values are indicated as follows: *** = 0,1%; ** = 1,0%; * = 5,0%; and a = 10%**

Although only about 60% of the variation in animal consumption of maize is explained by Equation 1, all three equations produce highly significant fits. However, the Durbin-Watson test for serial correlation is indecisive in each case. The signs of all the coefficients of the variables correspond to *a priori* expectations in each of the equations, and are statistically significant. The price elasticity of demand for maize for animal consumption is consistently highly significant and was respectively calculated as -2,766; -1,56 and -1,29; indicating a relatively elastic demand. The cross-elasticity between hay prices (Ph) and animal consumption of maize was calculated from Equation 1 as being 1,25. This implies that, in this case, hay acts as a substitute for maize. However, the validity of Equation 1 can be questioned because this equation does not include a price or quantity-variable with regard to meat. Equation 1 is therefore ignored in the final discussion. From Equations 2 and 3 it can be deduced that the prices of red-meat (PIv) and poultry products (PIp) influence the quantity of maize demanded positively.

Logarithmic transformed data

$$Hd = 3{,}837 - 2{,}198\,Pgm + 0{,}477\,Ph + 1{,}252\,PIv + 0{,}318\,PIp \ldots 4$$
$$-3{,}05^{**} \qquad 2{,}56^{**} \qquad 2{,}77^{**} \qquad 3{,}89^{***}$$
$$F = 71{,}34^{***} \quad R^2 = 0{,}9254 \quad d = 1{,}19$$

$$Hd = -5{,}730 - 2{,}133\,Pgm + 0{,}433\,Ph + 2{,}051\,PIv + 2{,}448\,Pv \ldots 5$$
$$-3{,}62^{***} \qquad 2{,}02^{*} \qquad 5{,}69^{***} \qquad 3{,}09^{**}$$
$$F = 60{,}04^{***} \quad R^2 = 0{,}9126 \quad d = 1{,}73$$

The two equations both explain more than 90% of the variation in animal consumption of maize. The coefficients of all the variables are statistically significant without exception, while the signs are consistent with *a priori* expectations. The Durbin-Watson value in Equation 4 is indecisive. The price elasticity of demand for the animal consumption of maize was, with the help of the two equations, respectively estimated as 2,198 and 2,133, suggesting a relatively elastic demand. It also appears that hay is a substitute for maize, while red-meat prices (PIv), poultry prices (PIp) and farm-feed prices (Pv) influence the animal demand for maize positively.

Human consumption of maize.

The results of only a few selected fits are represented.

Actual data

In general the fits were very unsatisfactory and the results of only one demand equation are shown:

$$KHm = 126{,}97 - 0{,}88T - 0{,}282\,Pwm - 0{,}057\,KI + 2{,}26\,Pb \ldots 6$$
$$-1{,}28^{b} \qquad -1{,}33^{a} \qquad -2{,}26^{*} \qquad 1{,}79^{*}$$
$$F = 13{,}60^{***} \quad R^2 = 0{,}5851 \quad d = 1{,}84$$

The equation explains approximately 59% of the variation in the per capita human demand for maize. The signs of all the coefficients are in accordance with *a priori* expectations; the coefficient of the time variable (T) and price of white maize (Pwm) are however, significant only at the 15% and 10% levels respectively. No serial correlation was encountered. According to the equation the price elasticity of demand for maize for human consumption was estimated on -0,149; thus relatively inelastic. It also appears that time influences the per capita consumption of maize negatively. This influence is, however, significant at a low level. The income elasticity of demand is -0,299. This implies that in this case maize is an inferior product because the quantity demanded decreases as disposable income increases. However, the elasticity is relatively low; thus the influence of income on the quantity demanded is small. The cross-elasticity between per capita human consumption of maize and bread prices (Pb) was estimated on 0,284. The positive sign implies that a degree of substitution does exist. The relatively low cross elasticity shows that the degree of substitution is small.

Logarithmic transformed data

$$KHm = 6{,}028 + 0{,}032T - 0{,}103\,Pwm - 0{,}235\,KI + 0{,}200\,Pb \ldots 7$$
$$1{,}37^{a} \qquad -1{,}34^{a} \qquad -1{,}61^{a} \qquad 1{,}10^{b}$$
$$F = 2{,}28^{a} \quad R^2 = 0{,}4846 \quad d = 1{,}53$$

The equation shows that the fit between the model and the data is significant at the 10% level. However, only 48% of the variation in consumption is explained. The actual data thus yield a more useful fit. It is nevertheless interesting to note that elasticities of the same magnitude appear: price elasticity = 0,10; income elasticity = 0,24; cross elasticity of bread = 0,20

Total demand for maize

In the light of the different underlying principles of the demand for maize for human consumption and the demand for maize as an animal feed, the question arises whether it is proper to estimate the total demand for maize. However, Equation 8 contains a price variable with regard to hay, so that the result is probably valid. The validity of Equations 9 and 10 are thus, because of the absence of similar variables, questionable. However, these two equations are included because relatively good fits were obtained. In the final discussion these two equations are ignored.

Actual data

$$Ht = 6645{,}14 \; - 96{,}12\,Pm + 54{,}18\,Ph + 22{,}99\,PIv \;\ldots\ldots\; 8$$
$$\qquad - 6{,}23^{***} \quad 7{,}12^{***} \quad 2{,}03^{*}$$
$$F = 122{,}18^{***} \qquad R^2 = 0{,}9385 \quad d = 1{,}20$$

$$KHt = 139{,}35 \; - 0{,}78\,Pm + 0{,}12\,KI + 1{,}27\,Ph \;\ldots\; 9$$
$$\qquad - 1{,}93^{*} \quad 3{,}56^{***} \quad 7{,}63^{***}$$
$$F = 101{,}97^{***} \qquad R^2 = 0{,}9373 \quad d = 1{,}57$$

Both the demand equations explain more than 90% of the variation in total demand for maize. The fits are also highly significant. In Equation 8 the price elasticity of demand for the total consumption of maize was calculated at -1,28. However, the effect of population growth was not taken into account in the first equation, so that the actual elasticity is probably lower. In Equation 9 the effect of the increase in population was eliminated by using per capita data. The price elasticity of demand was estimated at -0,22, which is relatively inelastic. In contrast to the human consumption of maize, the income elasticity of the total demand for maize is positive. This can possibly be attributed to a relatively high positive income elasticity of demand for certain animal products and the importance of maize as an animal feed. It is nevertheless relatively inelastic with an elasticity of 0,35.

Logarithmic transformed data

$$KHt = 2{,}90 \; - 0{,}216\,Pm + 0{,}392\,KI + 0{,}234\,Ph \;\ldots\; 10$$
$$\qquad - 1{,}95^{*} \quad 4{,}27^{***} \quad 7{,}02^{***}$$
$$F = 110{,}09^{***} \qquad R^2 = 0{,}9323 \quad d = 1{,}67$$

This demand function corresponds largely to that obtained by using actual data. However, the F and R^2 values were slightly higher in the logarithmic form. The price elasticity and income elasticity of demand for maize were estimated at -0,22 and 0,39 respectively.

CONCLUSION

Human and animal consumption of maize together comprise more than 95 per cent of the total consumption of maize. The volume of animal consumption tends to increase over time relative to that of human consumption. Total human and animal consumption of maize increase over time. The total per capita consumption increases slower than the per capita animal consumption of maize; the per capita human consumption of maize declines over time.

A significant four-year cycle that corresponds with that of pigs and chickens was found to exist in the animal consumption of maize.

The mean price elasticity of the animal demand for maize was estimated with actual data at between -1,56 and -1,29. With logarithmic transformations constant price elasticities of between -1,84 and -2,20 were calculated. The demand for maize for animal consumption thus appears to be relatively elastic. This corresponds to the findings of Nieuwoudt (1973:37-40). The constant cross-elasticity between hay prices and the animal consumption of maize were respectively calculated at between 0,43 and 0,48, and 0,43 with logarithmic and actual data. Prices of meat, poultry and poultry products and feed mixtures are positively related to animal consumption of maize.

The mean price elasticity of demand for maize for human consumption was calculated on -0,15 with actual data, while a constant elasticity of -0,10 was obtained with logarithmic transformed data. Cross-elasticities for bread prices of between 0,20 and 0,28 were calculated. Negative income elasticities of between -0,24 and -0,30 were obtained. This implies that the human demand for maize is relatively inelastic with regard to disposable income. The negative sign implies an inferior product; quantity demanded decreases as income increases.

If it is taken into consideration that the demand for animal consumption of maize increases over time relatively to that of the human consumption, it can be deduced that the total demand for maize will over time probably become more elastic. It also appears that as income rises, demand for human consumption of maize declines, but that the demand for animal consumption increases. More red-meat, poultry products and dairy products will thus probably be purchased. The large discrepancies between individuals, non-uniform changes in income over time and purposeful attempts aimed at a narrowing of the wage gap between population groups imply that per capita animal consumption of maize will probably increase, while the per capita human consumption of maize will probably decrease. This tendency will probably cause hay and other substitutes for maize as an animal feed to show an increasing positive cross-elasticity with the total demand for maize over time.

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APPENDIX

TABLE 2 - Correlation between independent variables in the demand equations of maize in South Africa, 1956/57 to 1983/84

	Pgm	Ph	PIv	PIp	Pv	Pwm	KI	Pb	T
Pgm	1,000	0,387	-0,612	0,591	0,587				
Ph		1,000	0,053	-0,005	0,632		0,098		
PIv			1,000	-0,451	-0,109				
PIp				1,000					
Pv					1,000				
Pwm						1,000	-0,524	0,463	-0,567
Pwm							1,000	-0,603	0,530
Pb								1,000	-0,581
T									1,000