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A DISCRIMINANT ANALYSIS OF QUOTA/PERMIT SUPPLY CONTROL FOR BEEF IN SOUTH AFRICA

by M.B. ELLIOTT, W.L. NIEUWOUDT and M.A.G. DARROCH*

ABSTRACT

Opinions of beef farmers regarding the quota/permit beef scheme were studied in a stratified country-wide sample of 178 beef farmers. A discriminant and principal component analysis of factors related to the successful application of quotas/permits was conducted focusing on the following variables: size, regularity in supply of livestock and percentage of gross farm income from non-beef enterprises. The study indicates that the method of restricting supply favours the large farmer who is a regular supplier of beef.

INTRODUCTION

Conditions of marketing pressure at Abattoir Corporation Facilities (referred to as controlled markets) necessitate supply control to prevent abattoir facilities from being overtaxed and to attempt to effect fair market access. (*Meat Board Focus* 1983, p.1). The object of supply control as stated by the Meat Board is: (i) To meet total marketing needs; (ii) to meet those needs according to grade composition; (iii) to grant fair market access to as many marketers as possible; and, (iv) to grant market access to new entrants in the livestock industry.

The purpose of this paper is to measure scientifically whether the method of restricting supply by quotas or permits favours large and regular suppliers of beef.

The supply of cattle to controlled markets is regulated by a quota or permit system. The quota system applies only to Natal and the Eastern Cape. In this scheme, quotas are allocated to producers via marketing agents who secure quota allocations from the Meat Board, based on the fulfilment of previous allocations. The permit scheme operates in the remaining controlled areas and permits are allocated to producers on request to the Meat Board in Pretoria. Both schemes regulate the supply of cattle and therefore benefit the producer who qualifies at the expense of the farmer who does not qualify (Nieuwoudt, 1985).

PROCEDURE

A country-wide stratified survey of beef farmers was conducted in mid-1985. Twenty magisterial districts were selected with replacement and probability proportional to size. Producers were selected using simple random sampling. Data collected from 178 beef producers include both quantitative and qualitative (opinion) variables. Two-stage sampling techniques were used. The address list of beef farmers from which the sample was drawn was obtained from the Meat Board.

Use was made of principal component analysis to combine various size factors into a single "size index". This component was used in conjunction with other variables in a step-wise discriminant function in order to determine characteristics of producers who gain controlled market access as opposed to those who gain limited access. Principal component and discriminant analysis techniques are outlined together with a brief description as to how they were used.

PRINCIPAL COMPONENT AND DISCRIMINANT ANALYSIS TECHNIQUES

Principal component analysis is a statistical method of substituting one set of variables for another. Three objectives are accomplished by using this method: (i) to identify relationships amongst variables; (ii) to reduce the number of variables being studied; and, (iii) to rewrite a number of variables in an alternative form in order to overcome severe collinearity.

The latter two objectives are the primary reasons for employing principal components in this study, thereby facilitating improved discriminant analyses. The basic logic behind principal components is to extract a common dimension which is a weighted representation of the original variables.

Discriminant analysis is a robust technique that may be described as a procedure to distinguish statistically between two groups. (Lachenbruch). The method attempts to maximize the separation of these groups by forming weighted linear combinations of explanatory variables. Wilk's Lambda, a step-wise selection criterion, was employed. Discriminant analyses were undertaken to distinguish statistically between producers who gain controlled market access as opposed to those who have limited access.

DISCRIMINANT ANALYSIS OF SUCCESS IN PERMIT AND QUOTA APPLICATIONS

The economic rent impacts of quotas, permits, licences, coupons and the Cochrane plan (USA) are synonomous. Quotas and permits operate in different regions of South Africa and are allocated by different bodies. The allocation procedure thus differs. The connotation attached to how a quota differs from a permit is created by local administrators and does not exist in the literature. For the purpose of analyses, quotas and permits were treated as being identical as the focus is on who gains access to controlled markets and who does not. Producers were requested to state the percentage of their permit and quota applications granted. Selected discriminant groups based on market access appear in Table 1. The purpose in the following analysis is to determine factors (such as small versus larger farmer) associated with limited marked access (farmers granted between 0% and 25% of permit or quota applications) in contrast to farmers granted between 75% and 100% of applications. No dependent variables are specified in a discriminant analysis.

TABLE 1 - Discriminant groups used to determine producers favoured by method of restricting supply

Group	Percentage of permit or quota applications granted %
Limited market access	0 to 25
Market access	75 to 100

A number of variables, both quantitative and qualitative, were explored, using a step-wise selection criterion, in order to select the "best" discriminant function. Selected variables include: A size index, regularity of supply (CV), value attached to a permit/quota (MINPQ) and percentage of gross farm income from non-beef enterprises (GFICO). A description of variates follows.

Size index

The size of a beef producer may be gauged in several ways. Selected size variables include farm size (SFARM), herd size (HERDNOW), and average number of stock sold per annum over the past five years (TOTSOLD). The producer estimates of herd size pertain to the number of livestock on the farm as at January 15, 1985. As expected, selected variables were highly correlated as is evidenced from Table 2.

TABLE 2 - Matrix of correlation coefficients of selected size variables

VARIABLE	SFARM	HERDNOW	TOTSOLD
SFARM	1,00	0,77**	0,53**
HERDNOW		1,00	0,49**
TOTSOLD			1,00

** = significance at the 1% level

The correlation problem was overcome by using principle components to extract a single "size" index. 72% of the variation in the data is explained by the size index which had an eigenvalue of 2,187.

SIZE INDEX = 0,6082 (SFARM") + 0,5993 (HERDNOW") + 0,5205 (TOTSOLD")

where " = a standardised variate

It should be noted that all of the latent vector loadings show a positive relationship with one another and have latent vector loading of a similar magnitude, thereby implying a common association between variables. Coefficients were estimated using GENSTAT (1977).

Regularity of supply (CV)

Respondents were asked to report the average number of animals marketed quarterly over the most recent 5 years. The coefficient of variation of livestock sales was calculated using these figures as a proxy for regularity of supply.

The value of the quota/permit (MINPQ, MODPQ, DESPQ)

Most producers were aware of the value of a quota/permit. In order to establish this value, producers were requested to state what they were "…. prepared to pay for a permit …."under the following hypothetical situations: most desperate time (i.e. drought) (DESPQ), moderately desperate time (MODPQ) and least desperate time (MINPQ). The value that producers attach to a quota/permit under favourable conditions (MINPQ) was selected in the step-wise analysis.

Percentage of gross farm income from other sources (GFICO)

Producers submitted estimates of their gross farm income as at December, 1984. The percentage of gross farm income from non-beef enterprises was found to contribute significantly to the discriminant function.

Variables included in the analysis may be ranked according to the magnitude of the standardised discriminant function coefficients as follows:
- Percentage gross farm income from other sources (GFICO)
- The value of a quota/permit under favourable conditions (MINPQ)
- Regularity of supply (CV)
- Size index

The discriminant function shows fair discriminatory power as indicated in Table 3. The function is capable of correctly classifying 94% of producers who are successful in their permit/quota applications and 50% of farmers who did not qualify for more than 25% of their applications. Of all farmers, 79% can be correctly classified into the two groups.

Group means of discriminant variables are based on 47 cases (Table 4). Results indicate that

TABLE 3 - Measures of discriminatory power of discriminant function

Eigenvalue	0,53
Canonical correlation	0,59
Wilk's Lambda	0,65
Percentage of farmers in known groups correctly classified (%)	
Market access	94,00
Limited market access	50,00
All farmers	79,00

those producers who qualify for permits/quotas are larger farmers, regular suppliers of cattle and farmers who derive higher percentages of income from enterprises other than beef. These farmers also attach a small value to permits.

Those farmers with more limited market access were smaller farmers and irregular suppliers of livestock. They also attach a greater value to the permit/quota in favourable periods and secure a smaller percentage of gross farm income from other enterprises.

TABLE 4 - Mean values of discriminating variables for producers who are successful/unsuccessful in their quota/permit applications

Discriminating variable	Producers who gain market access	Producers with more limited market access	Difference %
	Group means		
Size index	0,394	-0,272	**
Value attached to a quota or permit in a least desperate time (MINPQ)	R0,323	R4,687	1 351
Regularity of supply of livestock (CV)	271,646	294,039	8
Percentage of gross farm income from non-beef enterprises (GFICO)	41,92%	31,25%	34
Number of cases	31	16	Total 47

** = Infinitely large

Percentage differences are calculated as the difference in the means divided by the smaller group mean and expressed as a percentage.

The distinction criterion in Tables 1 to 4 is success in permit/quota applications. The possibility exists that farmers have "deflated" their stated percentage of successful permit/quota applications.

A further investigation was thus undertaken in an attempt to verify or refute previous findings.

DISCRIMINANT ANALYSIS ON MARKET ACCESS BASED ON MARKETABLE ANIMALS

In order to account for this possibility, further analyses were undertaken; the new discriminant

TABLE 5 - The new discriminant criterion to determine market access

Group	Percentage of marketable stock sold at controlled markets %
Limited market access	0 to 25
Market access	75 to 100

classification criterion used being the percentage of marketable animals sold at controlled markets (Table 5).

The same variables were analysed using the new discriminating criterion. Similar results were obtained for the size index, CV and MINPQ, however, the GFICO relationship had reversed, i.e. the farmers who obtain limited market access had a greater percentage of gross farm income generated by non-beef enterprises. The step-wise selection chose only the variables of size and CV. These results were based on 87 cases and are presented in Table 6. Results indicate that farmers who sell a large percentage of marketable animals on controlled markets are the large farmers and regular suppliers. Since quota/permits have value, the quota/permit scheme favours these farmers at the expense of the small and irregular suppliers.

The number of cases increases as variables are eliminated (or the criterion is changed) owing to missing values which result in the exclusion of cases.

TABLE 6 - Mean values of discriminating variables for producers based on their market access using the new criterion

Discriminating variable	Producers who gain market access	Producers with more limited market access	Difference %
	Group means		
Size index	0,483	-0,459	**
Regularity of supply of livestock (CV)	276,21	292,14	6
Value attached to a permit in a least desperate time (MINPQ)*	R2,38	R3,41	43
Percentage of gross farm income from non-beef enterprises (GFICO)*	35,37%	40,90%	16
Number of cases	65	22	Total 87

* = Variable not selected ** = Infinitely large

Group means indicate that the large farmer, with a low coefficient of variance (CV) with respect to the supply of livestock, attaches a smaller value to a permit under favourable conditions and is less diversified than the producer with limited market access. The difference in "diversity" is, however, small.

A final analysis was executed concentrating on the size index and CV variables. The number of cases was boosted to 145 and relationships between groups were confirmed once more. The value of the Wilk's Lambda statistic increased whilst the canonical correlation and the eigenvalue declined, consequently the predictive power of the discriminant function was not as great (Table 7). 70% of all producers in known groups can be correctly classified into the two discriminant groups.

TABLE 7 - Measures of discriminatory power of the function based on the new discriminant criterion

Eigenvalue	0,14
Canonical correlation	0,35
Wilk's Lambda	0,87
Percentage of farmers in known groups correctly classified (%)	
Market access	94,00
Limited market access	23,00
All farmers	70,00

As indicated in the original analysis, it is the large farmer who is capable of delivering a regular supply of livestock who qualifies for market access. The quota/permit scheme therefore discriminates against the small producer who is an irregular supplier of livestock. Results are presented in Table 8.

TABLE 8 - Mean values of the discriminating variables for producers based on market access under the new criterion

Discriminating variable	Producers who gain market access	Producers with more limited market access	Difference %
	Group means		
Size index	0,374	-0,681	**
Regularity of supply of livestock (%)	284,153	305,663	8
Number of cases	97	48	Total 145

** = Infinitely large

The results secured in any discriminant analysis depend on the number of cases and the magnitude of the variables included in the analysis. Consistent results, indicating stable data, inspired confidence in the analyses.

CONCLUDING COMMENTS

In the allocation of permits/quotas regular suppliers are favoured, such as large feedlots. Reasons why a smaller farmer may not receive permits/quotas are: (i) the large farmer is better able to plan his sales than a small sporadic producer and the former is more likely to qualify; (ii) a small farmer may disqualify himself by not submitting regular information; (iii) a small farmer may find it more convenient to sell on country auctions for various reasons; and (iv) the small producer may be less informed and may not be aware of the value of permits/quotas.

It was found that successful permit/quota applications are associated with large and regular suppliers while unsuccessful applications are associated with small and irregular suppliers. These findings were expected. *Although there may be good reasons why smaller, irregular suppliers may not qualify for permits/quotas, the existence of a supply restriction scheme harms them.* The welfare redistributional impact of quotas/permits is that quotas/permits have value and it benefits some (large regular supplier) at the expense of others (small, irregular supplier). *The criticism expressed in this paper is not that quotas/permits are "unfairly" allocated to larger regular suppliers, but that the existence of such a scheme at present in the beef industry in South Africa benefits the large, regular supplier at the expense of the smaller, irregular supplier.*

Quotas and permits are more restrictive during April and December and more freely available during spring. The study focuses on the welfare effects created by this restriction. Whether market access was regulated by the Meat Board (permits) or through its agents (quotas) was therefore, for the purposes of this paper, not further investigated.

Because a two-stage sampling procedure was used, data in the sample were compared with national totals. Data on the structure of the beef herd appeared similar to that of the national herd.

SUMMARY

A discriminant analysis of data obtained from 178 beef farmers indicates that producers who have a better chance of qualifying for permits or quotas are the larger farmers who are also regular suppliers of cattle. A further discriminant analysis indicates that producers who sell a large percentage of marketable animals on controlled markets are the large and regular suppliers. Since quota/permits have value the quota/permit scheme favours these farmers at the expense of the small and irregular supplier.

Discriminant analyses were used to determine factors associated with limited market access, i.e. farmers who receive 0% to 25% of permit/quota applications in contrast to producers granted 75% to 100% of permit/quota application. The following variables were considered in the discriminant function: size, regularity of supply, percentage of income from non-beef enterprises and the value attached by producers to quota/permits. The size variable was expressed as a weighted average of several variables as determined by a principal component analysis. The regularity of supply variable was calculated as the coefficient of variation of past deliveries.

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