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SUPPLY RESPONSE OF BEEF IN NAMIBIA: EMPIRICAL EVIDENCE

H J Sartorius von Bach

INTRODUCTION

This paper considers the regional influence of prices and access to markets on beef numbers in Namibia, given present inequalities. This is particularly relevant in view of Namibia's structural adjustment following its recent independence, and the beef sector's importance in the Namibian economy.

In recent years discussions of economic and agricultural development in Africa have focused strongly on structural adjustment, i.e. basic policy changes aimed at allowing international and domestic markets to play a greater role in coordinating national economic activities (World Bank, 1988). These structural adjustments and accompanying policies aimed at improving economic performance have often been based on several implicit assumptions on how African food systems operate (Weber et al., 1988), for example that farmers are highly price-responsive. Yet for many countries, there has been little empirical information to test these hypotheses. Hence, designing policies too often becomes an exercise in planning without facts, with the result that policies are frequently ineffective or even harmful. Successful policies can also have unforeseen or often ignored negative side-effects on specific groups of producers, traders, processors and consumers. Structural adjustment often involves changes in relative prices, as well as more 'traditional' elements such as actions aimed at improving access to markets through better technologies and institutions available to farmers and consumers. Gaining an empirical understanding of how prices affect the constraints and incentives facing various groups in the economy, and hence influence their behaviour, is a key to designing effective policies based on structural adjustment (Van Zyl & Coetzee, 1990).

An overview of the Namibian beef industry is given in the next section of the paper. This is followed by a regional econometric analysis of factors influencing cattle numbers and a discussion of the results. The final section evaluates the implications of the findings.

AN OVERVIEW

Beef production is the life-line of Namibia's agriculture and occurs both in commercial and communal farming areas. It contributes approximately 85 percent to the gross agricultural income, which as a whole contributes roughly 10 percent to the Gross National Product. Most of Namibia's beef is exported to South Africa and annually contributes between 9 and 21 percent to that market. Beef producer prices in Namibia are therefore lagged weighted average prices obtained at the main abattoirs of South Africa (Meat Board, 1989:6-12).

Environment and the beef industry

Climatic and geographical conditions are important in cattle farming in Namibia. Namibia has a dry climate characteristic of a desert country. Only one half of the country receives an annual rainfall exceeding 300 mm, thus rendering this half suitable for cattle

production. Namibia's agricultural natural resources are therefore sensitive; they react drastically to agricultural misuse in terms of bush-encroachment, erosion and desertification. The open southern areas with marginal rainfall are used extensively by smallstock and to a lesser extent by beef. The central and northern parts are used mainly for beef production, and are characterised by grassland with trees and shrubs. Cattle farming is practised exclusively on natural grazing supplemented by mineral licks to which a limited amount of grain is added. The ten main cattle-producing regions are located in the northern, eastern and central parts of Namibia. Cattle-producing regions with an annual rainfall less than 300 mm are Damaraland North, Omaruru and Karibib in the western parts of Namibia, while Maltahöhe, Marienthal and Keetmanshoop are located in the south of Namibia.

Sixty five percent of the total number of cattle are found in the ten main beef-producing regions, with a mean (1970-1989) of 1,4 million head. The coefficient of variation with respect to cattle numbers in the different regions varies between 5 and 30 percent.

Cattle production

Cattle-raising operations differ according to climatic regions and management skills. Most commercial ranchers use the slaughter-steer production system. Subsistence farming is encountered only in the communal areas, although some commercial farmers are also located in these areas. Feedlots are generally not viable or competitive due to the paucity and unreliability of grain production and high transport costs in Namibia. Cattle are normally transported over long distances by road to a meat processing plant, or are exported on the hoof. Due to the long travelling distances, losses of beef quality occur due to bruising. Results obtained by Van der Walt (1977:178) give statistical evidence of a two to three percent loss in mass due to the long travelling distances. The quality of the beef also deteriorates. Van der Walt (1977:398) pointed out that this beef is unattractive, tasteless and unpopular.

Marketing

Namibia has for long been a net exporter of beef. Table 1 illustrates the fluctuations in Namibia's beef industry. During the 1980s exports on the hoof and of carcasses made up 51,90 percent and 30,42 percent of Namibia's total marketed production, respectively. Commercial meat-processing plants are centralized in Okahandja and Windhoek. These plants are recognised by the EEC as export plants and are therefore inspected annually by EEC officials. Namibia's beef producers are remunerated according to carcass weight and grade. A well-established grading system is used whereby beef is classed according to age and condition.

Non-market factors play an important and even dominant role in the traditional farming sector. Most of the communal beef are slaughtered locally where the consumers buy directly from beef producers. These markets are not subject to veterinarian and health regulations, and carcasses normally generate more revenue than those processed in the small local abattoirs for the same farmers. Carcasses processed in these abattoirs receive a fixed price regardless of quality, thereby discouraging the supply of quality beef to those abattoirs.

Two statutory controlling bodies are involved in the beef industry. SWA Meat controls both meat processing plants at Windhoek and Okahandja, and determines beef producer prices. A monopoly situation regarding export slaughtering thus exits. The Meat

Board, a marketing institution, serves primarily as a negotiating body in controlling Namibia's beef exports.

General

Namibia's northern regions are separated by a cordon fence from the rest of Namibia, preventing the uncontrolled movement of animals from these areas into the rest of the country. Such movements pose a threat to the livestock industry in view of export market requirements and health regulations (Administration for Ovambo, 1989). For various reasons, the areas north of the fence are regarded as high-risk areas for diseases, such as bovine lung-sickness and foot-and-mouth disease. According to Agrecona (1990:7) this means that about 40 percent of the total livestock production is barred from prime markets.

Table 1
Fluctuations in Namibia's beef industry

Years	National cattle stock (millions)	Commercially marketed cattle (head)	Percentage of stock marketed (percentage)
1978	2,65	398 877	15,05
1979	2,67	423 180	15,85
1980	2,48	423 170	17,06
1981	2,08	473 375	22,76
1982	1,91	323 317	16,93
1983	1,81	268 646	14,84
1984	1,88	268 890	14,30
1985	1,87	301 046	16,10
1986	1,99	304 084	15,28
1987	1,83	348 200	19,03
1988	1,97	327 002	16,60
1989	2,01	346 378	17,23
Mean:	2,10	350 514	16,75
Coeff. of var (%):	14,47	18	13,66
Standard deviation (SD)	0,30	62 766	2,29

Source: Directorate Veterinary Services (1990), Namibian Meat Board (1990).

ANALYSIS OF REGIONAL BEEF NUMBERS

Model development

Econometric analysis based on time-series data was used to determine the factors influencing the total number of cattle on a regional basis. Although it would have been better to use marketed cattle to determine supply response, these figures are unreliable due to difficulties in determining the region of origin. Total cattle numbers were therefore used as independent variable in the regression equations. The model used to some extent draws from, and in a sense is a combination of, the approaches of Nerlove (1956; 1958), Jones (1965), Hill (1971) and others (Askari & Cummings, 1977; Low et al., 1980). The

following functional relationship was hypothesized and tested separately for each region:

$N_t = f\ (C_{t-1};\ S_{t-1};\ R_{t-1,\ t-2};\ NP_{t,\ t-1,\ t-2,\ etc.};\ NRP_{t,\ t-1,\ t-2,\ etc.};\ T)$

where N_t = cattle numbers in the regions concerned;
C_{t-1} = cattle numbers lagged one year;
S_{t-1} = sheep numbers lagged one year;
$R_{t-1,\ t-2}$ = rainfall lagged one year, two years;
$NP_{t,\ t-1,\ t-2,\ etc.}$ = Namibia average beef producer price, lagged one year, two years, etc.;
$NRP_{t,\ t-1,\ t-2,\ etc.}$ = Namibia real average producer price, lagged one year, two years, etc.; and
T = time.

Either nominal or real monetary values were used in developing the model. Both actual data and natural logarithmic data were used. Several variables were lagged with one or more years in order to determine the number of cattle in a specific year. Because of possible structural changes, lagged variables of rainfall were limited to two years. The above pertains to each individual major beef producing region. Furthermore, from the above relationships, another model was constructed to predict the total cattle stock of the sixteen regions, making use of export data, prices, foreign beef prices, cattle slaughtered and the cattle stock. The development of this model was based on the above approach.

The additive time-series model was used to solve the different hypothesized models:

$N_t = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_k X_k + \epsilon$

where N_t = regional number of cattle;
X = independent variables, k in number;
β = unknown population parameters to be estimated,
and ϵ = error or distribution term.

The regression constant β_0 was excluded in the determination of the best-fit regressions when lower R^2 values resulted or when statistical results were insignificant. Variables were selected according to a variety of stastistical measures which were combined with the test of logic to obtain statistically and logically meaningful results.

Data and related factors

Meaningful econometric analysis of Namibia's beef industry can only be done with data collected since 1970, mainly due to a paucity of adequate time series data, but also because of some structural changes in the period prior to 1970. Some estimates do exist for earlier years, but these are unreliable. The ten major beef-producing regions were used for the analysis. These regions include the two commercial areas with processing plants (Windhoek and Okahandja), other commercial areas (Outjo, Otavi/Tsumeb, Grootfontein, Otjiwarongo and Gobabis), and traditional communal areas (Hereroland East, Hereroland West and Rehoboth). Analyzed theoretically, these areas had some access to the same markets. The other areas analysed were in the western parts of Namibia and in the south, where sheep farming is the main farming enterprise. No areas in the restricted area north of the cordon fence were included in the analysis.

Data on livestock numbers were obtained from the annual stock census by the Directorate of Veterinary Services (1990) which takes place in December. Rainfall data from stations located in the various regions were supplied by Meteorological Services (1990). Annual rainfall is used as weather variable, as well as a proxy of the condition of Namibia's pastures. Sartorius von Bach (1990) shows that high correlations and coefficients of determination between rainfall and the condition of the pasture render this feasible. The Meat Board (1990) supplied data concerning the producer prices of beef.

Results

Table 2 shows the results of the selected best-fit equations obtained with the procedure already explained. The t-value of the coefficient is given in parentheses directly below the value of the coefficient, together with the significance level. All F-values are highly significant. The different elasticities are given below the t-values. Three general trends can be deduced from the results:

- Cattle numbers in the previous year were selected as the only statistically significant independent variable in the three communal areas (Hereroland East, Hereroland West and Rehoboth). Elasticities approximate one. This indicates that neither trend, climatological nor economic variables have a significant effect on cattle numbers and stocking rates in the traditional communal areas.
- Environmental conditions as indicated by the rainfall variables have a statistically significant effect on the number of cattle in the commercial farming areas. This shows that commercial farmers react to changes in the condition of pastures.
- Price has a statistically significant effect on the number of cattle only in those commercial regions with processing facilities (Windhoek and Okahandja) or in an adjacent area with easy access to these facilities through railway and tarred road linkages (Otjiwarongo). This indicates that even commercial farmers only react to price incentives when markets are readily available and easily accessible.

The results thus clearly accentuate the role of access to markets in beef production in Namibia. In cases where access is severely restricted due to lack of infrastructure like processing facilities and adequate transport opportunities, for example in the communal regions, beef producers do not act on price incentives, and climatological and ecological variables. This leads to rigidity, overgrazing and eventual degradation of the natural resources base. On the other hand beef producers with limited access to markets, mainly due to high transport costs, react to environmental changes, but not to price incentives. Only producers with easy access to markets react to both environmental changes and price incentives.

Modelling the total supply response of marketed beef (total of 16 areas), the model shows a good fit with high R^2 (99,34%) and t-value (40,75), and a significant Durbin-Watson statistic (1,849). In all the various tests, the elasticity of the one year lagged total number of cattle (sixteen regions) was relative unitary elastic varying from 0,9976 to 1,043. Thus, the elasticity of the model is unitary elastic (1,0012). Testing this model to forecast the marketed beef shows a good fit with a high R^2 value. Using this means that all variables selected in the regional analyses are lagged with a further year.

Table 2
Best-fit equations for the regional supply response of live cattle measured in terms of cattle numbers (N_t)

Regions		C_{t-1}	$\ln C_{t-1}$	S_{t-1}	R_{t-1}	R_{t-2}	RP_t	T	DF	adj R^2	F	DW
Outjo	:			0.308	104.624	99.737			15	0.981	248.9	2.04
	t :			(4.56)***	(4.04)***	(3.69)**						
	ϵ :			0.2299	0.3911	0.3755						
Otavi/Tsumeb	:				117.818	110.735			17	0.978	369.7	1.72
	t :				(6.26)***	(6.16)***						
	ϵ :				0.4976	0.4892						
Grootfontein	:				110.885	122.751			18	0.972	296.3	1.80
	t :				(6.01)***	(6.70)***						
	ϵ :				0.4669	0.5290						
Otjiwarongo	:			2.204		50.451	-340.30	42.59	16	0.990	375.4	2.02
	t :			(5.46)***		(3.18)**	(-2.81)**	(3.79)**				
	ϵ :			0.2859		0.2256	-0.3690	0.6067				
Hereroland W	:		1.001						13	0.999	239058.0	2.25
	t :		(488.94)***									
	ϵ :		1.0007									
Hereroland E	:	0.971							15	0.938	212.1	2.35
	t :	(14.56)***										
	ϵ :	0.9687										
Gobabis	:	0.691		0.212	55.278				14	0.998	3248.2	2.00
	t :	(9.40)		(2.54)*	(2.11)*							
	ϵ :	0.7109		0.2190	0.0698							
Okahandja	:				51.238		-384.53	90.85	16	0.982	285.4	1.85
	t :				(2.96)**		(-2.65)**	(4.66)***				
	ϵ :				0.2398		-0.5635	1.7707				

Note: Figures in parentheses refer to t-values of the estimated coefficients. Significance of these values are indicated as follows: * = 5.0 per cent; ** = 1.0 per cent; and *** = 0.1 per cent. All F-values are statistically significant at the 0.1 per cent level. According to the Durbin-Watson values, there is no serial correlation at the 0.1 per cent level of significance. The elasticity of the coefficient is indicated by ϵ.

Table 2 (continued)

Regions	C_{t-1}	$\ln C_{t-1}$	S_{t-1}	R_{t-1}	R_{t-2}	RP_t	T	DF	adj R^2	F	DW
Windhoek :				180.269		-941.32	129.35	17	0.968	164.2	1.82
t :				(2.69)**		(-2.33)*	(3.86)**				
ϵ :				0.3684		-0.7816*	1.3941				
Rehoboth :		1.001						17	0.999	22749.8	2.01
t :		(150.83)***									
ϵ :		1.0015									
Damaraland North :	1,011		-0,725	57,04				16	0,938	76,7	2,23
t :	(5,88)***		(3,06)**	(4,09)***							
ϵ :	1,0332		-0,4998	0,4877							
Omaruru :	0,445			23,963	31,215			18	0,056	122,8	1,95
t :	(2,79)*			(2,05)*	(2,51)*						
ϵ :	0,4641			0,2285	0,3034						
Karibib :	0,528			22,732	26,885			15	0,955	98,7	1,62
t :	(3,48)**			(2,19)*	(2,28)*						
ϵ :	0,5260			0,2169	0,2463						
Maltahöhe :	0,829			7,269				17	0,949	159,4	1,91
t :	(8,59)***			(2,08)*							
ϵ :	0,8109			0,1711							
Marienthal :	0,682				76,528			18	0,976	351,6	1,83
t :	(9,66)***				(4,79)***						
ϵ :	0,6852				0,3023						
Keetmanshoop :	0,766			36,898				17	0,886	62,8	2,26
t :	(6,59)***			(1,85)							
ϵ :	0,7865			0,1980							

Note: Figures in parentheses refer to t-values of the estimated coefficients. Significance of these values are indicated as follows: * = 5.0 per cent; ** = 1.0 per cent; and *** = 0.1 per cent. All F-values are statistically significant at the 0.1 per cent level. According to the Durbin-Watson values, there is no serial correlation at the 0.1 per cent level of significance. The elasticity of the coefficient is indicated by ϵ.

IMPLICATIONS FOR STRUCTURAL ADJUSTMENT

It can be concluded from the above results that the centralization of abattoirs discriminates against producers in outlying areas in that access is not equal. This specifically applies to the communal grazing areas.

Cattle numbers in Namibia's communal regions are not adjusted according to rainfall variables. However, in order to avoid overgrazing and to assure optimum long-term production, the cattle stock has to be adjusted to the condition of the pastures. The importance of quality of management is reiterated because it determines grazing control, the quality of the veld, its production capacity and eventually the profit of beef production. With a lack of an adapted marketing structure, the individual communal cattle owner cannot react to the fact that additional livestock impose costs upon all livestock owners and thereby threatens the ecology (for a detailed discussion of these observations, see e.g. Low et al., 1980; Vink, 1986; Vink & Kassier, 1987, 1988; Ault & Rudman, 1988; Vink & Van Zyl, 1990).

Traditionally, Namibia's beef prices were determined according to export demand (mainly from South Africa), as well as by a smaller group of preferential consumers. Poorer consumers therefore had no choice but to pay for high health and abattoir regulations. In a country where shortages of protein occur, beef marketing systems should not be determined by a small group of preferential consumers only. A choice to consumers of either high standards of quality and hygiene related to higher meat prices, or alternatively lower standards with concomitant lower meat prices, could stimulate the beef industry. In this respect it is important to note that food prices are an important determinant of household income in especially poorer households. Lower meat prices will therefore contribute towards increased food security in Namibia through increasing access to food (Van Zyl & Coetzee, 1990). Lower meat prices and increased access to beef will therefore also benefit rural populations.

However, in this regard, Weiner (1984:267) examined the interrelationship between economic policies, development policies and ecological problems. He indicated that the access to the protected EEC market with higher prices stimulated Botswana's cattle herd growth and beef production to an extent that the ecology of the rangeland, the main natural resource, was severely threatened. This must be kept in mind by Namibia's policy-makers. Policy-makers must realize that an increase of cattle numbers because of favourable prices could lead to overgrazing. It is important that cattle numbers must be determined according to the carrying capacity of the natural pastures, and not according to maximum short-term profits, to avoid overgrazing and to assure optimum long-term production.

The availability of beef, processed at low cost and smaller decentralised abattoirs with low hygienic standards, could therefore benefit Namibia's beef producers. However, a prerequisite for successful decentralisation is change in the current marketing system and control. These changes will most probably benefit beef producers in the northern parts of Namibia, including those in the communal areas. Poor consumers will also benefit from the resulting lower beef prices. Access to markets by producers will become more equal and entitlement to food by consumers will increase. Social costs will therefore decrease. Eales (1979) showed in this regard that centralised abattoirs under similar conditions in South Africa contribute towards lower net returns to livestock farmers as a group, higher meat prices to consumers and high social costs relative to a policy of more and smaller decentralised abattoirs in production areas. The results also pointed out that such a system

of centralized abattoirs favours the big farmer closest to town, while the smaller farmers in the outlying districts are disadvantaged.

The promising possibilities offered by deregulation and decentralisation of the meat market described above necessitate a further investigation of these proposals. For exports and the preferential consumers, centralised abattoirs, however, appear to be desirable. On the other hand, different standards of abattoirs could stimulate regional beef production, increase consumption and thereby contribute towards rural development.

CONCLUSION

This paper discussed the influence of prices and access to markets on cattle numbers in Namibia, based on regional empirical evidence and econometric analysis. The results obtained clearly accentuate the role of access to markets in beef production in Namibia. In cases where access is severely restricted due to lack of infrastructure like processing facilities and adequate transport opportunities, for example in the communal regions, beef producers do not act on price incentives, and climatological and ecological variables. This leads to rigidity, overgrazing and eventual degradation of the natural resource basis. On the other hand, beef producers with limited access to markets, mainly due to high transport costs, do react to environmental changes, but not to price incentives. Only producers with easy access to markets react to both environmental changes and price incentives.

Namibia's cattle numbers must be determined according to the carrying capacity of the natural pastures and not according to maximum short-term profits, in order to avoid overgrazing and to assure optimum long-term production. The major conclusion of this study is that the present production and marketing structure in Namibia with respect to beef is probably non-optimal. The results highlight the need for an overall policy which accounts for all related industries, producers, consumers and other relevant factors simultaneously. Policy measures facilitating structural adjustment, such as different marketing policies, have to be evaluated in this context. If not, results can be poor, negative or even counter-productive.

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