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THE SOUTH AFRICAN WOOL SUPPLY RESPONSE

M. Abbott and A. Ahmed[1]

The production of wool in South Africa has declined substantially over the past twenty years. This has been a consequence of a number of factors, the most important being the relative decline in world prices, both gradually before the collapse of the Australian wool price scheme, and more abruptly since then. The purpose of this article is to analyse the impact of the changes in the price of wool and some other variables on the supply response of the South African wool industry.

DIE AANBOD RESPONS VAN WOL IN SUID-AFRIKA

Wolproduksie in Suid-Afrika oor die afgelope twintig jaar het noemenswaardig afgeneem. Dit was die resultaat van verskillende faktore, veral die stelselmatige daling van wêreldpryse en die ineenstorting van die Australiese wolprysskema. Die doel van hierdie artujek is om die impak van die veranderinge in wolpryse en party ander veranderlikes op die aanbodkant van die Suid-Afrikaanse wolbedryf te ontleed.

INTRODUCTION

Despite a steady decline in the level of production of wool since the early 1970s South Africa still has the potential to be an important player in the international wool market. South African wool production has been in long tern decline over the past thirty years, falling from an average of 130-145 million tonnes per annum in the 1960s to 56 million tonnes in 1997/98 (South African Wool Commission, *Annual Report*; International Wool Textile Organisation, *Wool Statistics*). From about six per cent of world production in the early 1960s South African wool production makes up around two per cent of world production today. As most of the wool produced in South Africa is exported (85-90 per cent; South African Wool Board, *Annual Reports*) the state of international markets is crucial to the South African industry. The high proportion of South African wool exported means that South Africa is more important as an exporter in world markets than the small proportion of world production indicates. South Africa is the world's fifth largest exporter of wool after Australia, New Zealand, Argentina and Uruguay.

[1] *Australian Competition and Consumer Commission and Deakin University.*

Table 1: Livestock numbers and crop area in South Africa

	Maize Crop Area	Wheat Crop Area	Wool Sheep	Non-Wool Sheep	Beef Cattle
	m ha	m ha	m	m	m
1965/66	4 241	1 134	32,7	4,7	na
1970/71	4 796	1 930	25,4	3,7	7,9
1975/76	4 989	1 959	26,1	5,0	8,8
1980/81	4 488	1 812	25.0	5,7	12,9
1985/86	4 829	1 946	21,9	5,9	12,0
1990/91	3 816	1 436	21,9	6,8	13,5
1994/95	3 526	1 363	18,5	7,0	12,6

Source: South Africa, Dept. of Agriculture, *Abstract of Agricultural Statistics,* 1997

The decline in the real price of South African wool has been accompanied by a fall in South African wool production. The lower price has meant that the value of wool exports has not kept pace with other South African exports. During the late 1950s wool made up around ten per cent of the value of total South African exports, but this figure has fallen to below one per cent (Table 2). A part of the reason behind this decline in South African wool production has been the falling real price of wool. Since the early 1950s the real price of wool has decline, except for a few exceptional years when price 'spikes' temporarily appeared (Figure 3). In recent years the price of wool has fallen to an all time low and it is possible that a moderate rise in wool prices, back up to its long trend level can be expected. With higher prices and a freeing up of agricultural markets it is possible that there will be a mild recovery of South African wool production in response to rising international wool prices. The size of this expansion will depend upon the responsiveness of the supply of South African wool production to changes in the price of wool. The specific objective of this research note is to estimate the responsiveness of the South African supply of wool to changes in the international price of wool.

ECONOMIC AND POLITICAL CLIMATE

South Africa is a country which is richly endowed with agricultural resources but has a history of political instability. There were approximately 25 000 woolgrowers in South Africa in 1991 a figure that has fallen to around 11 000 today. More than 90 per cent of South African wool production is in the micron categories which are defined as for apparel and for this reason South African wool competes directly with Australian exports (Australia also

Table 2: Export Income of major South African Agricultural Commodities Rm

	Maize	Sugar	Preserved fruits and jam	Citrus fruits	Deciduous fruits and table grapes	Wool	Total agriculture	Total exports	Wool % of Agr'
	Rm	Rm	Rm	Rm	Rm	Rm	Rm	Rm	%
1965/66	5,4	32,7	44,5	28,0	35,5	120,4	391,5	1 111,3	30,8
1970/71	62,3	69,1	48,5	36,3	38,4	51,0	457,6	1 418,3	11,2
1975/76	236,5	209,8	131,8	64,2	82,7	173,7	1 237,4	4 532,1	14,0
1980/81	589,8	256,0	147,1	137,6	138,4	244,6	2 045,9	18 206,5	12,0
1985/85	381,1	358,7	281,0	206,6	242,1	415,2	3 024,6	41 327,8	13,7
1990/91	178,4	616,7	630,8	459,9	794,1	832,0	5 448,4	61 146,5	15,3
1994/95	679,6	584,6	978,0	809,0	1 152,2	718,5	10 153,2	100 715,9	7,1

Source: South Africa, Dept. of Agriculture, *Abstract of Agricultural Statistics*, 1997.

produces mainly apparel wool). The fine woollen merino makes up around 70 per cent of South African sheep stock numbers, the other main breeds being the Dorner, Dorper and Karabul. In the 1992/93 season the clip was divided into Merino 80 per cent (69 per cent in 1980/81), other white wool 11 per cent (11 percent in 1980/81), coarse and coloured three per cent (seven per cent in 1980/81), Karabul zero (6,5 per cent in 1980/81) and other types six per cent (6,1 in 1980/81) (South African Wool Board, *Annual Report,* 1981, 1993*)*.

As South African exports of wool makes up only a small fraction of the international market for apparel wool the South African industry can be regarded as being a price taker. South African wool exports tend to be concentrated in a small number of markets where the South African share is more significant than South Africa's share of total exports. The European Union is the largest market for South African wool taking 87 per cent in 1994/95 (South African Wool Board, *Annual Report*, 1995). South African wool makes up only three per cent of world production it makes up around 20 per cent of Western European imports (International Wool Textile Organisation, *Wool Statistics*, 1996). Despite this concentration of wool sales the price of South African wool is fundamentally determined in international markets, the main influence on South African wool prices being the supply and price of Australian wool, Australia being the world's greatest exporter (Liebenberg, Vivier & Groenewald, 1991).

Wool has long been an important export earner for the South African economy and in the late 1960s around 30 per cent of agricultural exports and 10 per cent of total exports was earned by the wool industry (Dept. of Agriculture, *Abstract of Agricultural Statistics*, 1997). In more recent times these respective figures have fallen to seven per cent and below one per cent (Table 2). At the same time that wool has declined in importance other sectors of South African agriculture such as beef production have expanded. In South Africa maize growing, beef grazing and wool compete in a number of regions for resources, particularly in terms of land. Most farming enterprises in South Africa are mixed with either crops and beef, or beef and sheep, with some specialised cropping and wool production. Despite the long term decline in wool production the relative size and importance of the agricultural sector in South Africa has remained virtually unchanged, with agricultural exports averaging around 10 per cent of total exports (Table 2). At the same time there has been a dramatic change in the composition of the agricultural sector with the beef industry expanding, largely at the expense of the wool industry (Tables 1 and 2). Maize production also expanded in response to higher prices (before the mid-1980s) and improvements in yields and plant varieties. High mutton prices have also encouraged sheep farmers to switch to sheep meat

breeds rather than wool breeds. Most sheep farming is now concentrated in the more

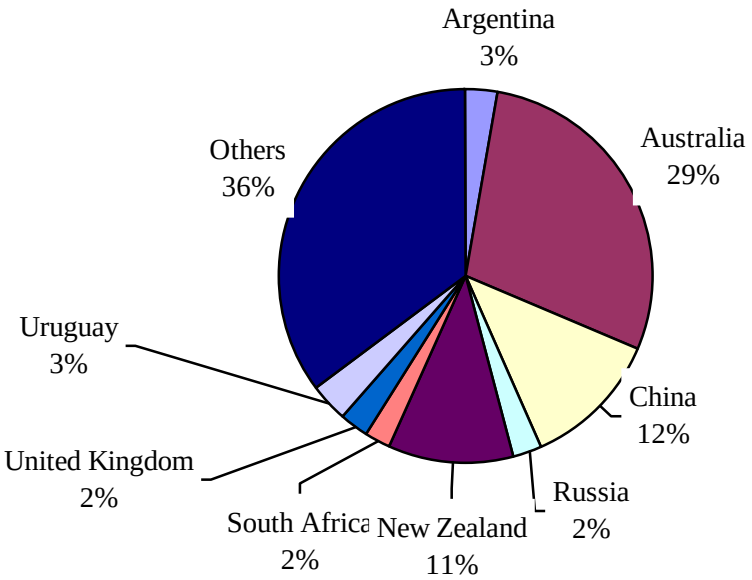

Figure 1: Contribution to World Greasy Wool Production, 1997/98

Source: International Wool Textile Organisation, *Wool Statistics, 1998.*

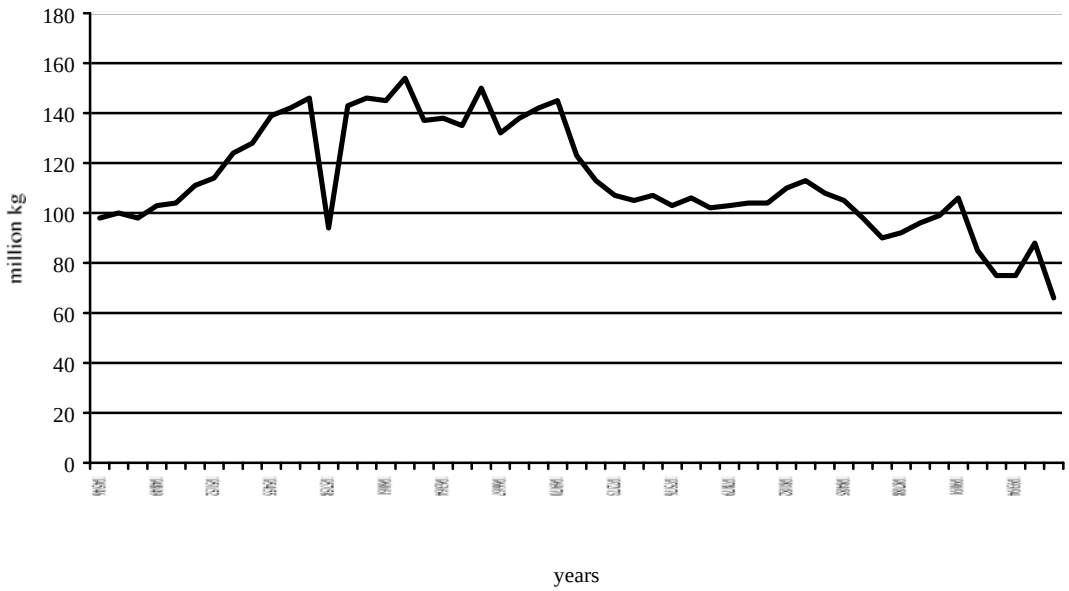

Figure 2: South African Greasy Wool Production, million kg

Source: Commonwealth Secretariat/International Wool Textile Organisation, *Wool Statistics,* (various issues).

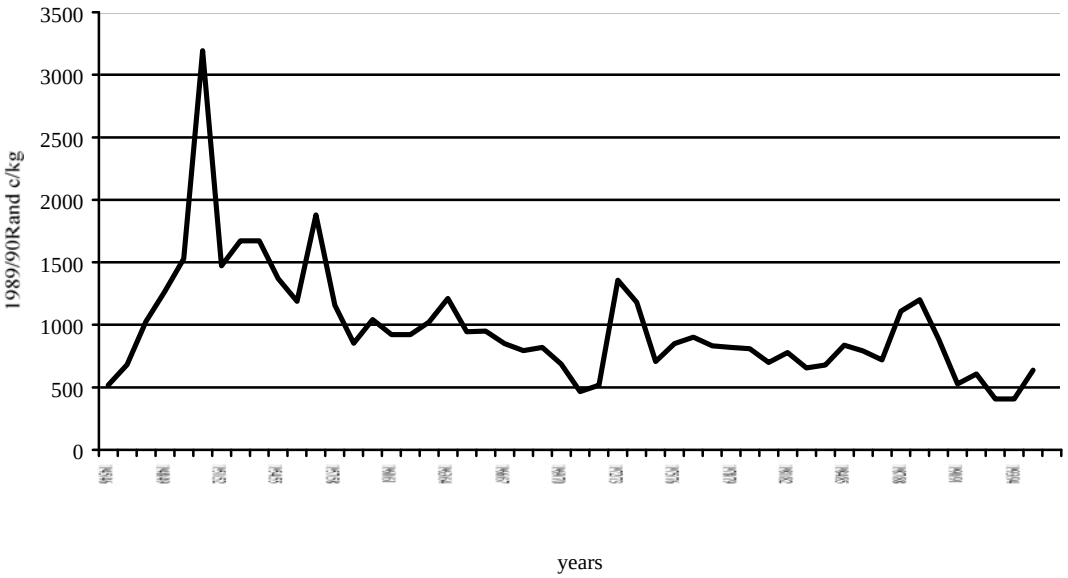

Figure 3: Average Real Price of South African Greasy Wool in 1989/90 R., c/kg.

Source: South African Wool Commission, South African Wool Board, *Annual Report* (various issues). Commonwealth Secretariat/ International Wool Textile Organisation, *Wool Statistics* (various issues).

arid regions of the Karoo where it is difficult to graze cattle of grow crops such as wheat or maize. Since the end of the Second World War the marketing of agricultural products in South Africa has been characterised by a complex pattern of regulations and institutional intervention. This has been manifested in marketing policy and technological research. Farmers in the past have been protected from foreign competition and have received a variety of subsidies, producer price premiums and have had access to the latest and most productive mechanical and biological technology through an extension network. For the wool industry a full acquisition scheme operated in South Africa between 1972 and 1993, but was suspended in June 1993 and since then the marketing of wool has been conducted through a system of private sales and auctions.

During the 1980s political and economic pressures had led to a more market related approach to the disposal of agricultural commodities in South Africa (Kirsten, Van Zyl & Van Rooyen, 1994). In 1992 the Kassier Report into the Marketing Act came out against the continuation of many Marketing Act schemes. The Kassier Report was particularly critical of the South African

Wool Board's acquisition scheme, pointing out that during the late 1980s and early 1990s the Board had managed to exhaust quite large reserves (Kassier Report, 1992:56). The Agricultural Marketing Policy Evaluation Committee, appointed by the Minister of Agriculture on the 12 January 1994 supported this trend in agriculture stating that: 'strong objections exist against producer bodies fixing prices'. This committee advocated the phasing out of single channel schemes (AMPEC, 1994:xv & xvi). After the suspension of the acquisition scheme the Wool Board continued to conduct wool promotion and research programs, both in South Africa and internationally through its membership of the International Wool Secretariat. Under the *Marketing of Agricultural Products Act*, 1996, agricultural boards began to be phased out. The South African Wool Board was disbanded on the 31 August 1997 and South Africa's participation in the International Wool Secretariat was terminated in 1998.

During the 1980s the South African Government granted subsidies to wheat, maize and dairy producers which rendered grain production relatively more profitable compared to sheep farming. Grain subsidies were reduced after 1988, and phased out by 1991, which reduced the encouragement of grain production at the expense of wool. From Table 1 it can be seen that there was a steady decline in maize and wheat crop area under cultivation between 1985/86 and 1994/95. Despite the reduction in wheat and maize subsidies, wool production and sheep numbers have continued to decline and there has been a switch from wool breeds to mutton breeds. This was caused mainly because of the fall in the international price of wool (Figure 3), but also because of the severe drought conditions that prevailed in the years 1992-94 and high mutton prices. The existence of the Australian wool stockpile (originally of 4,6 million bales when the Australian stock purchasing scheme came to an end in 1991) which has been gradually released onto the international market has ensured that wool prices have remained low. At the end of 1998 the Australian wool stockpile still contained over 1 million bales of unsold wool (Wool International, *Quarterly Report*, September 1998). Although some writers have speculated that South African wool production has the potential to rise, in practice this is dependent upon the state of international prices (Visser, 1989). International prices should remain sluggish until the exhaustion of the Australian stockpile which is expected in 2001.

THE MODEL AND THE RESULTS

The degree to which wool production in South Africa changes in response to the prices reflects two factors. The first factor is the degree to which prices faced by producers in South Africa reflect changes in world prices and the

second the ease with which supply can change. The degree to which supply changes in response to changes in the price of wool depends on whether the price changes are independent of changes in the price of inputs or competing outputs. The mobility of resources used in wool production is also important. A characteristic of wool production, and most other agricultural enterprises, is that resources are quite immobile in the short run (say one to two years) and thus the adjustment to price changes is usually slow.

A model was constructed to measure the responsiveness of wool supply changes to changes in prices. Most attempts to estimate supply functions for the wool industry attempt to model the relationship between wool supply and wool price but also wool supply with the prices of agricultural products, which are viable alternatives to woolgrowers. Most Australian studies, for instance, model wool supply not only with the price of wool but also with the prices of wheat and beef (see for instance AWC/BAE, 1987). In the case of the wool industry of Argentina and Uruguay the main substitute price used by Findlay, Dewbre & Geldard (1989) in their work was the price of beef. In the South African case maize is the main grain crop and so therefore its price is a more important variable to include in the model rather than wheat. The prices of beef and mutton might also be included as wool sheep farmers often have the choice of substituting beef cattle or mutton sheep breeds for wool sheep. Finally an index of average real farm costs has been included in the model.

Data on wool production were obtained from the International Wool Textile Organisation's *Wool Statistics*, and price data for wool, other agricultural products and farm costs from the Department of Agriculture's *Abstract of Agricultural Statistics*. The prices were converted in real indices and appear these in Table 5 in the Appendix. The model is as follows:

$$\ln Sw_t = \beta_0 + \beta_1 \ln Pw_{t-n} + \beta_2 \ln Pb_{t-n} + \beta_3 \ln Pm_{t-n} + \beta_4 \ln Pmu_{t-n} + \beta_5 \ln C_{t-n} + \mu_t$$

Where

Sw is the production of wool in million kilograms.
Pw is the average price of greasy wool per kilogram
Pb is the average price of beef per tonne
Pm is the average price of maize per tonne
C is the average index of farm costs
Pmu is the average price of mutton
t is the present year
n is the number of lagged years

It would be expected that wool production would be positively related to the price of wool and negatively related to the prices of the substitute agricultural products (beef, maize and mutton).

Since the study uses time-series data, it calls for testing for stationarity, or more popularly known as the test for unit root and the order of integration. To test for unit root the Augmented Dickey-Fuller (ADF) test has been carried out[1] using the Time-Series (TSP) version 4.3. From the results we can conclude that these data series are non stationary or exhibit unit root I (1). The test for cointegration was performed to ascertain whether the linear combination of the variables of the cointegrating regression exhibit any long run relationship. The test for cointegration has been performed using the Augmented-Engle Granger (AEG) procedure (Davidson & Mackinnon, 1993, pp. 715-22). The estimated τ values (tau) of the supply equation is –4.01. The Engle-Granger one per cent, five per cent and ten per cent critical values of the τ (t-statistic in the regression) is –2.5899, -1.9439 and –1.6177 respectively (Davidson & Mackinnon, 1993, Table 2.2, p. 722). Since the absolute terms of the estimated τ value exceeds the critical value, the conclusion would be that the estimated μ_t is stationary (ie they do not have unit root), and therefore, the variables in the model, despite being individually non-stationary, are cointegrated, and hence they exhibit long run relationships.

The model was first run using ordinary least squares using the dependent variable in the present year (t) and separately for the independent variables for the lagged years t-1, through t-5. The estimated Durbin-Watson value confirmed the existence of first degree serial correlation, therefore the equation was re-estimated after correcting for serial correlation. To test the stability of the regression coefficients the Chow test (χ^2) has been performed. The data set has been divided into the following two groups (1947/48 to 1972/73 and 1973/74 to 1994/95). The year 1973 is an appropriate dividing point as it was the first full year that the single channel scheme operated as well as the year that the oil price shock hit South Africa. The test accepted the null hypothesis of structural stability of the regression coefficients. The estimates are presented in Table 3.

Although the coefficients for the individual variables were correct only a couple were found to be statistically significant. In the case of the beef price no lagged relationship between the beef price and wool production was found to be statistically significant. The reason for this is probably that the beef and sheep regions in South Africa do not strongly coincide in South Africa and so therefore only a relatively small number of pastoralists in South Africa choose between beef and sheep production on the basis of the relative prices of beef

and wool. No statistically significant relationship was found between the supply of wool and the average level of farm costs. In the case of maize the lagged one year coefficient was the only one to be found to be statistically significant: the coefficient being –0,3694. This indicates that there is a statistically significant negative relationship between the production of wool and the price of maize. This relationship is as you would expect to be, that is, when maize prices are high, some woolgrowers reduce wool production and switch to maize production. There was also found to be a negative relationship between mutton prices and wool production, with a one year lag. This is as expected as low wool prices and high mutton prices would encourage wool growers to switch to sheep meat breeds.

Table 3: Estimates of the Cointegrating Supply Function for South African Wool, 1948-1995, n = 48

Coefficients	Estimates	t-values
β_1 (constant)	4,7770	48,7223**
β_2 ($\ln Pw_{t-2}$)	0,0815	1,3571**
β_3 ($\ln Pm_{t-1}$)	-0,3694	-2,0379*
β_4 ($\ln Pmu_{t-1}$)	-0.3326	-1.9567*

Adjusted R^2=0.8767 Durbin-Watson=2.3132
** significant at one and five per cent levels
* significant at ten per cent levels

Wool production seems to respond more slowly to a change in wool prices. The lagged two year variable is the only statistically significant coefficient in this case. In this case a one per cent change in the price of wool would lead to a 0,0815 per cent change in the production of wool. As logs were used to estimate this coefficient it is the price elasticity of supply for wool. This relatively inelastic supply response is consistent with the work done by other analyst's of wool supply responses. In the work conducted on the Australian industry, for instance, estimates of short term (after one year) responses range from 0.07 to 0.25 and in the medium term (five years) from 0.13 to 0.45 (Table 4). Findlay, Dewbre and Geldard arrived at similar results for the wool supply response in Argentina and Uruguay (price elasticities of supply for 1 year of 0.10; for 5 years 0.35; Table 4).

In South Africa the price of wool peaked in 1988/89 at 1054,9 cents per kilogram or 1200,1 cents in constant Rand terms (1989/90 Rands) (International Wool Textile Organisation, *Wool Statistics*, various issues). With

the suspension of the Australian wool price support scheme in 1991 the world price of wool collapsed; the South African price falling to a real level of 527,8 cents in 1991. By 1994/95 the real price of wool had risen slightly to 637,1 cents per kilogram but was still far below that of the late 1980s. The collapse in international wool prices caused world wool production to decline and the continual release onto the market of wool from the Australian wool stockpile has meant that the recovery of world wool prices has been sluggish. World greasy wool production fell from 3366 kt in 1989/90 to 2432 Kt in 1997/98 (International Wool Textile Organisation, *Wool Statistics,* 1990, 1998*)*. With the exhaustion of the Australian stockpile around 2001 and low levels of wool production world wide it might be expected that wool prices will rise to somewhere near, in real terms, to what they were during the late 1980s. In this case it can be expected that South African wool production will increase, with a lag of approximately two years. This increase would be more substantial if mutton and maize prices remain low relative to wool prices.

Table 4: Estimates of Wool Supply Elasticities

Authors	Short term	Medium term
Australia		
Powell and Gruen 1967	0.07	0.33
Witherell 1969	0.07	0.13
Wicks and Dillon 1978	0.25	0.36
Vincent, Dixon and Powell 1980	na	0.26
Meikle, Smith and Smith 1981	0.09	na
Adams 1984	na	0.46
Hall 1985	na	0.35
Dewbre, Shaw, Corra and Harris 1987	0.04	0.35
Harris and Shaw 1990	0.00	0.22
Connolly 1993	0.04	0.45
Kokic, Beare, Topp and Tulpule 1993	na	0.45
Argentina and Uruguay		
Findlay, Dewbre and Geldard 1989	0.10	0.36

Short term is one year, medium term five years.

Sources: Authors cited: Haszler, Chisholm, Edwards and Hone, 1996. Findlay, Dewbre & Geldard, 1989.

The real price of wool in 1988/89 was approximately 66 per cent higher than it was in 1994/95. Therefore if prices gradually rise to those levels wool production will rise by 10-11 million kilograms (the price elasticity of supply being 0,0815), or back to the 100 kilogram average production which was

common during the 1979s and 1980s. Any further increase in South African wool production would be unlikely as an increase of this magnitude would be dependent upon a very substantial increase in world wool prices.

CONCLUSION

The analysis reported in this note indicates that wool production in South Africa responds significantly to changes in wool prices after a two-year lag. In the case of the South African wool industry the collapse in world wool prices and sluggish price recovery has helped to lead to a reduction in wool production well below the average levels of the 1970s and 1980s. Wool producers in South Africa will continue to be exposed to world market prices and as these recover – as is expected after the Australian stockpile is exhausted – then it is possible that there will be a gradual recovery in South African wool production in the first decade of the twenty first century.

NOTE

1. *For a theoretical discussion on the ADF test see Gujarati (1995), pp. 720-29).*

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APPENDIX

Table 5: South African wool production and real price indexes for wool, maize, beef, mutton and farm costs

	Greasy Wool	Greasy wool price	Sheep numbers	Wool price index	Maize price index	Beef price index	Farm costs index	Mutton Price index
	m kg	c/kg	m	Pw	Pm	Pb	C	Pmu
1947/48	98	48,2	25,8	1,157	1,149	1,019	0,691	0,503
1948/49	103	62,1	25,6	1,431	1,102	1,000	0,729	0,503
1949/50	104	77,9	26,0	1,725	1,137	1,006	0,810	0,502
1950/51	111	175,6	29,6	3,605	1,255	1,040	0,856	0,581
1951/52	114	88,3	30,3	0,163	1,280	1,178	0,088	0,814
1952/53	124	103,7	31,4	1,888	1,452	1,165	0,889	0,820
1953/54	128	105,3	32,9	1,887	1,429	1,152	0,875	0,860
1954/55	139	89,1	32,7	1,548	1,385	1,202	0,865	0,920
1955/56	142	78,4	33,5	1,341	1,394	1,399	0,864	0,863
1956/57	146	105,2	34,4	2,125	1,714	1,648	1,045	1,078
1957/58	94	80,9	33,7	1,305	1,571	1,430	0,846	0,811
1958/59	143	60,5	34,5	0,962	1,465	1,501	0,844	0,752
1959/60	146	75,1	33,5	1,178	1,542	1,356	0,847	0,883
1960/61	145	67,3	35,0	1,041	1,575	1,473	0,855	1,039
1961/62	154	69,1	35,0	1,040	1,587	1,447	0,841	1,056
1962/63	137	76,6	35,1	1,160	1,587	1,773	0,849	1,128
1963/64	138	92,1	36,1	1,368	1,566	1,553	0,842	1,103
1964/65	135	74,7	36,9	1,068	1,506	1,785	0,823	1,088
1965/66	150	78,0	38,0	1,074	1,451	1,698	0,817	1.045
1966/67	132	72,3	36,2	0,960	1,306	1,611	0,788	1.131
1967/68	148	69,1	34,4	0,897	1,264	1,558	0,782	1.071
1968/69	142	73,0	34,3	0,926	1,337	1,352	0,775	0.979
1969/70	145	63,7	32,5	0,773	1,258	1,012	0,774	1.002
1970/71	123	45,7	30,3	0,527	1,265	0,967	0,776	1.036
1971/72	113	54,2	26,8	0,583	1,257	0,893	0,771	1.197
1972/73	107	155,9	27,6	1,531	1,304	1,076	0,783	1.437
1973/74	105	151,0	28,1	1,336	1,469	1,331	0,828	1.494
1974/75	107	102,3	28,7	0,797	1,407	1,301	0,883	1.521
1975/76	103	137,5	24,5	0,958	1,327	1,136	0,914	1.449
1976/77	106	162,1	25,0	1,017	1,350	1,098	0,928	1.426
1977/78	102	165,0	24,7	0,941	1,333	1,001	0,949	1.195
1978/79	103	183,6	24,3	0,925	1,473	0,913	1,013	1.072
1979/80	104	206,0	24,5	0,912	1,510	0,986	1,051	1.124
1980/81	104	205,4	28,5	0,789	1,310	1,454	1,010	1.317
1981/82	110	262,1	28,7	0,878	1,315	1,331	1,027	1.259

	Greasy Wool	Greasy wool price	Sheep numbers	Wool price index	Maize price index	Beef price index	Farm costs index	Mutton Price index
	m kg	c/kg	m	Pw	Pm	Pb	C	Pmu
1982/83	113	247,9	25,5	0,740	1,466	1,181	1,042	1.087
1983/84	108	285,9	24,1	0,765	1,694	1,115	1,007	1.098
1984/85	105	410,3	24,2	0,945	1,459	0,984	1,033	1.039
1985/86	98	460,5	23,4	0,893	1,316	0,934	1,038	1.053
1986/87	90	485,3	23,8	0,812	1,230	1,106	0,978	1.130
1987/88	92	844,9	24,2	1,252	1,115	1,251	0,978	1.236
1988/89	96	1054,9	25,9	1,355	0,978	1,159	1,017	1.200
1989/90	99	885,7	25,6	1,000	1,000	1,000	1,000	1.000
1990/91	106	608,6	25,0	0,596	1,025	0,870	0,970	0.824
1991/92	85	687,2	22,6	0,686	1,317	0,840	1,051	0.991
1992/93	75	584,3	20,7	0,458	0,956	0,912	0,904	0.857
1993/94	75	639,2	18,5	0,460	0,799	0,799	0,892	0.975
1994/95	88	1086,3	18,5	0,719	1,121	1,024	0,894	1.022

Source: South African Wool Board, South African Wool Commission, *Annual Reports*. South Africa, Dept of Agriculture, *Abstract of Agricultural Statistics*. South Africa, Bureau of Statistics, *Statistical Year Book*. International Monetary Fund, *International Financial Statistics*.