DETERMINING PRICE DIFFERENCES AMONG DIFFERENT CLASSES OF WOOL FROM THE U.S. AND AUSTRALIA

A Thesis

by

SHAYLA DESHA HAGER

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

May 2004

Major Subject: Agricultural Economics

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May 2004
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ABSTRACT

Determining Price Differences Among Different Classes of

Wool from the U.S. and Australia. (May 2004)

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Chair of Advisory Committee: Dr. Ernest E. Davis

The U.S. wool industry has long received lower prices for comparable wool types than those of Australia. In order to better understand such price differences, economic evaluations of both the U.S. and Australian wool markets were conducted.

This research focused on two primary objectives. The first objective was to determine what price differences existed between the Australian and U.S. wool markets and measure that difference. The second objective was to calculate price differences attributable to wool characteristics, as well as those resulting from regional, seasonal, and yearly differences.

In order to accomplish the objectives, the study was set up into three different hedonic pricing models: U.S., Australian, and combined. In the U.S. model, there were significant price differences in season, year, region, level of preparation, and wool description. In addition, average fiber diameter (AFD) had a negative nonlinear relationship with price and lot weight had a positive linear relationship with price.

The Australian model was notably different than the U.S. model in that there were only three variables. The yearly variable follows the same general pattern as the

U.S. data but with a smaller span of difference. The seasonal price differences were distinctly different than the U.S. because of the difference in seasonal patterns. In addition, the AFD had a similar negative nonlinear relationship with price.

The final model combines both the U.S. data and the Australian data. The combined model had only three variables: season, year, AFD and country. As in the case of the previous two models, AFD had the same negative nonlinear relationship and similar price elasticity. Overall, there was a -30.5 percent discount for U.S. wool when compared to Australian wool. This can be attributed to several different factors. One of which is that the Australian wool industry has a more extensive marketing scheme when compared to the U.S wool market as a whole.

However, this is only a beginning to future research that needs to be conducted. Continuing this study for future years, having more descriptive categories, and additional countries would further add explanation to wool prices.

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CHAPTER I

INTRODUCTION

Problem Statement

U.S. wool production has been on a steady decline since the 1940's. However, wool prices have fluctuated widely. Major wars such as World War II and the Korean conflict had large influences on the world market. The demand for wool uniforms, blankets and such caused wool demand to increase and prices to rise. After these wars, a drop in price was experienced due to a decrease in demand. The National Wool Act of 1954 was passed to help stabilize producers' total income from wool. Even with the Wool Act, production continued to decline, but at a slower rate.

Another factor contributing to wool market difficulties was the floor, or support, price scheme administered by the Australian Wool Council (AWC) in the 1980's. The council purchased Australian wool that did not receive a minimum bid. In the early 1990's, a fluctuation in monetary exchange rates accompanied by over supply caused prices to fall. To compensate for the drop in prices, the support price was raised too high and most of the production for that year was bought by AWC. The stockpile reached its highest point in 1991 with 1.9 billion pounds of wool, which was equivalent to a year of Australian production. At this point the floor scheme was abandoned and the price of wool plummeted immediately. New Zealand and South Africa also had similar support price schemes during this period and had the same problems. The stockpiles were gradually put on the market over the next decade. The wool stockpile on the market kept

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prices depressed. In addition, the Soviet Union collapsed in the early 1990's. The demand for wool from the resulting fragmented countries quickly declined causing prices to decrease worldwide.

In the U.S. in November 1993, the National Wool Act was repealed, phasing out the incentive program over the next two years starting in 1994 and ending in 1995. At the end of 1995, U.S. wool production had declined dramatically. Not only did production decline, but prices received by the producers also declined.

The Australian stockpile was finally liquidated in August of 2001. With the stockpile gone, prices now became more responsive to world supply and demand. In 2001 and 2002 prices began to show this effect, rebounding from the lowest prices seen in twenty years.

The trend in the work place in recent years had become more casual. Employers were allowing less formal attire to be worn and some have implemented casual Fridays. Consequently, wool suits were not needed or required in the work place causing the demand for wool to decrease. These factors have contributed to the decrease in wool prices. Figure 1-1 illustrates domestic wool production and price changes over the last seventy years. This study will investigate differences in U.S. and Australian wool prices to better understand where premiums and discounts exist within the wool market.

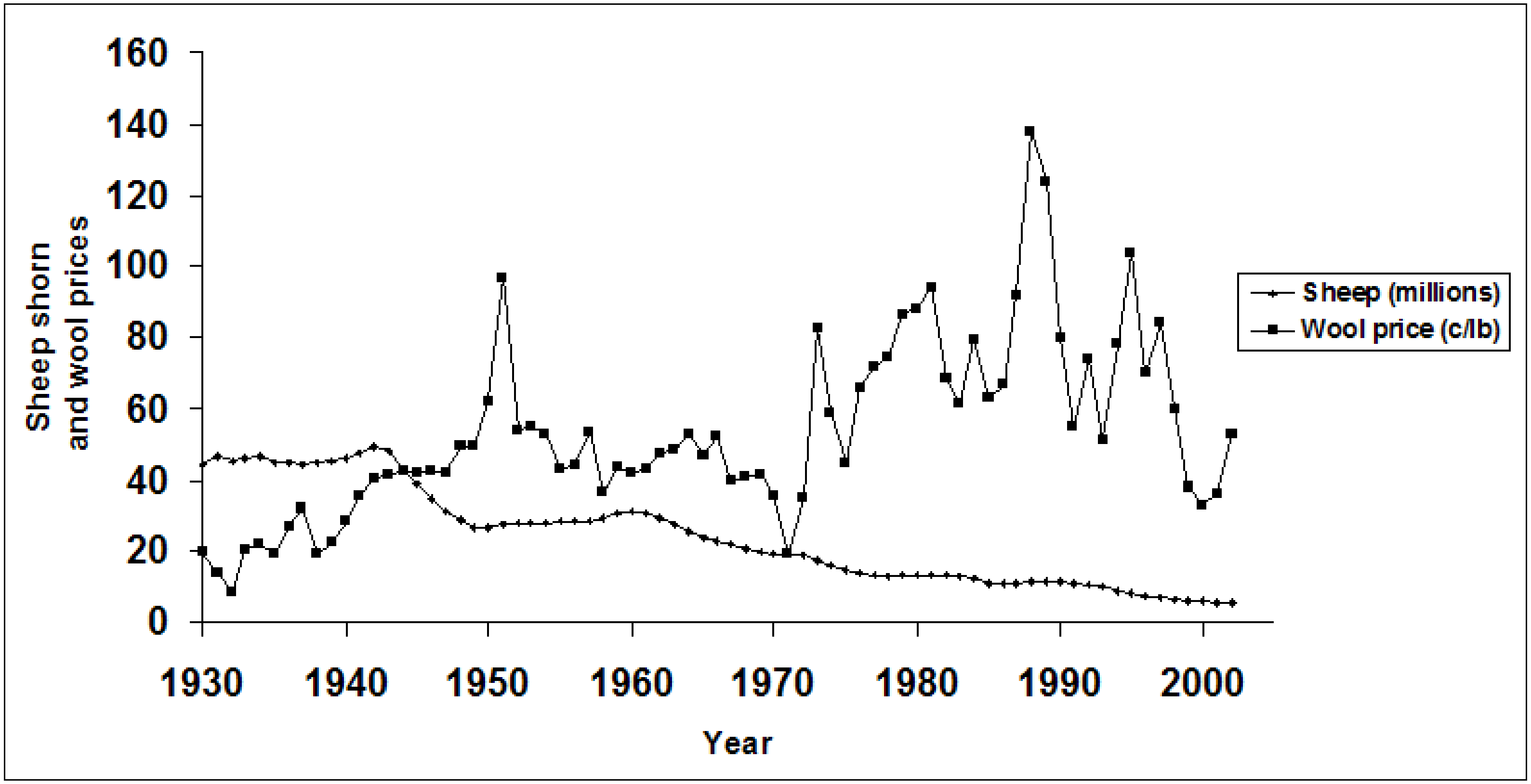

Figure 1-1. U.S. sheep shorn and wool prices from 1930 to 2002

Objectives

The primary objective of this study was to determine if U.S. wool producers can obtain higher prices by adding value to their wool through additional preparation and to determine if there were significant price differences between U.S. and Australian wool markets. More specifically the primary objectives were:

1. To determine if there were any price differences between U.S. and Australian wool markets for similar wools. Also, to determine why these differences, if any, exist.
2. To determine the size of price differences between skirted and classed wools versus original bag wool sales in the United States.

Justification

This project was designed to examine price differences among different wool preparation techniques in regional, national, and world markets. Information on differences could be used to determine possible marketing strategies to enhance returns to U.S. wool producers. This issue was important because U.S. wool production in the past fifty years had been in decline. Wool production between 1993 and 2000 declined from 78 million pounds, greasy basis, to 47.3 million pounds, greasy basis. This represents a 40 percent decline in only seven years. The decline also was paralleled by the 41 percent reduction in sheep numbers, from 8.3 million head to 4.9 million head (Livestock Marketing Information Center, 2000). The change in wool production was due, in large part, to the signing of P.L. 103-130 into law by President Clinton in November of 1993. This law phased out, over a three-year period, the wool and mohair incentive payment effective December 31, 1995, implemented by the National Wool Act of 1954.

In 1991, the reserve price schemes in Australia, New Zealand, and South Africa were removed. The stockpile of wool in these three countries was at an all time record high of 5.66 million bales. Without the support scheme in place, the stockpile was gradually placed on the market driving down prices throughout the world. Also in this year, the USSR started to disintegrate causing the demand for wool from the fragmented country to decline. It was not until August 2001 that the Australian stockpile was completely exhausted.

Another consideration was the exchange rate between Australia, Asian countries and the U.S. Australia was the largest producer of wool in the world and as such was considered to set the world price for wool. Australia, however, had very few processing plants and must export their product, in recent years, mainly to Asia. As a result, their market was heavily impacted by changes in currency exchange rates. If the currency in Asia was devalued, more than likely the price for wool will decline (Livestock Marketing Information Center, 1998). In addition, the world was becoming a more open market with more free trade agreements. The final factor to consider was the marketing of Australian wool. In Australia, most wool was skirted and then subjectively classed by fineness, staple length, color, condition, style, and soundness. Classers produce as few lines as possible from a wool clip while maintaining uniformity within a line and eliminating contamination of the clip with stained and pigmented fibers and all foreign material. Subsequently, most of the lots were objectively measured (prior to sale) for clean yield, vegetable matter content, average fiber diameter (and variability), staple length, staple strength and color (Lupton, Pfeiffer, and Blakeman, 1989).

Most of the wool produced in the U.S. was in the rangelands of the Western and Great Plains States. The production of lamb in these areas often represents the highest opportunity to generate revenue. Much of the area was comprised of rural communities and must depend on the rangeland for livelihood (Davis, Whipple, and Anderson, 1995). With the combination of the factors mentioned above, the U.S. wool industry had been on a steady decline (since World War II). Dr. Rodney Knott (Montana State University Sheep Extension Specialist) wrote in the Sheep Industry Journal "Getting the most for your wool was a complete process that involves growing it, proper harvesting and packaging, and then proper marketing" (1997).

Literature Review

Past research had compared skirted (inferior fleece portions removed) and classed wool to original bag wool (OB) to determine if skirting and classing wool could attain additional revenue. Lupton, Pfeiffer, and Byrns (1996) conducted an experiment over four years, ending in 1996, that used sheep flocks from the Texas Agricultural Experiment Station in San Angelo to determine if skirting and classing of wool was beneficial. They found that the sale of skirted and classed wool, when compared to OB, produced higher gross returns. The magnitude of the span of the value added varied from year to year from 9 to 30 cents per greasy pound of wool. This interval was equivalent to a range in price differentials for the OB and prepared products of 6.6 to 26.9 percent.

One key factor in determining profitability of skirting fleeces was to minimize the amount of skirts removed while maintaining the integrity and uniformity of the skirted wool. The potential to add value to the wool by skirting and classing was suggested because less sorting was required when the wool clip reaches the textile mills. This savings of labor at the mill could be passed back to the producers in the form of higher prices.

In general, skirted and classed fine wool received a higher price than original bag wool, but this does not guarantee a fixed, higher return for this type of wool (Lupton et al 1992). Lupton, Pfeiffer, and Blakeman (1989) conducted a study that took into consideration the differences between skirted and classed wool and original bag wool. They concluded that "overall, the data suggest that skirting can profitably be applied to fine-wool fleeces when prices were at relatively high levels." On the contrary, the financial incentive to skirt was lowered as wool prices decrease or as skirting costs increase. This also can be linked to medium and coarser wools, as they usually receive lower prices (due to the inverse relationship between price and fiber diameter) causing the incentive to skirt to be lower. However, little information had been collected to support this point.

Another factor to be considered was the way wool was presented to buyers. One experiment conducted by Lupton, Pfeiffer, and Blakeman (1993), presented buyers with subjective measurements for all wool lots. Additionally, objective measurements were available on half of the lots. The wool lots that were accompanied by the objective measurements consistently received higher prices. These two practices combined were similar to what was done in Australia. There they use the "sale-by-sample" or "sale-by-separation" scheme. In both of these situations, brokers take representative grab and core samples for display use and for testing by the Australian Wool Testing Authority. The display sample and test information are made available to the buyers but in the "sale-by separation" scheme a sample of the wool was sent to another location for sale (Lupton, Pfeiffer, and Blakeman, 1989). This was in contrast to how many U.S. producers sell their wool, which was still on a greasy basis in sealed-bid sales after subjective evaluation only by the buyer. Thus, in this study there was a need to examine whether or not these factors contribute to the price difference in the wool market as a whole. One short study conducted by Pfeiffer and Lupton (1999) contradicts these views. The conclusion was that "marketing these skirted and classed wools failed to produce more income than would have been generated by selling comparable weights of wool packaged in OB form." So, skirting and classing wool does not always guarantee higher prices but it may become necessary in order to make a sale.

The model used in this project was a hedonic regression model developed by Dr. Oral Capps, Jr., agricultural economist at Texas A&M University. This type of model also was used in a thesis written by Jaret Schulte (2001), "Economic Viability of a Commingled/Backgrounded Cattle Sale." Schulte used the pricing model to regress the selling price on breed, color, frame size, muscle score, fill, flesh, sex, date of sale, lot size, and weight to find the premium or discount among differing breeds, colors, etc. in each category. This study with cattle was designed to show how producers could potentially capitalize to produce higher returns. A similar methodology will be used in this study by regressing the sale price on wool characteristics.

Another study, conducted by Toby Rogers (1996), used a similar model to analyze regional U.S. utility slaughter cow prices. In his thesis, Rogers uses utility slaughter cow supply, lagged prices, per capita disposable personal income, prime interest rates, price of wholesale utility beef, seasonality, and yearly effects to explain price of utility slaughter cows for five regions in the United States. The economic model depicts price differences seasonally and yearly per region, which was similar to what was used in this study.

Procedures

In this study, data were gathered from across the United States and Australia. A comprehensive survey spreadsheet and key was sent to warehouses and pools across the U.S. The most critical part of this project was to collect historical data on skirted and classed, and original bag wool sales. It was one of the most difficult tasks because warehousemen were generally reluctant to provide information due to the time and expense, on their part, to go through their historical files, some were uneasy about how the information would be used. In order to ease these concerns, we decided to send someone to the locations that did not have the resources to collect the information. In addition, it was difficult to compile the data in a manner that was comparable for each area of the country since each area had unique descriptions, methods of preparation, *etc*. The survey spreadsheet was made in a way that each area could compile similar types of wool in the same category. We then were able to compare wool from across the country.

We gathered data over a ten-year span starting in January 1993 and ending in December 2002.

The data were analyzed for differences in market locations, seasonality, clean fiber yield, average fiber diameter, vegetable matter content, estimated staple length, clean price, and greasy price.

CHAPTER II

PRICE DIFFERENCES IN U.S. WOOL

U.S. Data Profile

The U.S. data were contained in a primary data set that was collected from various markets around the U.S. We used seven categories in our attempt to rationalize U.S. clean wool prices. These categories consisted of regional, seasonal, yearly, wool preparation, wool type, average fiber diameter (AFD), and grease weight.

The United States was divided into three regions: Eastern, Central, and Western. The regions were chosen by demographic and market attributes. The Eastern market was made up of smaller volumes of wool that were typically combined to obtain shipping volume. The growers had few market outlets except in niche areas. The wool itself, like the sheep that grow it, tends to be highly variable in quality and style. The Central region produced more uniform wool in terms of quality, style, and quantity. In this region, most growers ran sheep on privately owned land that was fenced. Also, the market structure in this region was well established for the growers. This means that the marketing outlets had been in the area for years and the warehousemen, growers, and buyers have a well-established relationship. In the Western region, wool production was greatly influenced by federal land. Here, the growers have bought the rights to graze on the land but they did not own the land. This in turn meant that the growers had more of a short-term outlook because the federal landlord could change the conditions for leasing the grazing rights from year to year. Thus, trying to create or maintain a uniform flock was not usually a high priority. As a result, the wool clips tend to be more variable in terms of all quality attributes. The marketing in this region was very similar to that of the Central region. The Eastern region was separated from the Central region by the Mississippi River and the Central region was separated from the Western region by a line that ran west of the Dakotas, Nebraska, Kansas and New Mexico.

In this study, the Central region had the largest percentage of observations at 78.3 percent and the Eastern region had the smallest percentage at 3.3 percent. The Central region had the most observations because more marketers in this region were cooperative. Figure 2-1 better illustrates this breakdown.

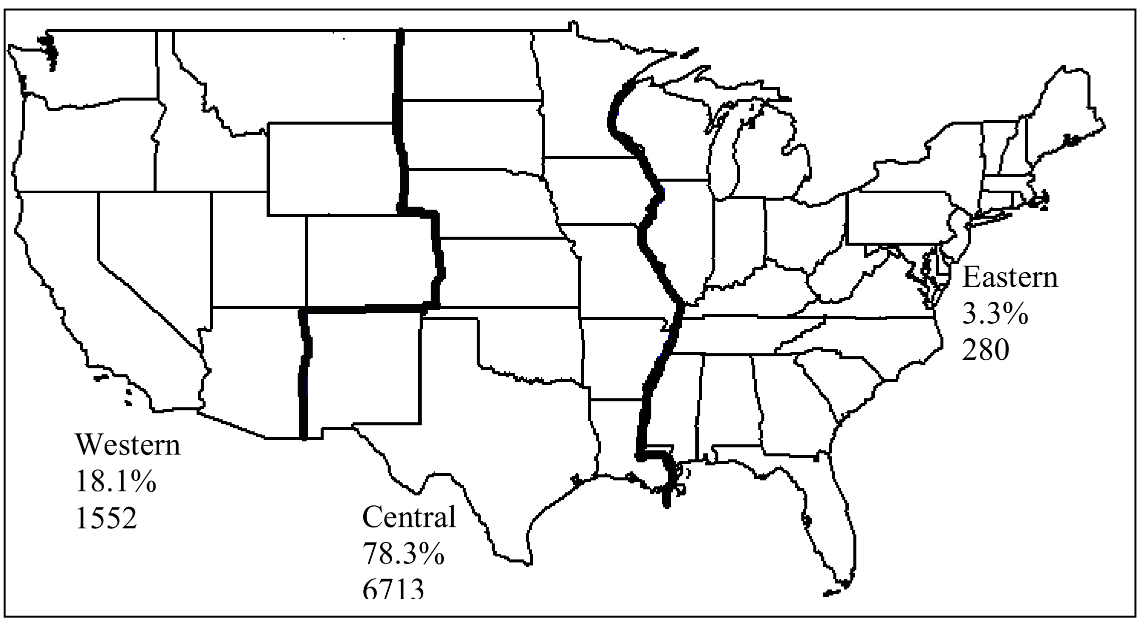

Figure 2-1. U.S. regional descriptions

Seasonally, the data were concentrated in the months of May and June with about 50 percent of the observations being in these two months. This was a function of when the wool clip was shorn and sold. Over 50 percent of the observations fell into the last three years of the data set. This was a function of the availability of historic records from the warehouses and pools across the U.S. Many marketers only saved records for three to five years and discarded old records annually. A more complete breakdown of the seasonal and yearly data can be found in Table 2-1.

The data were separated into three levels of preparation. Original bag (OB) was wool that had been sheared off the sheep and put into a bag with nothing removed. The OB wool constituted 22.6 percent of the total observations in the data set. The second level of preparation was Bellies Out Untied (BOU). When the sheep were shorn and the belly wool was removed, packaged and sold separately from the remainder of the fleece. This type of wool had the largest percentage of observations with 56 percent. The final level of preparation (comparable to Australian) was Table Skirted and Classed (TSC), which accounted for the last 21.4 percent of the observations. The TSC was the highest level of preparation, being that when the fleece was thrown across a table and the outer, poorer quality wool was separated from it.

The largest and most complex category was the wool type. Seventeen different wool types were identified and evaluated. The highest percentage of the observations was in the Wool Breed Main Line category (61.8 percent). The reason that this was such a large percentage was because both the BOU and TSC levels of preparation fell into this type. The Main Line category was the highest quality wool from wool breed sheep. The Tender or Short Line category consisted of 8.6 percent of the observations. Tender meant that the staple was not strong and could be easily broken and Short, was where the staple length was shorter than three inches. Wool Breed Bellies and OB Wool Breeds constituted 7.06 and 6.72 percent of the observations, respectively. Bellies were inferior wool that was sheared from the belly of the sheep. This was a higher percentage because this type of wool was taken out of the fleeces of both the BOU and TSC levels of preparations. A summary of the wool types can be found in Table 2-1.

Table 2-1. Breakdown of the Number of Observations per Category

Seasonal	Number of Observations	Percentage of Observations
January	220	2.56
February	267	3.11
March	376	4.38
April	726	8.45
May	2567	29.89
June	1761	20.50
July	706	8.22
August	453	5.27
September	571	6.65
October	439	5.11
November	334	3.89
December	169	1.97
TOTAL	8589	100.00

Yearly	Number of Observations	Percentage of Observations
1990	1	0.01
1991	7	0.08
1992	5	0.06
1993	434	5.05
1994	426	4.96
1995	436	5.08
1996	408	4.75
1997	537	6.25
1998	657	7.65
1999	821	9.55
2000	1630	18.98
2001	1447	16.85
2002	1768	20.58
TOTAL	8577	99.85

Table 2-1. Continued

Level of Preparation	Number of Observations	Percentage of Observations
Original Bag	1941	22.60
Bellies Out Untied	4812	56.03
Table Skirted Classed	1836	21.38
TOTAL	8589	100.00

Region	Number of Observations	Percentage of Observations
Western	1555	18.11
Central	6726	78.31
Eastern	281	3.27
TOTAL	8562	99.69

Wool Types	Number of Observations	Percentage of Observations
Wool from TSC and BOU		
Wool Breed		
Main Line	5305	61.77
Tender or Short Line	736	8.57
Bellies	606	7.06
Pieces	146	1.70
Stains	78	0.91
Locks	446	5.19
Clothing	77	0.90
Main Line Lamb	220	2.56
Meat Breed		
Main Line	133	1.55
Bellies	1	0.01
Wool Types from OB		
Wool Breeds	577	6.72
Meat Breeds (White Face)	100	1.16
Meat Breeds (Black Face)	91	1.06
Hair or Cross Bred	42	0.49
Wool Breed Lamb	18	0.21
Meat Breed Lamb	3	0.03
Black	10	0.12
TOTAL	8589	100.00

Model

A hedonic pricing model was used to determine the premiums and discounts due to wool characteristics, as well as differences due to region, year, and season. Past research in the wool industry had not used this type of model to examine detailed premiums/discounts. Instead, most research had looked only at the level of preparation to determine if there were sufficient price differences to justify the practice. Whereas this hedonic model took seasonal, yearly, average fiber diameter (AFD), and lot size into consideration when considering price differences, most previous research efforts took the average price for the individual levels of preparation to find the price differences. In this model more detailed information was collected and analyzed to better understand where and why price differences existed.

The qualitative characteristics used an arbitrarily chosen base to determine premiums and discounts. The bases for yearly and seasonal were chosen to be 1997 and September, respectively. The Central region was chosen to be the base for the region category. This region was chosen due to the fact that the largest percentage of the observations was found here. The bases for level of preparation and wool type were Original Bag and Original Bag Wool Breeds. Original Bag was chosen because it was the lowest level of preparation and the Original Bag Wool Breed was the highest quality wool for this level of preparation. The two quantitative categories that were used to describe clean price were AFD and grease weight. To allow for the possibility of a nonlinear relationship between price and AFD, a natural log function was used. In order to adjust for outliers or observations that would skew the end results, observations that were five standard deviations above or below the mean of that category were removed from the data set.

Via the hedonic price model, we may derive a dollar amount for the premium or discount. To better illustrate the price differences, a percentage premium/discount was calculated. In order to do so, a logarithm of the model was utilized. The coefficients for each category were used to calculate an expected value. The expected value was then multiplied by 100 percent to find the percentage.

The statistical model was as follows:

$$\text{Log Clean Price}_{it} = \alpha + \beta_Y Y_i + \beta_S S_i + \beta_L L_{it} + \beta_T T_{it} + \beta_R R_{it} + \log\beta_M M + \log\beta_W W + \varepsilon_{it} \quad (2\text{-}1)$$

$$\text{Exp}(\beta\text{-}1)*100\% = \text{Percentage of Premium/Discount} \quad (2\text{-}2)$$

where α was the intercept denoting the base wool lot, and $\beta_{Y,\,S,L,T,R,M,W}$ referred to the value of the wool characteristics. The other letters represented the categories that were used to describe clean wool price. Y refers to the yearly variable, S was the seasonal, L was the level of preparation, T was wool type, R referred to regional, M was for AFD, and W was for grease weight. β represented the coefficient for each category from the previous equation.

Results

The hedonic pricing model defined above was used to calculate the statistical significance of the price differences among the different characteristics of wool in the United States.

The U.S. model used 8,589 observations and was found to have a R-squared of 0.8001. The R-squared demonstrates that the model as a whole was statistically significant with the model explaining 80 percent of the variation in U.S. wool prices. A five percent significance level was chosen in order to establish statistical significance.

Seasonal Effects

In the seasonality category, September was chosen to be the base month. The months of April, May, July, and August were found not to be significantly different from September. The month of June was found to have the highest premium at 8.1 percent higher than the base month. January was the lowest at -17.4 percent. Initially, the hypothesis was that the months of May and June would have the highest premiums. The majority of the world wool production was clipped and sold during the winter months in the U.S. The textile factories, therefore, had purchased most of the wool needed for their production for the year by that time. A high proportion of the U.S. wool was clipped in April and May. When the U.S. clip was placed on the market buyers were able to buy this wool to fill the gaps in the factories production. These factories estimated what the next seasonal demands would be for their product. Thus gaps in wool supplies in their factories occur. Table 2-2 depicts the percentage differences in season.

Yearly Effects

The yearly differences were primarily negative when compared to the base of 1997. The highest premium occurred in 1995 with a positive percentage of 17.7 percent above the base. The lowest points were found to be 1999 and 2000 with both being below –50 percent. The price differences in yearly effects can be found in Table 2-2.

Regional Effects

The U.S. was divided into three regions (Eastern, Central, and Western) for this analysis. The Central region was chosen to be the base of this category. Before the regression analysis was completed, the hypothesis was that both the Eastern and Western regions would have a discount when compared to the base. This was found to be true with the Eastern region having a discount of –7.9 percent and the Western region having a –9.8 percent discount.

Level of Preparation Effects

The lowest level of preparation, Original Bag, was used as the base for this category. It was expected that the other two levels would have a premium. The question was to what extent would there be a difference. It was important to find these differences because producers can have a more educated decision on whether or not it was profitable to skirt their wool. The Bellies Out Untied level, however, was not significantly different than the O.B. base. The only premium was found in the Table Skirted Classed level with a positive 8.4 percent.

Wool Type Effects

This category was the largest and most descriptive of all. The Original Bag Wool Breeds type was the base. This base was the lowest level of preparation for wool breed sheep. As expected, the TSC and BOU Main Line wool was shown to have the highest premium of 23.5 percent, whereas the lower quality wools, bellies, pieces, tags, and locks, were considerably lower. There were several categories that were not significantly different from the base and these included: Meat Breed Main Line, Meat

Breed Bellies, and Original Bag Black Face Lamb. The entire wool type premiums/discounts can be viewed in Table 2-2.

Table 2-2. Estimated Coefficients and Percentage Price Differences

Month	Estimated Coefficients	Premium/Discount (%) Relative to Base	P-Value
January	-0.19127	-17.4	<0.0001
February	-0.078873	-7.6	<0.0001
March	-0.060827	-5.9	<0.0001
April	-0.015576	-1.5	0.212
May	0.0064575	0.6	0.532
June	0.077869	8.1	<0.0001
July	0.0039067	0.4	0.756
August	-0.023966	-2.4	0.081
September	**Base**	**Base**	**Base**
October	-0.062365	-6.0	<0.0001
November	-0.1154	-10.9	<0.0001
December	-0.12674	-11.9	<0.0001

Year	Estimated Coefficients	Premium/Discount (%) Relative to Base	P-Value
1993	-0.49471	-39.0	<0.0001
1994	-0.19216	-17.5	<0.0001
1995	0.16285	17.7	<0.0001
1996	-0.12604	-11.8	<0.0001
1997	**Base**	**Base**	**Base**
1998	-0.27023	-23.7	<0.0001
1999	-0.70128	-50.4	<0.0001
2000	-0.73794	-52.2	<0.0001
2001	-0.62485	-46.5	<0.0001
2002	-0.2921	-25.3	<0.0001

Level of Preparation	Estimated Coefficients	Premium/Discount (%) Relative to Base	P-Value
Original Bag	**Base**	**Base**	**Base**
Bellies Out Untied	0.020922	2.1	0.27
Table Skirted Classed	0.081091	8.4	<0.0001

Region	Estimated Coefficients	Premium/Discount (%) Relative to Base	P-Value
Central	**Base**	**Base**	**Base**
Western	-0.10357	-9.8	<0.0001
Eastern	-0.082315	-7.9	<0.0001

Table 2-2. Continued

Wool Type	Estimated Coefficients	Premium/Discount (%) Relative to Base	P-Value
Wool from TSC and BOU			
Wool Breed			
Main Line	0.21137	23.5	<0.0001
Tender or Short Line	0.055089	5.7	0.013
Bellies	-0.29026	-25.2	<0.0001
Pieces	-0.41786	-34.2	<0.0001
Stains	-0.68077	-49.4	<0.0001
Locks	-0.98939	-62.8	<0.0001
Clothing	0.19864	22.0	<0.0001
Main Line Lamb	0.14321	15.4	<0.0001
Meat Breed			
Main Line	0.039387	4.0	0.174
Bellies	-0.12882	-12.1	0.545
Wool from OB			
Wool Breeds	**Base**	**Base**	**Base**
Meat Breeds (White Face)	-0.23252	-20.7	<0.0001
Meat Breeds (Black Face)	-0.38261	-31.8	<0.0001
Hair or Cross Bred	-0.32257	-27.6	<0.0001
Wool Breed Lamb	-0.17902	-16.4	<0.0001
Meat Breed Lamb	-0.69882	-50.3	<0.0001
Black	-1.1606	-68.7	<0.0001

Average Fiber Diameter Effects

Average fiber diameter was hypothesized to have a negative relationship with price and was suspected to be linear. The relationship in fact was negative but it was not linear. Instead there was a curvilinear relationship between the two. This means that the curve was downward sloping but not at a constant rate. The estimated coefficient calculated for AFD was the AFD price elasticity. This elasticity was found to be -1.4160. This suggests that for a 10 percent increase in AFD there would be a corresponding decrease in price of 14.160 percent. Figure 2-2 depicts this relationship. In addition to this figure, Table 2-3 shows the expected price changes from one AFD to another. This table helps to illustrate how much of a price difference a grower can obtain by producing finer wool. Theoretically, the expected price changes cannot be added together to find the expected price difference between AFD's that were more than one micron apart.

Lot Size Effects

The final determinant was lot size. The relationship between lot size and clean price was a positive, linear relationship. This suggests that the larger the lot the better the price. It was because the closer a lot was to a truckload the less money buyers spend on transportation per pound. The estimated coefficient was the lot size price elasticity and was calculated to be a positive 0.01624. This means that a 10 percent increase in lot size increases the price by 0.1624. This relationship was best described as a gentle upward sloping graph (Figure 2-3).

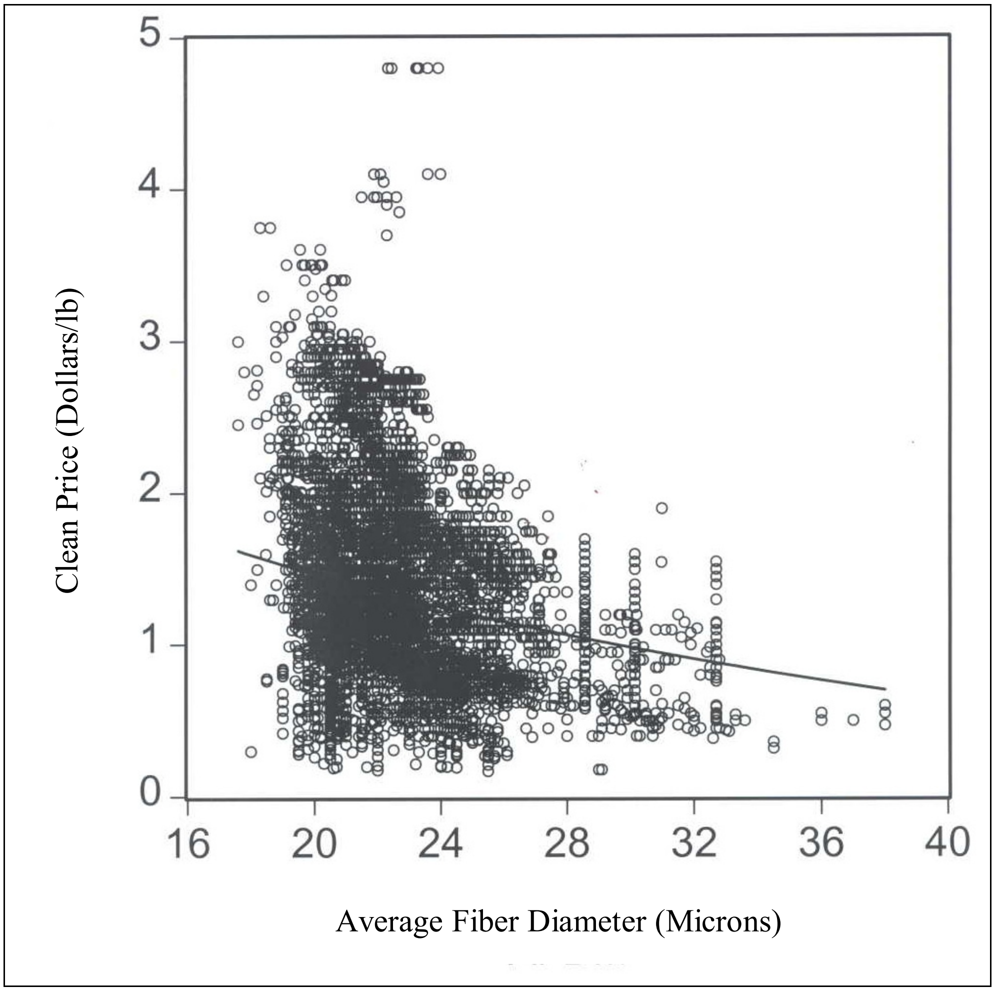

Figure 2-2. U.S. average fiber diameter and price relationship

Table 2-3. U.S. Expected Price Change from One Micron to Another

Average Fiber Diameter	Percentage Change in AFD	Percentage Price Change
30		
	-3.33%	4.72%
29		
	-3.45%	4.88%
28		
	-3.57%	5.06%
27		
	-3.70%	5.24%
26		
	-3.85%	5.45%
25		
	-4.00%	5.66%
24		
	-4.17%	5.90%
23		
	-4.35%	6.16%
22		
	-4.55%	6.44%
21		
	-4.76%	6.74%
20		
	-5.00%	7.08%
19		
	-5.26%	7.45%
18		

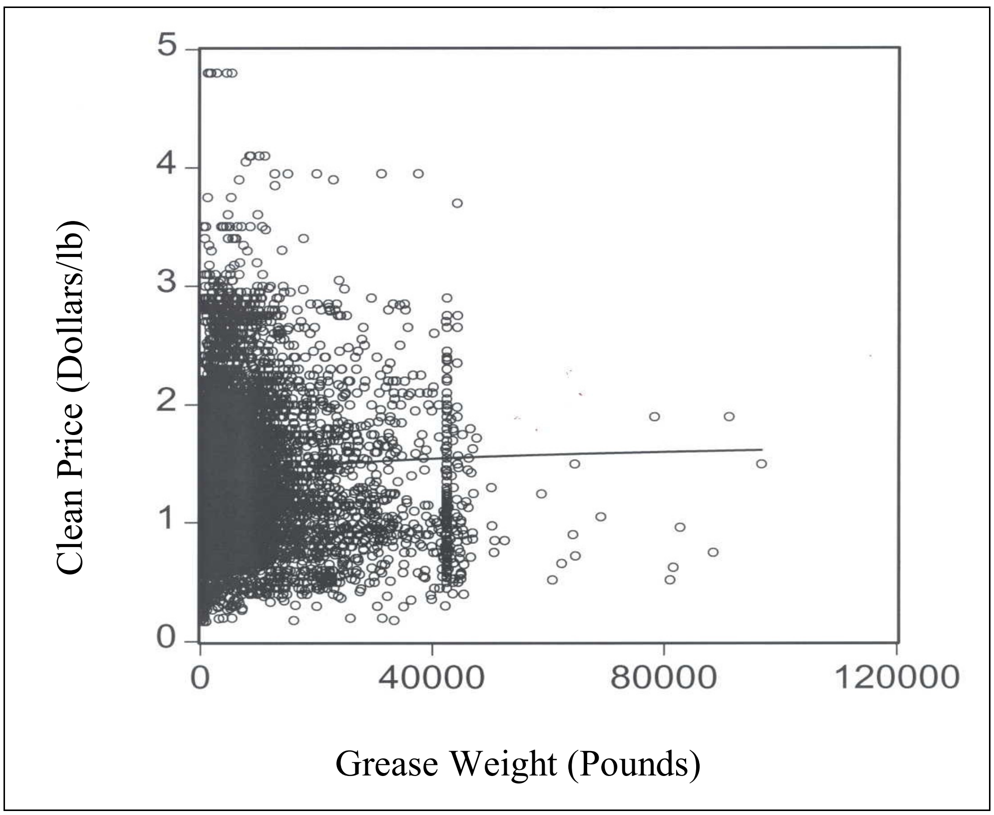

Figure 2-3. U.S. grease weight and price relationship

CHAPTER III

PRICE DIFFERENCES IN AUSTRALIAN WOOL

Australian Data Profile

The Australian data for this study was a secondary data set supplied by Livestock Marketing Information Center (LMIC). Only four variables were contained in the data set: season, year, average fiber diameter, and price received. The data were converted from Australian currency to U.S. dollars and from kilograms to pounds. This enabled a comparison of the U.S. and Australian clean wool prices. The seasonality of the Australian data set was significantly different from the U.S. The amount of wool sold was relatively uniform over the twelve months with low points being in April, July, and December. The data were also quite smooth over the ten-year span. This was due, in part, to the data set being a secondary continuous series and had nearly the same number of observations per year.

Model

A hedonic pricing model, similar to the U.S. model, was used to analyze the Australian data to find premiums and discounts relating to year and season. The main difference in this model was there were fewer categories used to describe clean wool price. Again, in this model the qualitative categories used a selected base to find a premium or discount relative to the base. The base for season was again chosen to be September and year was 1997. The quantitative category, average fiber diameter, was thought to have a negative linear relationship to price, but found this to not be true as it was curvilinear.

The hedonic model initially calculated the dollar amount discount or premium for each category, but to better illustrate the findings a percentage difference was calculated. In order to find the percentage, a natural logarithm was taken of the model. The coefficients were then used to find the expected value. The expected value was then multiplied by 100 percent.

The statistical model was as follows:

$$\text{Log Clean Price}_{it} = \alpha + \beta_Y Y_i + \beta_S S_i + \text{Log } \beta_M M + \varepsilon_{it} \quad (3\text{-}1)$$

$$\text{Exp}(\beta\text{-}1)*100 = \text{Percentage Premium/Discount} \quad (3\text{-}2)$$

where α was the intercept denoting the base wool lot, $\beta_{Y,\,S}$ refers to the value of the wool characteristics, Y was for the year variable, S was for season and M was for AFD measured in microns.

Results

Unlike the U.S., the Australian data (6,550 observations) had only three variables to describe the clean wool price and thus the statistical fit was not as good as that of the U.S. model. The R-square of 0.7519 shows that the model had a relatively good statistical fit (i.e., explained 75 percent of the variation in clean price). A level of significance of 5 percent was chosen to determine statistical significance.

Seasonal Effects

The effect of seasonality was not surprisingly different from that of the U.S. This was because the seasons occur during different months on each continent. Again, the base for this category is was chosen to be September. The months of May and June had the highest premium of 6.1 percent and 4.7 percent respectfully. October was found to have lowest discount of -2.5%. The months of August, November and December where shown not to be significantly different from September. Table 3-1 summarizes the seasonal effects.

Yearly Effects

Australia and U.S. had a similar pattern in the effects of year. The base for this category was chosen to be 1997. The highest premium was found to be in 1990 with 18.2% and also 1995 with a premium of 13.0%. The lowest discounts were found to be in the same period as the U.S. These discounts were from 1998 to 2001. However, the difference was not as severe as that of the U.S with the discounts ranging from –30.3% to –38.8% at the lowest point. Table 3-1 depicts the premium/discounts.

Average Fiber Diameter Effects

The average fiber diameter (AFD) in the Australian model affected the clean price much in the same way that the AFD of the U.S. model affected clean price. The relationship between AFD and clean price was negative and curvilinear. The Australian AFD price elasticity was calculated to be –1.426, which was very similar to the U.S. AFD price elasticity. This relationship is illustrated in Figure 3-1. Another way to portray the effect AFD had on clean price was in Table 3-2. This table shows the expected price change from one micron to another.

Table 3-1. Australian Data Analysis

Month	Estimated Coefficient	Premium/Discount (%) Relative to Base	P-Value	Number of Observations	Percentage of Observations
January	0.036388	3.70	<0.0001	493	7.50
February	0.023808	2.40	<0.0001	587	9.00
March	0.026817	2.70	<0.0001	637	9.70
April	0.018096	1.80	0.1	374	5.70
May	0.058786	6.10	<0.0001	622	9.50
June	0.046029	4.70	<0.0001	656	10.00
July	0.027532	2.80	<0.0001	248	3.80
August	0.000469	0.00	1	614	9.40
September	**Base**	**Base**	**Base**	630	9.60
October	-0.024947	-2.50	<0.0001	618	9.40
November	-0.0039701	-0.40	0.7	663	10.10
December	-0.01343	-1.30	0.2	408	6.20
Total				6550	100

Year	Estimated Coefficients	Premium/Discount (%) Relative to Base	P-Value	Number of Observations	Percentage of Observations
1990	0.16744	18.20	<0.0001	473	7.20
1991	-0.17467	-16.00	<0.0001	528	8.10
1992	-0.14352	-13.40	<0.0001	559	8.50
1993	-0.41426	-33.90	<0.0001	559	8.50
1994	-0.058501	-5.70	<0.0001	572	8.70
1995	0.12264	13.00	<0.0001	572	8.70
1996	-0.070607	-6.80	<0.0001	546	8.30
1997	**Base**	**Base**	**Base**	520	7.90
1998	-0.38329	-31.80	<0.0001	514	7.80
1999	-0.49123	-38.80	<0.0001	416	6.40
2000	-0.43788	-35.50	<0.0001	419	6.40
2001	-0.36159	-30.30	<0.0001	439	6.70
2002	0.057073	5.90	<0.0001	433	6.60
Total				6550	100

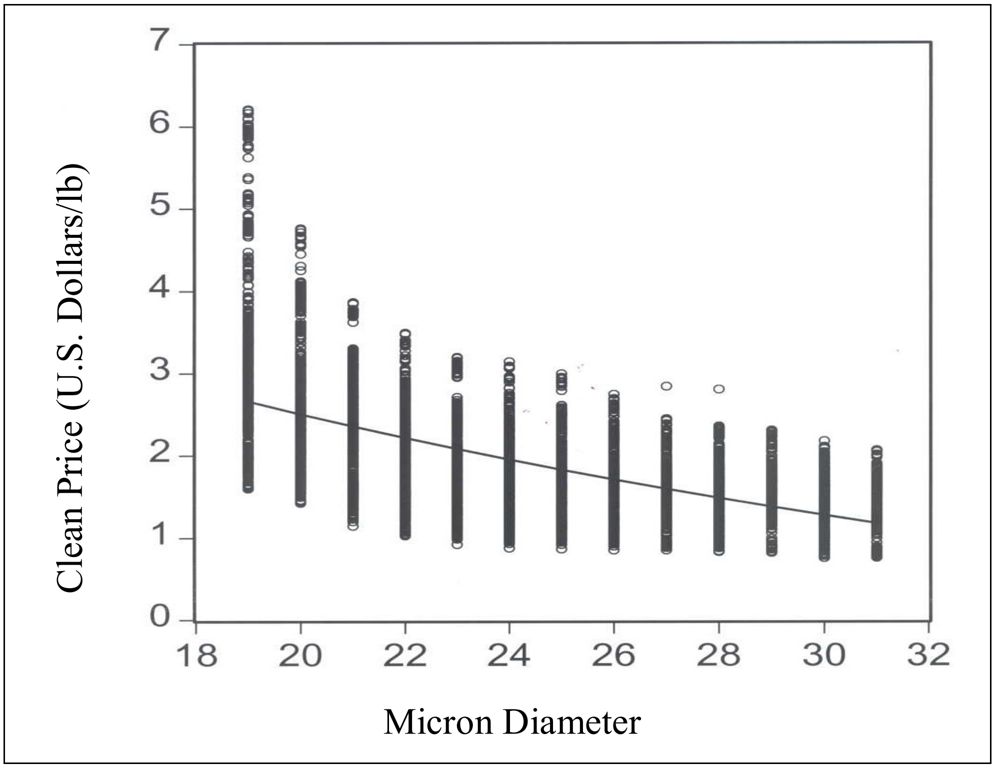

Figure 3-1. Australian average fiber diameter and price relationship

Table 3-2. Australian Average Fiber Diameter Expected Price Change

Average Fiber Diameter	Percentage Change in AFD	Percentage Price Change
30	-3.33	4.75
29	-3.45	4.92
28	-3.57	5.09
27	-3.70	5.28
26	-3.85	5.49
25	-4.00	5.70
24	-4.17	5.94
23	-4.35	6.20
22	-4.55	6.48
21	-4.76	6.79
20	-5.00	7.13
19	-5.26	7.51
18		

CHAPTER IV

COMPARISON OF U.S. AND AUSTRALIAN WOOL PRICES

When comparing the Australian and U.S. data a compiled or combined data set was used. In order to do so, we had to use fewer categories in the U.S. data to describe clean price in order to match the fewer categories available in the Australian data set. There must be the same number of determinants in order to perform the combined regression analysis. The model thus contains yearly, seasonal, and average fiber diameter categories.

Model

The model in this chapter was identical to that used to analyze the Australian data set above. This was a hedonic pricing model. The qualitative categories in this model were seasonal, yearly, and country with bases being September, 1997 and U.S., respectfully. The quantitative variable was average fiber diameter (AFD). Like the previous two models, to allow for the possibility of a nonlinear relationship between AFD and clean price, a natural logarithm function was used to calculate the relationship.

The hedonic pricing model initially found the dollar premium/discount for each category, but to better illustrate the premium or discount a percentage was calculated. In order to compute this percentage, a natural logarithm was taken. From this, the coefficients were used to find the expected value for each category. These values were then multiplied by one hundred percent.

The statistical model was as follows:

$$\text{Log Clean Price} = \alpha + \beta_Y Y_i + \beta_S S_i + \log \beta_M M + \beta_c C_{it} + \varepsilon_{it} \qquad (4\text{-}1)$$

$$\text{Exp} (\beta - 1) * 100\% = \text{Percentage Premium/Discount} \qquad (4\text{-}2)$$

where α was the intercept that denotes the base wool lot and β referred to the value of category represented. The other symbols represented the individual categories. The Y represented the year category, S was for seasonal, M was for average fiber diameter, and C was for country.

The main objective for this part of the study was to find the effects of average fiber diameter on price and find the percent premium or discount that the U.S. was receiving when compared to Australia. The effects of seasonal and yearly individually were not important in this analysis. However, both of these variables were very important for the analysis in that the effects of both season and year on price were taken into consideration.

Results

The hedonic pricing model described above was used to find the percentage premium or discount for each category. The statistical fit of this model was the lowest of the three models considered. This model, however, still had a significant statistical fit with an R-square of 0.6432. The statistical significance of each individual category was found using the p-value at a 5% significance level.

Average Fiber Diameter Effects

The previous models have shown that the effect of AFD on clean price is a negative curvilinear relationship. This also was true for the combined model. The AFD price elasticity was calculated and found to be equal to -1.430. From this finding, we may infer that if the AFD were to change 10 percent, then the clean price would change by 14.3 percent in the opposite direction.

Overall Comparison

The overall comparison highlights the major points of comparison in all three of the models. These include AFD and clean price means, AFD price elasticity, and overall U.S. clean price discount compared to Australian clean price.

The first comparison was of the means of both AFD and clean price. The U.S. model calculated the mean of the AFD to be 22.2 microns and the clean price mean to be $1.34 per pound. The Australian model calculated the means of AFD and clean price to be 24.6 microns and $1.89 per pound. Thus the Australian wool marketers were receiving a higher price for a larger micron, which was contrary to the relationship between AFD and clean price. This difference may be attributed to the greater degree of preparation and competitive, open auction form of marketing of the Australian wool. In Australia, most wool was table skirted and classed. In addition, the wool was tested in an Australian Wool Testing Authority laboratory for several different factors some of which include AFD, vegetable matter content, and clean yield, plus possibly, strength and length. At the time of purchase, buyers were given the laboratory tests and were shown a sample of the lot up for sale. In the U.S., a significant amount of wool had no further level of preparation other than being sheared off the sheep. Also in the U.S., there was not a consistent way of presenting wool for sale. Some sales only have the wool lots and estimated characteristics of the wool. In other sales, the wool had been table skirted and classed, tested, and a sample was available for viewing.

The AFD price elasticity illustrates the relationship between AFD and price. The AFD price elasticity of the U.S. was -1.416 and –1.426 in Australia. The significance of this was that the two elasticities were relatively close (despite all the preparation and marketing differences between the two countries).

The final comparison was of the discount received by the U.S. when compared to Australia. In the combined model, the Australian variable was chosen to be the base variable in country category to show what discount or premium the U.S. received. Overall, the U.S., in fact, had a 30.5% discount when compared to Australia. When the mean prices of both countries were taken and the percentage difference was calculated, the percent found would be very close to what was found here. The difference, however, was that the mean did not adjust for seasonality, yearly, or AFD effects. Thus, the calculation found in the combined model was significant and reliable.

CHAPTER V

SUMMARY AND CONCLUSIONS

Restatement of Problem

The U.S. wool producers have seen a steady decline in production for over sixty years. During this time, price had seen many fluctuations. These price changes have been due to world events ranging from wars, to climate changes, to changes in dress code in the work place.

The National Wool Act of 1954 no doubt helped to slow the decline in U.S. production, and stabilized income to producers from wool. However, in November 1993 a law was passed to phase out this act over the next two years. With the Wool Act gone in 1995, the U.S. wool producers saw a sudden decline in production and income.

Australia, New Zealand, and South Africa also had a type of support price scheme that allowed quasi-government organizations to buy wool that did not receive the floor price at auction. The stockpiled wool from this plan reached a very high level in 1991, 5.66 million bales (each containing about 425 lb.). At this level, the governments of each country could not continue to support their floor price schemes. Consequently, the policies were canceled and wool from the stockpiles began to be put on the market. The knowledge of all this extra wool caused prices to be depressed for the next ten years. It wasn't until August 2001 that the Australian stockpile was completely sold. With the stockpile depleted, wool prices were more respondent to world supply and demand.

In recent years, fashion in the work place has become more casual. This was evident in the widespread adoption of casual Fridays. On casual Fridays, an employee is allowed to wear less formal attire. As a result, fewer wool suits were required causing wool demand to decrease.

Previous economic research conducted in the U.S. had not used in-depth models like the hedonic models used in this study. There have only been studies to analyze the effects of different levels of preparation in U.S. wool. Finding price differences associated with wool type, season, and year, along with level of preparation, micron and grease weight will better help wool producers to find ways to gain revenue.

Restatement of Objectives

The primary objective of this study was to determine if U.S. wool producers can obtain higher prices by adding value to their wool through additional preparation. In addition, calculations were made to find if there were significant price differences between U.S. and Australian wool markets. More specifically the primary objectives were:

1. To determine if there were any price differences between the U.S. and Australian wool markets for similar wools. Also, to determine why these differences, if any, exist.
2. To determine the size of price differences between skirted and classed wools versus original bag wool sales in the U.S.

Results

Price Differences in U.S. Wool

A hedonic pricing model was used to find price differences due to wool characteristics as well as regional, yearly and seasonal differences. Wool characteristics used in this model included level of preparation, wool type, AFD, and lot size.

There was only one seasonal variable found to have a significant premium when compared to the September base. June was the month with a premium of 8.1%. On the other hand, the largest discount was in January with a –17.4%. There also were several months that were not significantly different from the base. These included April, May, July, and August. The yearly variable also only had one factor that had a premium over the base of 1997. This was found in 1995 with a premium of 17.7%. The highest discounts, however, were found in 1999 and 2000, -50.4 and –52.2 percent, respectively.

The regional variable confirmed the hypothesis that the Eastern and Western regions did receive discounts when compared to the base of the Central region. Level of preparation was also hypothesized to have a similar outcome. The base for this category was the lowest level of preparation, Original Bag wool. Both the Table Skirted Classed and Bellies Out Untied wools received a higher premium than the base, though the latter difference was not significant (p-value = 0.27).

The largest and most complex variable in the U.S. data was the wool type. In this category, Original Bag Wool breed wool was established as the base. As expected, the higher quality TSC wools received premiums however the BOU wools were not significantly different from OB wools. Whereas the lower quality wools, which included bellies, tags, and OB meat breed wool all of which received substantial discounts.

The AFD was found to have a negative, non-linear relationship with clean price; with an increase in AFD price decreases. However, because of the non-linear relationship between the two, as AFD increases, price decreases at an increasing rate. Grease weight was found to have a positive linear relationship: when weight increases price also increases.

Price Differences in Australian Wool

The Australian model was similar to the U.S. model except with fewer characteristics used. Again, a hedonic pricing model was used to describe price differences attributable to year, season, and AFD.

Seasonal differences were considerably different from the U.S. due to hemispheric differences. In Australia, there were primarily positive premiums with the highs being in May and June with respect to the base of September. The only discount found was in October with a –2.5%. Once more, there were several months that were not significantly different from the base. These months included April, August, November, and December.

The yearly variables of both the U.S. and Australian models mimic each other. Meaning that high and low points occurred in the same years but not at the same magnitude. Like the previous model, 1997 was randomly chosen to be the base year. The premiums in this model occurred in 1990, 1995, and 2000. However, the discounts were more prevalent with the highest discounts taking place in 1999 and 2000.

The final variable used to describe clean price was AFD. Calculations found that there was again a negative non-linear relationship between the two.

Comparison of U.S. and Australian Wool Prices

The third section of this study combined both the U.S. and Australian data sets to find price differences between the two countries using a combined model. Due to the smaller data set (less variables) of Australia, the U.S. set had to conform in order to make the comparison. This meant that the only categories used in this model were yearly, seasonal, AFD and country. The hedonic pricing model in this section was identical to the Australian model with more observations.

The season variable was considerably different from the two other models because of the combination of the data sets from differing hemispheres. Premiums were found to exist in July and April and discounts were found in January, May, and December with respect to the September base. Like the other two models, there where several months that were not significantly different from the base. These included February, March, June, and August.

The yearly variable was very similar to both the U.S. and Australian models. The base of 1997 was randomly chosen. Both the premiums and discounts were found to be in the same years for both countries. The only premiums occurred in 1990 and 1995 and the highest discounts were during the later part of the twentieth century and the early parts of the twenty first century.

The country variable showed that the U.S. was receiving a significant discount compared to the Australian wool producers. Also, the AFD price elasticity of both countries was extremely similar, illustrating that the wool market was truly a world market.

Conclusions and Implications

The results of the U.S. hedonic pricing model showed that the Western and Eastern regions both had discounts when compared to the Central region. The month of June was found to have had the only significant premium. In 1995, the highest and only premium for the year variable was found. The highest level of wool preparation, TSC, received a significant premium when compared to O.B. In addition, wool type was found to follow this same trend with wools of higher preparation levels and higher quality receiving more premiums. The AFD was found to have a negative non-linear relationship with price whereas lot size had a positive linear relationship with clean price.

The Australian model found October to be the only month to have a discount with all others having premiums or were not significant. The yearly variable was very similar to the U.S. model. However, there were more years with positive premiums, which included 1990, 1995 and 2002.

The combined hedonic pricing model showed that both July and April have premiums when compared to September. The year 1995 was the only year that premiums were found for the yearly variable. One of the most important findings of this study was that the U.S. received a significantly lower price for wool than Australia.

This study allows producers and marketers alike to calculate what their individual gains or losses might be when they attempt to add value to their wool. The percentage premiums or discounts can be applied to OB wool to find what the expected price may be if the wool had the bellies removed or table skirted classed, etc. Producers can also calculate the expected financial rewards of selecting for finer wool. Also, the model gives insight into Australian wool prices. The overall industry can take advantage of the findings in this study to better understand where they can capitalize on premiums.

The combined model illuminates opportunities for the U.S. to capitalize with their product. It shows that the U.S. was receiving lower prices than Australia for wools of comparable AFD (though not comparable preparation). Growers and marketers alike need to find more consistent ways to present U.S. wool to buyers. In having this consistency, the world buyers would have a better understanding of the wool characteristics within the lot. Consequently, with these improvements the buyers should be more willing to compensate the growers for a higher quality product.

The U.S. wool warehouses, pools and growers all have their individual ways to present their wool to buyers. In addition, most buyers have been purchasing wool from the same sources for years and have formed strong relationships. Even so, there were still uncertainties in wool purchasing that need to be addressed. Some lots only have subjective measures to describe the wool. In other words, the seller gives descriptive comments of the wool lots but does not have the actual, correct measurements. The buyer must take the word of the seller of what he or she was buying. Having these uncertainties and inconsistencies in U.S. wool marketing undermines the actual value of the product being sold.

Limitations

The U.S. model offers a detailed analysis of the domestic wool industry. Nevertheless, there were areas that can be improved and more knowledge of the industry can help producers better understand where opportunities can be capitalized upon. The U.S. wool industry as a whole had no consistent means of recording lot descriptions and sales. Some warehouses and pools only keep subjective descriptions of wool characteristics (with exception of greasy weight) and little or no testing was conducted on the wool. In other instances, the warehouse or pool keeps accurate tested records of all lots sold. With these differences in record keeping it was hard to form an extremely accurate analysis of price differences. In addition, historical records were not always kept. In most cases, available technology was not advanced enough or was not present to maintain adequate records. So, boxes of paper documents were kept and after several years the documents were no longer needed and were discarded. Also, warehouses and pools were not always willing to give out information pertaining to their sales. They do not want others to capitalize on the knowledge of what prices they were receiving. In the Australian model, the main limitation was the limited variables used to describe clean price. Price differences were not available pertaining to wool type or level of preparation.

This study identified significant differences between U.S. and Australian wool prices. However, with limited comparable categories the model was not as complete as it could be. A more descriptive data set particularly from Australia could help to better understand the difference in prices received between the U.S. and Australia.

Future Research Needed

Although this study had significant findings in price differences among wool types produced in the U.S., Australia, and combined models, there are areas in which future research could be very beneficial. Continuing to use this model in future years would help to better understand the wool industry pricing structure. Furthermore, additional information, such as vegetable matter content, staple length and strength, and fiber color, would help to determine where potential price premiums exist. Figure 5-1 was an example of a spreadsheet that could be used to gather more information for future analysis. This was the spreadsheet used to collect data in the current study. In addition, to better understand the premiums and discounts due to wool characteristics, marketing practices can also be studied. It would be possible to set up an additional factor in the model to account for marketing practices (open auction, sealed bid, private treaty, or subjective and objective description), which could help identify where further premiums might be found.

Name of Market:
Year:

Date of Sale	Level of preparation	Wool description	Wool style	Gease weight, lbs	Average fiber diameter, microns	Wool grade	Clean yeild, %	Vegetable matter content, greasy basis, %	Estimated staple length, in	Estimated staple strength	Fiber Color	* Clean price, $/lb
	(OB, BOU, TSC)	(SEE KEY)	(B, G, O)		(E or M)	(E or M)	(E or M)	(E or M)		(S, T, B)		(FOB)
===========	============	=========	=======	=======	=======	=======	=======	=======	=======	=======	=======	=======

Figure 5-1. Sample spreadsheet for future analysis

Key for Spreadsheet

Level of Preparation Abbreviations:
OB = original bag
BOU = bellies out untied
TSC = table skirted and classed

Wool Description Abbreviations:
For wool from skirted and classed wool breeds

A	Main Line
A-2	Tender or short lines
BLS	Bellies
PCS	Pieces
STN	Stains
LKS	Locks
CTH	Clothing

For wool from skirted and classed meat breeds

M	Main Line	**(M-WF or M-BF, whiteface or blackface)
M-2	Tender or short line	
M-BLS	Bellies	
M-PCS	Pieces	
M-STN	Stains	
M-LKS	Locks	
M-CTH	Clothing	

**L add to these descriptions for lambs wool

For wool that has not been skirted **(M-WF or M-BF, whiteface or blackface)

OB-W	Original bag from wool breed sheep
OB-M-WF or OB-M-BF	Original bag from meat breed sheep
OB-H	Original bag form hair or cross sheep

Wool Style Abbreviations:
B = Best
G = Good
O = Other
*** E or M Refers to estimated or measured

Estimated Staple Strength Abbreviations:
*** S, T, B refers to sound, tender, or broken wool

*****Clean Price**
The clean price should be the clean price the producer received.

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APPENDIX

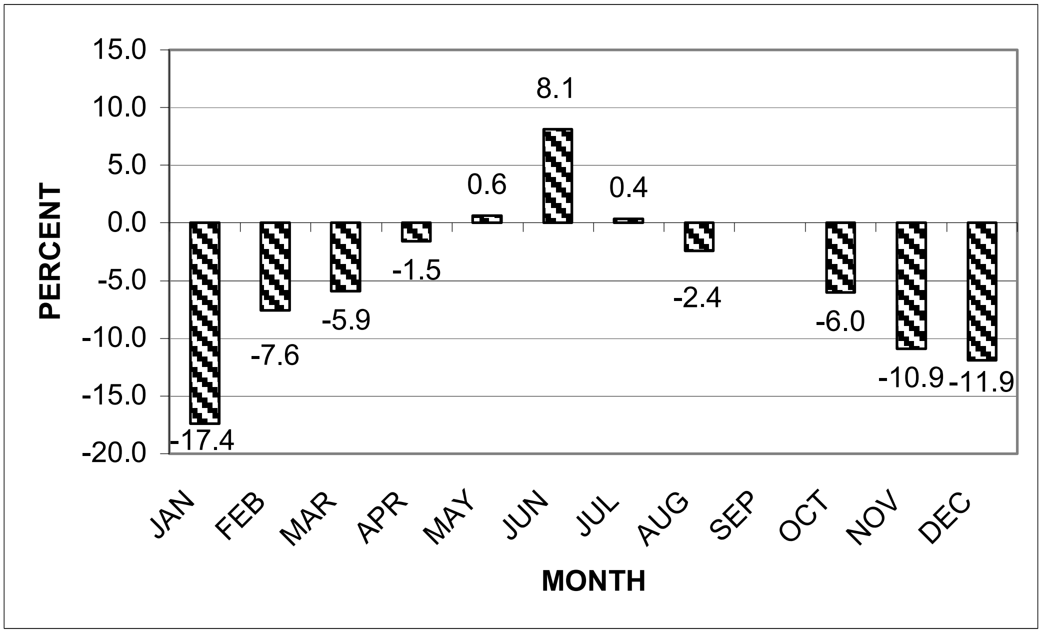

Figure A-1. Percentage price difference per month in U.S. wool (base Sept.)

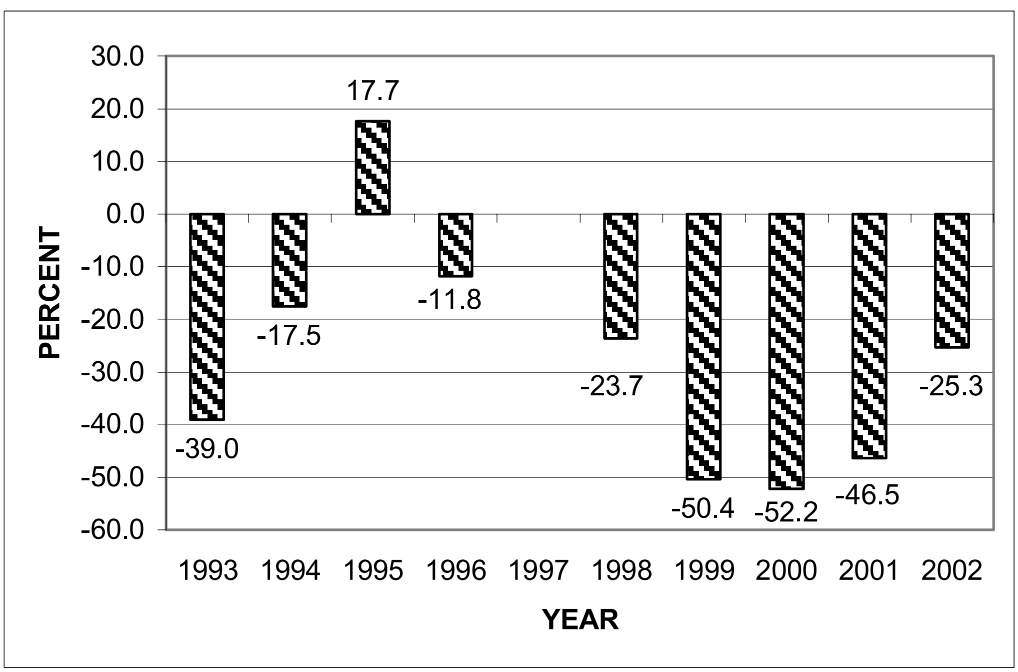

Figure A-2. Percentage price difference per year in U.S. wool (base 1997)

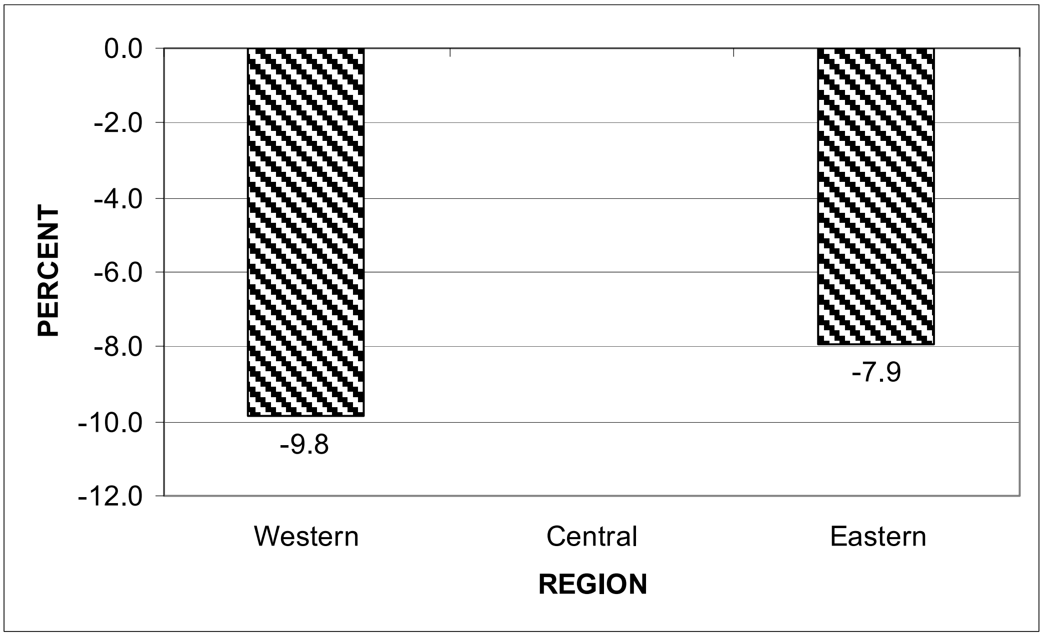

Figure A-3. Percentage price difference per U.S. region (base central)

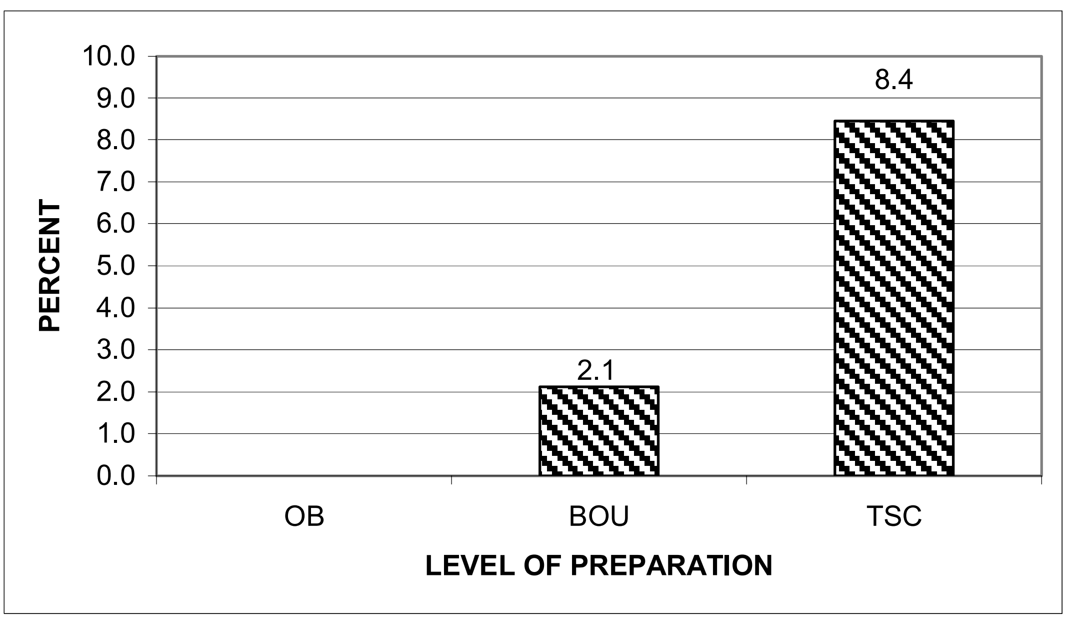

Figure A-4. Percentage price difference in level of preparation in U.S. wool (base OB)

Figure A-5. Percentage price difference in U.S. wool types (base OB-Wool Breeds)

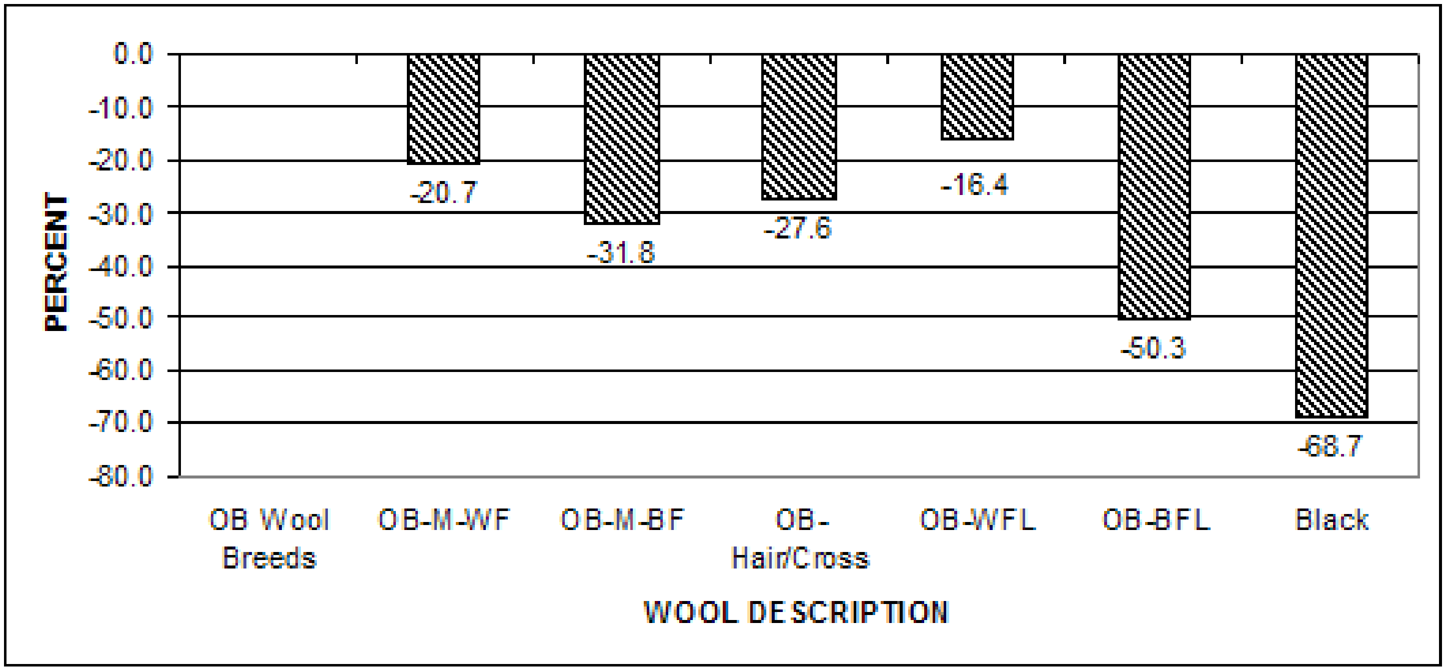

Figure A-5. Continued

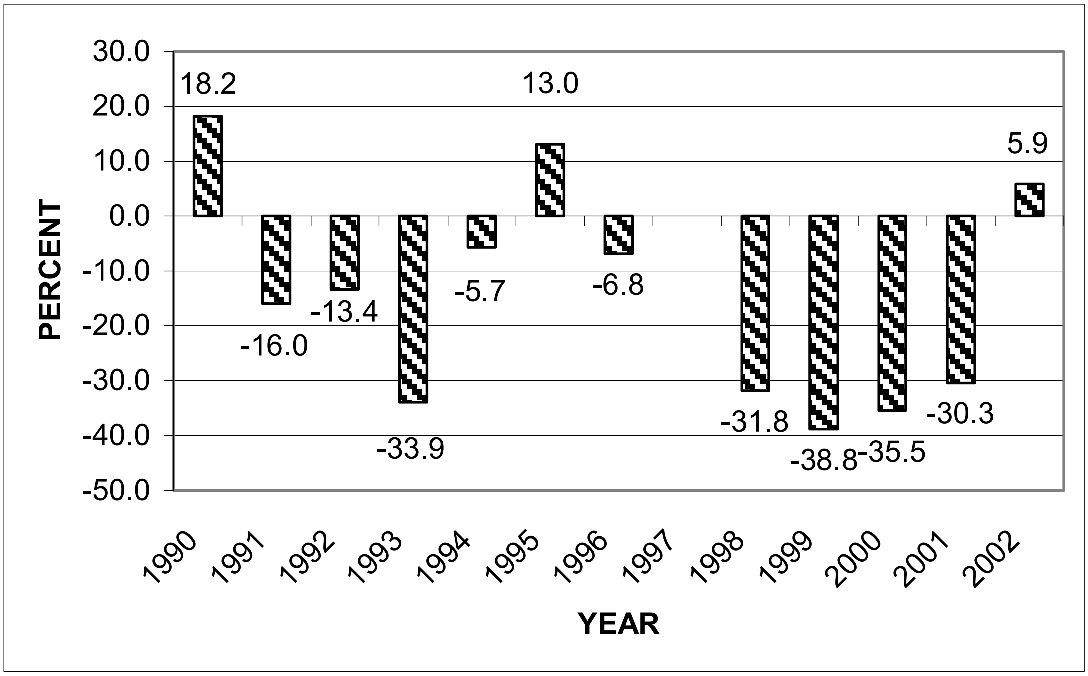

Figure A-6. Percentage price difference per year in Australian wool (base 1997)

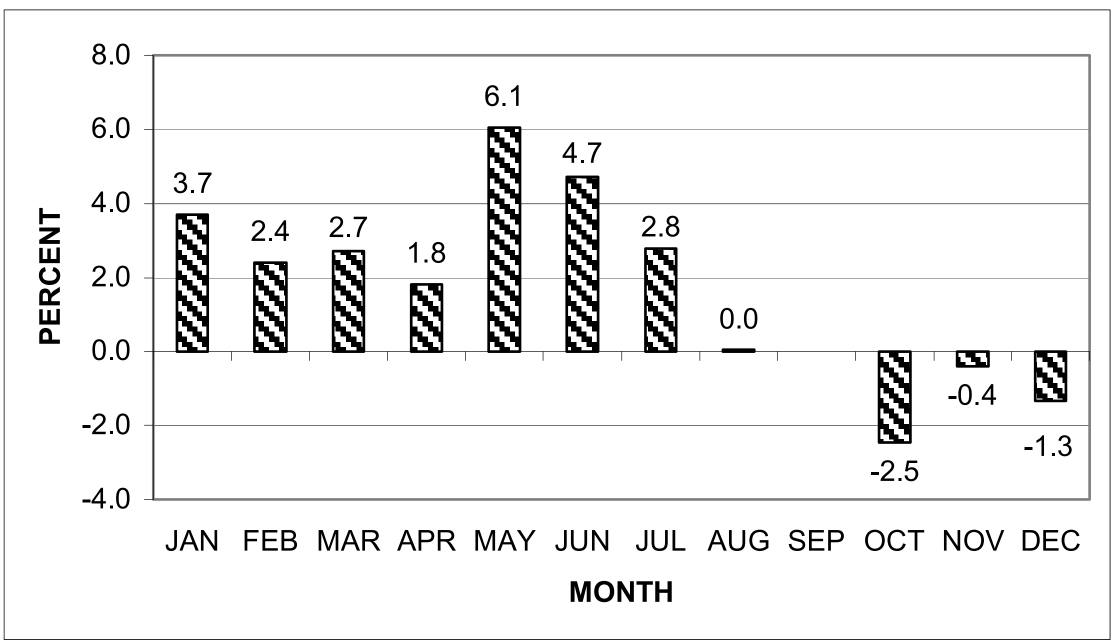

Figure A-7. Percentage price difference per month in Australian wool (base Sept.)

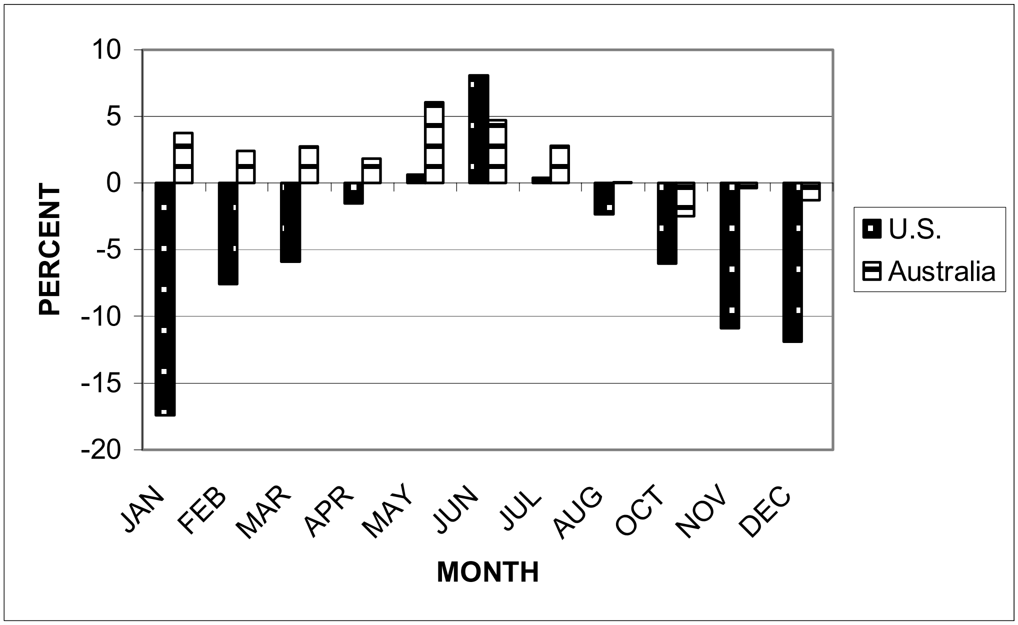

Figure A-8. Percentage price difference per month in both the U.S. and Australia (base Sept.)

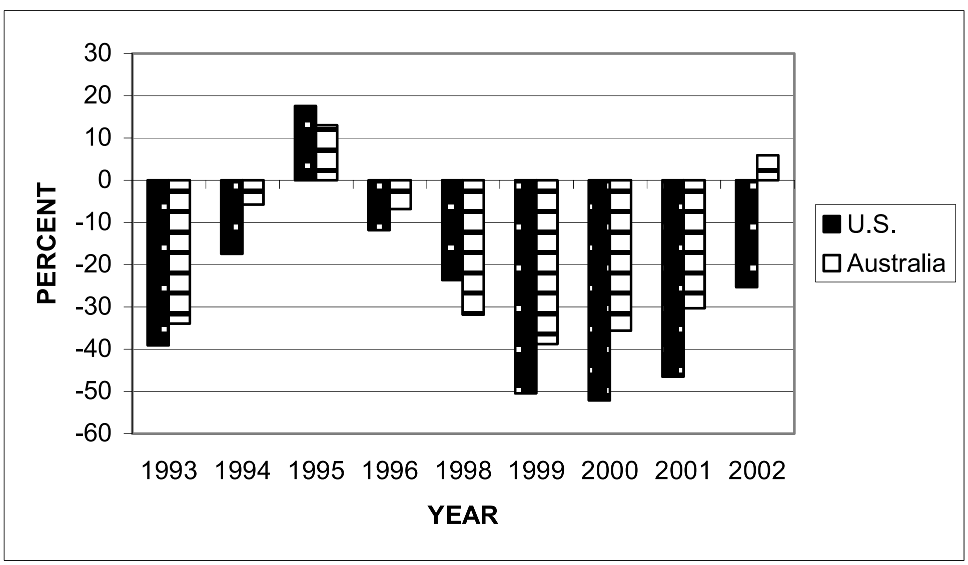

Figure A-9. Yearly percentage price differences in both U. S and Australian wool (base 1997)

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