MONTANA STATE UNIVERSITY

An economic analysis of the sheep and lamb industry in the United States, 1930-1968
by Gordon Lynn Langford

A dissertation submitted to the Graduate Faculty in partial fulfillment of the requirements for the degree of DOCTOR OF PHILOSOPHY in Agricultural Economics
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Abstract:
The steadily declining sheep numbers over the past eight years points out the problem area of the sheep and lamb industry. This study analyzes factors influencing demand, supply, and price of sheep and lamb at the farm level and examines some short run price forecasting models for the industry.

Two objectives were considered: 1) to identify and quantify factors affecting lamb and sheep prices at the farm level; 2) to determine possible future trends of lamb and sheep prices for forecasting purposes in the short run.

A detailed econometric model was fitted to annual time series data to examine the structural relationships of the industry. Lamb demand and supply was partitioned into spring lamb and fed lamb to obtain greater precision. The complete model included demand and supply equations for spring and fed lamb, demand and supply equations for sheep, and an import equation. The relationships were estimated by two stage least squares techniques for three recent time periods.

Forecasting models were developed for three estimating periods which included one month, three month, and six month advance estimations. Ordinary least squares estimation techniques were applied to monthly time series data.

The results of the structural annual analysis indicated that demand for both spring and fed lamb was more highly inflexible to price (higher elasticity) at the farm level than earlier studies had indicated. Income was found to be an important factor in demand for spring and fed lamb. Imports of lamb and mutton were found to have a small impact on lamb prices.

Results from the forecasting model suggest that lamb prices and price trends can be predicted with considerable reliability, particularly when all three time periods are used in chronological order. However, since the possibility exists of large errors in the estimates obtained, the model should be used as a forecasting tool with good judgment.

There is a need for further exploration and refinement of the model in terms of lagged price variables, data arrangement, and weighting techniques as well as improved statistical procedures. Additional testing of the equations with future data should add precision to the price forecasts.

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THE UNITED STATES, 1930-1968

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A dissertation submitted to the Graduate Faculty in partial
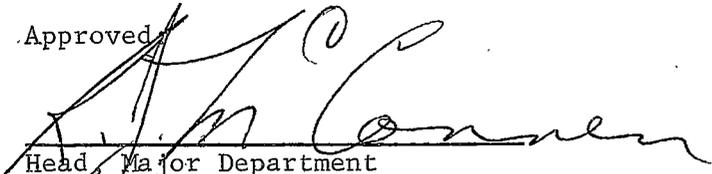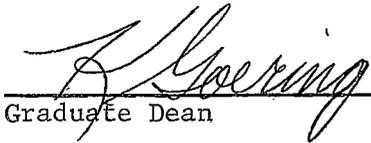fulfillment of the requirements for the degree

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ABSTRACT

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CHAPTER I

INTRODUCTION

Historical Survey

Past records indicate that domestic sheep have been raised by the

earliest people in history and with the development of civilization they

have gradually spread over the entire face of the globe.[1]

The development of the Spanish Merino sheep industry during the

period from 1400 to 1700 A.D. resulted from the fusion of various blood

lines brought to Spain by the Phoenicians from Asia, Africa, Greece, and

Rome.[2] While exportation of these sheep from Spain was prohibited until

the latter half of the 18th century, Merino sheep with its fine wool qual-

ities and heavier wool production has had a marked impact on the sheep

industry of the world.[3]

Sheep were brought to North America by the Spanish discoverers and

conquerors. In 1493 on his second voyage, Columbus brought sheep to His-

paniola. Spanish ships later carried sheep to Cuba and Panama.[4] In the

early 1600's sheep were brought into Virginia and Maryland as well as the

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[1]Charles E. Raymond. "Where in the World Will Sheep Be Produced?"
The Future for Sheep, CAED Report 21, Iowa State University of Science and
Technology, 1964, p. 17.

[2]Edward N. Wentworth. America's Sheep Trails. Iowa State College
Press, Ames, Iowa, 1948, p. 9.

[3]Ibid., p. 12.

Ezra A. Carman et al. Special Report on the History and Present
Condition of the Sheep Industry of the United States. Government Printing
Office, Washington, D.C., 1892, pp. 17-18.

New Dutch and Swedish settlements.[5] In the 1790's the first Merino sheep were brought into the United States. During the next ten years 25,000 head of Merino sheep were imported and distributed to all states. These formed the foundation for much of the sheep industry of America.[6]

As development of the country extended west, the center of sheep production moved until today sheep numbers are concentrated in the far western United States. The industry reached its peak in numbers in 1884, when the number of stock sheep totaled 51.1 million head.[7] However, as the industry developed from east to west, emphasis has changed during the last half century from wool production to meat production. Today about three-fourths of the industry income is derived from the production of meat (Table I, page 3), although producers have tended to develop breeds which would produce good meat as well as wool.[8]

While concentration of sheep production has focused on the western United States, total sheep numbers have generally declined. Considerable fluctuation has occurred since the peak of 1884. However, after a high of 49.3 million head in 1942, numbers dropped to about 27 million through the 1950's and peaked to a high of 28.8 million in 1960. Since that time stock

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[5] L. G. Conner. A Brief History of the Sheep Industry of the United States. Government Printing Office, Washington, D.C., 1920, p. 93.

[6] M. E. Ensminger. Sheep Husbandry. Interstate Printers and Publishers, Danville, Illinois, 1952, p. 23.

[7] U. S. Department of Agriculture. Livestock and Meat Statistics 1957. Statistical Bulletin No. 230, Economic Research Service, Washington, D.C., July 1958, p. 4.

[8] Ensminger. op. cit., p. 25.

TABLE I. CASH RECEIPTS FROM LAMB AND SHEEP AND WOOL FOR SELECTED YEARS

Year	Cash receipts from lamb and sheep* (mil. dol.)	Cash receipts from wool (mil. dol.)	Total cash receipts (mil. dol.)	Cash receipts from wool as a percent of total income
1910	105.3	66.4	171.7	38.7
1915	110.8	53.3	164.1	32.5
1920	166.3	114.2	280.5	40.1
1925	206.9	100.0	306.9	32.5
1930	161.5	68.7	230.2	29.8
1935	152.2	69.6	221.8	31.4
1940	180.0	105.5	285.5	37.0
1945	319.5	130.0	449.5	28.9
1950	387.3	134.6	521.9	25.8
1955	315.7	99.8	415.5	24.0
1958	358.1	88.6	446.7	19.8
1960	327.1	111.5	438.6	25.4
1965	328.6	95.0	423.6	22.4
1966	334.1	101.2	435.3	23.2
1967	299.2	74.8	374.0	20.0

*Includes income from lamb and mutton and sale of sheep and lambs.

Source: Compiled from Agricultural Statistics 1968, Table 491; 1966, Table 512; 1962, Table 515; 1957, Table 504; 1941, Tables 521 and 533.

sheep inventory numbers have declined each year until on January 1, 1968, slightly over 19 million head of stock sheep were reported on farms.[9]

The decline in inventory numbers is reflected in the decline in total

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[9] U. S. Department of Agriculture. Livestock and Meat Statistics. 1967 Supplement to Statistical Bulletin No. 333, Economic Research Service, Washington, D.C., June 1968, p. 2.

production and consumption, particularly in recent years (Table II).

TABLE II. PRODUCTION AND CONSUMPTION OF LAMB AND MUTTON FOR SELECTED YEARS

Year	Total production (mil. lbs.)	Change in production (percent)	Total consumption (mil. lbs.)	Change in consumption (percent)
1899	487		486	
1900	493	+ 1.2	492	+ 1.2
1905	530	+ 7.5	529	+ 7.5
1910	597	+12.6	596	+12.7
1915	605	+ 1.3	612	+ 2.7
1920	538	-11.1	578	- 5.6
1925	603	+12.1	605	+ 4.8
1930	825	+36.8	824	+36.2
1935	877	+ 6.3	923	+12.0
1940	876	- 1.1	873	- 5.4
1945	1054	+20.3	943	+ 8.0
1950	597	-43.4	596	-36.8
1955	758	+27.0	753	+26.3
1958	688	- 9.2	719	- 4.5
1960	768	+11.6	852	+18.5
1961	832	- 8.3	923	+ 8.3
1962	809	- 2.8	950	+ 2.9
1963	770	- 4.8	908	- 4.4
1964	715	- 7.1	795	-12.4
1965	651	- 8.9	716	- 9.9
1966	650	- 1.5	771	+ 7.7
1967	646	- 6.1	759	- 1.6

Source: Compiled from Agricultural Statistics 1966, Table 531;
1962, Table 533; 1899, 1900, and 1905 data taken from E. J. Working, Demand
for Meat, Table 1, p. 90.

Role of the Lamb and Sheep Industry

Lamb and mutton play a relatively small role in the United States

meat industry. Per capita consumption in 1900 averaged 6.5 pounds. In

1945 consumption reached 7.3 pounds per person. However, in 1967 this had

declined to 3.9 pounds, a 46.5 percent decrease in 22 years. In sharp con-

trast, per capita consumption of beef increased from 59.4 pounds in 1945 to

106.3 pounds in 1967.[10]/ Poultry consumption per capita increased 81.6

percent to 46.3 pounds in 1967.[11]/

In 1930, lamb and mutton as a percent of all red meat consumed was

5.2 percent. Although some fluctuations have occurred, a general decline

is clearly noticeable. In 1967, lamb as a percent of all red meat had

declined to 2.2 percent. In contrast, beef consumption as a percent of

all red meat has trended upward from 37.9 percent in 1930 to 59.7 percent

in 1967. Table III, page 6, points out this relationship in percentage as

well as actual consumption in pounds. Pork consumption has likewise de-

clined over this period.

As mentioned earlier, the emphasis of the sheep and lamb industry

has changed somewhat in the last half century. Reference to Table I,

page 3, indicates that while considerable fluctuation has taken place, the

percent cash income from wool of the total cash income in the industry has

gone from 38.7 percent in 1910 to a high of 40.1 percent in 1920, followed

[10]/Ibid., p. 145.

[11]/U.S. Department of Agriculture. Agricultural Statistics.
U.S. Government Printing Office, Washington, D.C., 1968, p. 691.

TABLE III. LAMB AND MUTTON CONSUMPTION PER CAPITA AS A PERCENT OF ALL RED MEAT CONSUMPTION PER CAPITA FOR SELECTED YEARS

Year	Lamb and mutton (lbs.)	Lamb and mutton (%)	Pork (lbs.)	Pork (%)	Veal (lbs.)	Veal (%)	Beef (lbs.)	Beef (%)	All red meat (lbs.)
1900	6.5	4.3	719	47.7	5.2	3.5	67.1	44.5	150.7
1910	6.5	4.4	62.3	42.6	7.2	4.9	70.4	48.1	146.4
1920	5.4	4.0	63.5	46.7	8.0	5.9	59.1	43.4	136.0
1930	6.7	5.2	67.0	51.9	6.4	5.0	48.9	37.9	129.0
1940	6.6	4.6	73.5	51.6	7.4	5.2	54.9	38.6	142.4
1945	7.3	5.0	66.6	45.9	11.9	8.2	59.4	40.9	145.2
1950	4.0	2.8	69.2	47.9	8.0	5.5	63.4	43.8	144.6
1958	4.2	2.8	60.2	39.7	6.7	4.4	80.5	53.1	151.6
1960	4.8	3.0	65.2	40.4	6.2	3.8	85.2	52.8	161.4
1961	5.1	3.2	62.2	38.6	5.7	3.5	88.0	54.7	161.0
1962	5.2	3.2	63.8	39.0	5.5	3.4	89.1	54.4	163.6
1963	4.9	2.9	65.6	38.6	4.9	2.9	94.5	55.6	169.8
1964	4.2	2.4	65.5	37.4	5.3	3.0	100.1	57.2	175.1
1965	3.8	2.3	58.8	35.1	5.2	3.1	99.6	59.5	167.4
1966	4.0	2.3	58.2	34.1	4.6	2.7	104.2	60.9	171.0
1967	3.9	2.2	64.2	36.0	3.8	2.1	106.3	59.7	178.2

Source: Compiled from Meat and Livestock Statistics, Statistical Bulletin No. 230, Table 209; Statistical Bulletin No. 333, 1965 and 1968 Supplements, Table 209.

by a recent high of 37.0 percent in 1940. The low occurred in 1958, but has trended downward in late years to 20.0 percent in 1967. Where earlier emphasis was placed on quantity and quality of wool production, present demand is for (1) a high quality, well finished lamb carcass and (2) a heavy fleece of merchantable wool.[12/] It is evident that the importance

[12/]Ensminger. op. cit., p. 25.

of wool production in the industry has been declining.

While the role of wool has been declining, an aspect of importance
to the sheep industry is the strategic role of wool in national security.
World War II brought out the value of wool as a fiber for military tex-
tiles.[13] The United States government recognized wool as an essential
and strategic commodity when the Congress passed the National Wool Act in
August 1954. The purpose of this act was to encourage the increase in raw
wool production by supporting the price of wool principally by means of in-
centive payments. These payments were designed to give producers a price
up to 110 percent of parity with the limitation that total payments under
the act must not exceed 70 percent of gross receipts from duties collected
on imports of wool and wool manufactures on or subsequent to January 1,
1953.[14] In this study, the wool market is considered to be an area for
a sizeable research project by itself and is not further examined here,
except as it relates to the production and pricing of sheep and lambs.

The level and geographical distribution of lamb meat consumption is
by no means uniform among United States population. One study conducted in
1964 indicates that nearly two-thirds of all United States households never

[13] Ibid., p. 27.

[14] William Hoyt Witherell. "Dynamics of the International Wool
Market: An Econometric Analysis." Unpublished doctoral dissertation,
Princeton University, 1967.

serve lamb.[15] Historically, people of particular ethnic groups have accounted for most of the lamb consumed in the United States. People with nationality backgrounds in the Middle East or Mediterranean countries appear to use more lamb on the average than other nationality groups in the United States. People of Jewish cultural heritage tend to be comparatively high users of lamb.

While recent estimates of lamb use are not available by states, earlier studies may give some indication of the present lamb distribution. Department of Agriculture estimates for 1954 indicated that 80 percent of the nation's lamb consumption occurred in twelve states.[16] The Northeast region and the Pacific region together accounted for 73 percent of the total. A large number of people in many areas of the country eat very little or no lamb.

Imports of lamb and mutton have been relatively insignificant prior to 1958. Since then imports have increased considerably. Imports consist largely of mutton (Figure 1, page 9). In 1967, imports of lamb and mutton combined were equal to 18.7 percent of United States lamb and mutton production. Since 1961, this has varied from 11.0 percent in 1964 to 20.9 percent in 1966.

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[15]American Sheep Producers Council, Inc. Lamb and the Consumer. A research project in cooperation with the U.S. Department of Agriculture, 1964, 22 numbered leaves.

[16]Darrell F. Fienup et al. Economic Effect of U.S. Grades for Lamb. Agricultural Economic Report No. 25, Economic Research Service, U.S. Department of Agriculture, Washington, D.C., 1963, p. 30.