



AMERICAN SHEEP INDUSTRY ASSOCIATION
YOUR INDUSTRY ADVOCATE SINCE 1865



AMERICAN SHEEP
INDUSTRY ASSOCIATION
U.S. SHEEP INDUSTRY
ECONOMIC IMPACT
STUDY

August 2017

ABSTRACT

A sheep industry impact analysis revealed that one dollar in sheep and sheep-related production added an additional \$2.87 to the U.S. economy in 2016. One dollar of sheep production and related goods has a multiplier effect of nearly 3 times the initial investment. An IMPLAN input-output model estimated that \$2.02 billion in sheep-related products generated a total impact of \$5.80 billion in the U.S. in 2016. The model also estimated that every sheep-production job—part time or full time in lamb, wool, pelt, and breeding stock production--supports an additional 0.88 jobs in the broader economy for a total of 1.88 jobs.

Julie Stepanek Shiflett, PhD
Juniper Economic Consulting, Inc.
julie@juniperconsulting.org

Executive Summary

The U.S. sheep industry generates economic activity and employment in rural communities and throughout the nation from its sheep and lamb production and a many of other sheep-related value-added activities such as wool sock exports and lanolin sales. In addition to this direct effect, there is a secondary multiplier effect of additional economic and employment activity as a direct result of the initial sheep investments. The input-output software IMPLAN by IMPLAN, LLC was utilized to estimate the total impact of sheep production in the U.S.

Model findings estimated the following:

- The model found that a \$2.02 billion investment in sheep production activities (ranging from lamb production at the farm gate to wool sock exports) generates a total economic benefit of \$5.80 billion.
- The impact results revealed that \$1 invested in sheep-production and related sheep-production activities generates \$2.42 in total labor income.
- One dollar in total sheep output adds an additional \$2.87 to the U.S. economy. Thus, one dollar invested in sheep has a multiplier effect of nearly 3 times the initial investment.
- The Employment Multiplier revealed that 10.4 jobs in the sheep industry at the farm gate supports an additional 3.1 jobs in indirect industries (backward-linked) and another 6.0 jobs in induced enterprises (expenditures from sheep-related income) for a total of 19.50 jobs. That is, one sheep job supports 0.30 jobs in backward-linked industries, another 0.58 jobs in induced industries for a total of 1.88 jobs generated.

This study is an update to sheep industry economic impact studies conducted in 2008 and 2011. The overriding differences in this study compared to the 2011 study is that the sheep industry has contracted, yet the modeling effort in this study improved, capturing more value added including wool hosiery exports, lanolin, and the pelt shearing value. The model also minimized double-counting impacts.

In the 2011 study, an estimated \$486.5 million in lamb, mutton, wool, sheep milk production, and breeding stock at the producer level supported an additional \$1.2 billion in economic activity for a total of \$1.7 billion. The 2011 study estimated a second model in order to quantify the value added to sheep products that were not captured in the first model. Estimates of retail lamb and wool, wholesale pelts, variety meats, meal, tallow, and lanolin, and retail sheep cheese sales revealed that \$785.6 million in production generates an additional \$1.9 billion in multiplier effects, summing to a total economic impact of \$2.7 billion. Therefore, a very liberal estimate—due to double-counting of some estimates--of the total economic value was \$4.4 billion compared to the improved current model that estimated a \$5.72 billion total contribution.

The sheep impact analysis reinforces the significance of economy-wide benefits of expanding lamb, wool, and lambskin demand. The return from promotional activities expanding demand—and stimulating an investment in sheep--has a positive return not only for the sheep industry, but for many other industries as well. Sheep production and new sheep investments have a positive effect in supporting local, rural jobs across industries.

Contents

Introduction 1

The Model 2

Sheep Production Multipliers 6

Sheep Industry Value at the Farm Gate 7

Dairy Sheep Industry at the Farm Gate 9

Sheep Industry Employment at the Farm Gate 10

Sheep Industry Value at the Processing Plant 11

Industry Value at the First Stage Wool Processor 12

Retail and Wholesale Wool Sales 13

Industry Value of Lamb and Mutton at Retail 14

Model Results 15

Conclusion 20

References 22

List of Figures

Figure 1 Lamb Retail Dollar Sales by Cut Category 15

List of Tables

Table 1 Sheep Sector and Subsector Modeled Values 5

Table 2 Sector 14 Sheep Production Multipliers at the Farm Gate (Not for entire industry) 6

Table 3 Sheep Industry Impacts 16

Table 4 Top Ten Industries by Employment Supported by the Sheep Industry 18

Table 5 Top Ten Industries by Labor Income 19

Table 6 Top Ten Industries by Value Added 19

Table 7 Top Ten Industries by Total Output 20

Introduction

The U.S. sheep industry generates economic activity and employment in rural communities and throughout the nation. Production of lamb, mutton, lambskins, and wool are only a few of the value-added products produced by the industry. Production of lamb and other value-added activities generates income and employment, but also spurs a ripple effect throughout the economy—backward and forward—, generating additional economic activity that contributes to rural communities and the broader U.S. economy. This contribution to the broader economy was estimated using the IMPLAN (Impact Analysis for Planning) modeling software and dataset by IMPLAN, LLC. This 2017 sheep industry contribution analysis is an update to a study first conducted in 2008 and revised in 2011.

The overriding differences in this study compared to the 2008 and 2011 studies is that the sheep industry has continued to contract while the modeling effort has improved by eliminating double counting sales and jobs between industry sectors and by capturing more value added throughout the industry. In the 2011 study, an estimated \$486.5 million in lamb, mutton, wool, sheep milk production, and breeding stock at the producer level supported an additional \$1.2 billion in economic activity for a total of \$1.7 billion. The 2011 study estimated a second model—in order to avoid double-counting—that quantified the value added to sheep products that were not captured in the first model. Estimates of retail lamb and wool, wholesale pelts, variety meats, meal, tallow, and lanolin, and retail sheep cheese sales revealed that \$785.6 million in production generates an additional \$1.9 billion in multiplier effects, summing to a total economic impact of \$2.7 billion. Therefore, a very liberal estimate—due to double-counting of some estimates—of the total economic value in 2011 was \$4.4 billion compared to the improved current model that estimated a \$5.72 billion total contribution.

Added value in the industry can help offset the contracting production base the sheep industry has witnessed. In the six years from the 2011 study—2011 to 2017—the production base from which to measure the sheep industry's contribution continued its long-term contraction. Breeding ewe inventory contracted 6 percent, or 180,000 head, to 3.04 million head. Total sheep and lamb inventory totaled 5.20 million head in 2016, down 5 percent or 270,000 head since the 2011 study. Estimated lamb production also fell, by 9 percent in 2011-2017, equating to 14.6 million lbs. Wool production contracted with lower sheep inventory. Wool production totaled 25.74 million lbs. greasy in 2016, down 15 percent in six years, or down 4.62 million lbs. greasy. Total sheep shorn was down 6 percent in five years, or 230,000 head.

The reasons for industry contraction are varied and complex. Regulatory pressures for federal grazing access and foreign labor use challenge large-scale sheep producers. Access to markets and capital can challenge all producers. Drought, challenges in managing predators, lack of infrastructure, and increased input costs can also constrain growth. Inventory contraction can overshadow the positive net benefit the sheep industry contributes to the U.S. economy through its many and varied value-added enterprises.

This impact analysis captures sheep production activity and value-added activities where it can most accurately estimate value. Many value-added enterprises such as the domestic wool hosiery market and the retail lanolin market for cosmetics, for example, were not captured in this study for lack of data. This impact analysis is therefore an underestimate of the U.S. sheep industry contribution. How much of an underestimate is unknown.

Producer contributions include the production of lamb, mutton, culled animals, breeding stock, wool, and pelts. Estimating the value of the producers' contribution is feasible given the availability of U.S.

Department of Agriculture, Agricultural Marketing Service (USDA/AMS) data in addition to data from the USDA National Agricultural Statistical Service (NASS). Export data from the U.S. Department of Commerce was used to obtain values of exported wool, lambskins, and wool hosiery. The domestic retail value of these markets is unknown.

The author is grateful to industry insiders that contributed to this analysis.

The Model

This analysis employed the use of the computer software and database package called IMPLAN (IMPact analysis for PLANning) owned by IMPLAN, LLC (formerly MIG, Inc.). This study is based upon an input-output model that was originally developed by Wassily W. Leontief to help track national accounts. The model quantifies the magnitude of interrelationships between sectors in an economy, thus it tracks the flows of dollars between producers and consumers in each sector. Within each industry, such as lamb production, there are firms (or subsectors) defining each stage of production such as lamb production, lamb harvest, and carcass fabrication. For a one-year production period, a transactions table in the IMPLAN software reflects the value of goods and services exchanged between sectors of the economy.

Impact Analyses are often used to measure the economic impact of an event or change to the economy such as opening a new business. These studies address the general question: *What are the marginal impacts of the project?*¹ A contribution analysis (what this study calls an impact analysis) is becoming increasingly common and concerns the role, importance, or contribution of an existing business, project, or industry.² These studies address the general question: *How much does existing industry contribute to the local economy? What would happen if that industry closed down?*³

Impact analyses and contribution analyses both utilize the input-output relationships defined in the IMPLAN software. The economic data for IMPLAN comes from the system of national accounts for the U.S. based on actual data collected by the U. S. Department of Commerce, the U.S. Bureau of Labor Statistics, and other federal and state government agencies. Some of the data collected for industry sectors of the national economy correspond to North American Industry Classification System (NAICS) codes. According to the U.S. Census, NAICS is the standard used by Federal statistical agencies in classifying business establishments for the purpose of collecting, analyzing, and publishing statistical data related to the U.S. business economy.

The model estimates the economic importance of the sheep industry by quantifying the linkages between input supply industries of the targeted industry as well as linkages between the incomes received in the targeted industry and expenditures on goods and services purchased. The model can quantify the direct effect, indirect effect, and induced effect from \$1 value of production in any given sector. The direct effect, indirect effect and induced effect sum to the total effect.

The direct effect shows how output changes with a given change in final demand. For example, if lamb demand increases, the direct effect can show the corresponding increased value of lamb production.

¹ IMPLAN, LLC. 2015.

² What is most commonly referred to as an impact analysis is now termed a contribution analysis by IMPLAN.

³ IMPLAN, LLC. 2017.

The indirect effects are the inter-industry purchases as they respond to the demands of the directly affected industries. Sheep production generates business for many contributing industries. From fencing supplies to pharmaceuticals, lamb production helps support these backward linked industries.

The induced effects reflect spending from households from the income received from the targeted industry and indirectly affected industries. Lamb producers spend a portion of their income in their local economy on goods and services from eating out, to buying work gloves, or haircuts. The induced effect represents the impacts on primarily local industries caused by the expenditures of household income generated by sheep and wool production.

The induced effect includes spending by sheep producers and employees as well as spending by all employees of all input-related industries contributing to sheep production. This may include employees of pharmaceutical companies, guard dog breeders, feedlot hands, shepherds, and part-time wool shearers.

The model was customized to capture production values at the farm gate in addition to value-added activities. In doing so, it is important that the model design avoid double counting impacts and thereby inflating impacts. For example, commercial lamb production is an output value at the farm gate and an input to production at the processing sector. The default model design is to count both values, which would be double counting.

To avoid double counting, the model specified in this study set the IMPLAN Regional Purchase Coefficient (RPC) for Sector 14 (Animal production except cattle, poultry, and eggs) to zero.⁴ An RPC represents the share of total demand for a commodity by all users in a local economy that is supplied by sheep producers in that economy. “For example, an RPC of 0.6 for the commodity “vegetable and melons” means that local farmers provide 60 percent of the demand for vegetables and melon (by other farmers, processors, vegetable wholesalers, and others).⁵ A RPC = 0 for sheep production means it supplies none of the demand for lamb or wool at the lamb processing or wool processing sectors.

IMPLAN, LLC advised that it was appropriate to set RPCs = 0 for only Sector 14 because the economic activity specified (the direct impacts entered into the model) for all other sectors are a sufficiently small share of total economic activity in these sectors to negate the double-counting risk. By contrast, it was assumed that the sheep value estimated at the farm gate in this model was close to 100 percent of sheep farm gate economic activity.

The modelling options ranged from very conservative in which the model is defined to prevent any feedback (indirect or induced) impacts to any sheep sector, to a more liberal approach whereby double-counting is not addressed. The approach adopted by this study was a middle-ground approach.

The U.S. sheep impact study captures the value of sheep production at the farm gate in addition to value-added activities at wholesale and retail levels (Table 1). Farm gate production included commercial and non-traditional sheep and lamb sales, live sheep exports, pelts, wool, breeding stock, and the value of milk by sheep dairies. The model also includes wholesale lamb sales and variety meats.

⁴ Sector 14 includes swine. The model assumes swine input to output functions are similar to sheep production.

⁵ Schmit, T. M., B. B.R. Jablonski, and D. Kay. N.d. “A Practitioner’s Guide to Conducting an Economic Impact Assessment of Regional Food Hubs using IMPLAN: a step-by- step approach.” Retrieved from <https://apps.ams.usda.gov/MarketingPublicationSearch/Reports/stelprdc5110439.pdf>

In the wool sector, greasy wool exports are included in addition to value-added wool products by first stage wool processors including scoured wool, tops and noils and yarn exported. Wool grease is also included. The U.S. military is an important buyer of finished wool blankets and apparel. Wool hosiery exports were also added, a sub-sector not previously included in the 2008 and 2011 studies. The pelt tanning subsector included exported pelts in addition to shearling products. Shearling products were also not included in the 2008 and 2011 impact studies. Last, lamb sales at retail and food service are captured to complete the model.

The U.S. sheep IMPLAN model captured \$2.30 billion in direct output, from farm gate to wholesale to retail (Table 1).

Table 1 Sheep Sector and Subsector Modeled Values

Activity	IMPLAN code	IMPLAN Description	Description (IMPLAN Event)	2016 Value (\$)	
Sheep and Lamb Production at the Farm Gate	14	Animal production, except cattle and poultry and eggs	Commercial market lamb	\$366,338,526	
			Non-traditional lamb market	\$1,313,511	
			Mutton	\$8,732,013	
			Live Sheep Export	\$3,445,000	
			Pelts	\$8,724,051	
			Wool	\$37,214,000	
			Breeding stock	\$71,161,661	
			Milk production	\$9,200,000	
Subtotal				\$506,128,762	
Processing	89	Animal, except poultry, slaughtering	Wholesale lamb	\$465,731,046	
			Wholesale mutton	\$21,307,751	
			Processing by-products (offal credit)	\$20,101,500	
Subtotal		Subtotal	\$507,140,297		
Greasy Wool Exports	395	Animal hair merchant wholesalers	Greasy wool exports	\$14,215,000	
Subtotal				\$14,215,000	
First Stage Wool Processor	117	Textile and fabric finishing mills	Scoured wool, tops, noils, carded, yarn	\$33,570,000	
			Animal, except poultry, slaughtering (includes wool grease)	\$1,127,203	
Subtotal				\$34,697,203	
Retail Wool Sales	126	Cut and sew apparel contractors	Military wool purchases	\$117,295,721	
			Athletic socks, knitting or knitting and finishing	Exported wool socks (at least 23% wool)	\$23,005,983
				Lanolin at retail	\$2,053,660
Subtotal				\$142,355,364	
Pelt Tanners	131	Leather and hide tanning and finishing	Pelt exports (dried, salted, sorted)	\$14,122,000	
			Tanning material-- leather & shearling	\$6,050,000	
Subtotal				\$20,172,000	
Retail & Food Service Lamb	400	Retail - Food and beverage stores	Retail lamb sales	\$374,766,407	
			Full-service restaurants	Foodservice lamb sales	\$701,927,351
Subtotal				\$1,076,693,758	
TOTAL				\$2,301,402,384	

Sheep Production Multipliers

The sheep production function, in addition to household spending, generates multipliers. The multiplier captures the ripple effect generated from \$1 of sheep production in backward-linked industries in addition to the induced effect of sheep-generated income spending in local economies. Multipliers measure the strength of these ripple effects.

The multipliers of sheep production activity at the farm gate are listed in Table 2. While IMPLAN can specify multipliers by specific sectors, it doesn't produce multipliers representing the aggregate impact of the combined sectors specified in the model in Table 1. Output multipliers typically range between 1 and 3. Generally, the more inputs purchased locally and the more consumers shop at local shops, the higher the multiplier.

Table 2 Sector 14 Sheep Production Multipliers at the Farm Gate (Not for entire industry)

	Direct Effect	Indirect Effect	Induced Effect	Total Effect	Type I Multiplier (2)	Type SAM Multiplier (3)
Output Multiplier	1.00	0.72	0.98	2.70	1.70	2.70
Employment Multiplier (1)	10.40	3.10	6.00	19.50	1.3	1.90

(1) The Direct, Indirect, Induced and Total Effects by Employment are per million of Output Demand

(2) Type I Multiplier = (Direct Effect + Indirect Effect)/(Direct Effect)

(3) Type SAM Multiplier= (Direct Effect +Indirect Effect + Induced Effect)/(Direct Effect)

One dollar of sheep production activity—be it selling lambs or wool or breeding stock—generates an additional \$0.72 in increased spending in backward-linked industry such as buying fencing supplies or feed (Indirect Effect) (Table 2). This spending is largely, but not absolutely, assumed to be spent in local, rural communities. One dollar of sheep production activity also generates an additional \$0.98 in purchasing local goods and services, groceries or haircuts. Again, this is assumed to be a positive effect in rural communities, but not absolutely. The total impact from \$1 of sheep production economic activity at the farm gate is \$2.70 in U.S. economic contributions. Thus, an investment in two breeding ewes worth \$2,000 generates \$5,400 in total economic contributions.

The Employment Multiplier represents the I-O (input-output) multipliers used to estimate the total number of jobs (both full time and part time) throughout the economy that are needed, directly and indirectly, to deliver \$1 million of final demand for a specific commodity.⁶ That is, 10.4 jobs in the sheep industry supports an additional 3.1 jobs in indirect industries and another 6.0 jobs in induced enterprises for a total of 19.5 jobs. That is, one sheep job supports 0.3 jobs in backward-linked industries, another 0.6 jobs in induced industries (from sheep income expenditures), for a total of 2.0 jobs (figures don't add due to rounding).

⁶ IMPLAN Glossary. Retrieved from http://support.implan.com/index.php?option=com_glossary&task=list&letter=&letter=E. The Direct Employment Multiplier for other livestock is lower: Beef cattle (Sector 11) is 8.0, dairy cattle and milk (Sector 12) is 3.0, and poultry and egg production (Sector 13) is 2.0.

The remainder of this study will delineate the contributions by sector and then discuss the model results, the economic impact of the sheep industry. The estimated subsector values were obtained from U.S. Department of Agricultural (USDA) reports, industry sources, and educated estimates from industry insiders.

Sheep Industry Value at the Farm Gate

Commercial sheep producers produce lamb, mutton, wool, pelts, breeding stock, and culled ewes and rams. Lamb production was also valued in the non-traditional market, a market not captured by official statistics. A smaller segment of the industry also included in the farm gate contribution is the value of the dairy sheep sector. This study captured nearly \$502 million in farm gate sheep industry production.

Commercial Lamb Market -- Sheep producers sell feeder lambs—for further finishing in a feedlot—and slaughter lambs, ready for harvest. Producers also sell lambs off grass—bypassing the high concentrate diet in a feedlot—for the grass fed lamb market. The IMPLAN modeling structure combines sheep production and lamb feedlot operations under the same code—with similar input-output relationships and thus, this study estimated only the value of slaughter lambs.

Slaughter lambs are sold through public auctions as well as direct trade with packers termed carcass-based formula trades and live, negotiated sales. Different marketing methods employ different pricing mechanisms and as a result, different average prices emerge. A weighted average price based upon marketing method was used in this analysis.

In 2016, an estimated 20 percent of lambs harvested were packer-owned, another 20 percent was on formula, 12 percent were live, negotiated and the remaining 43 percent were sold at an auction. Slaughter lamb prices were available in 2016 for the live, negotiated and auction trade. Prices were not available from USDA/AMS for carcass-based formula trades. A weighted average of the auction and live, negotiated markets was used to estimate the value of the commercial lamb market.⁷

In 2016, slaughter lamb prices ranged from \$145.24 per cwt. for live, negotiated trades and \$143.16 per cwt. in auction sales with a weighted average of \$143.60 per cwt. Average prices didn't control for weight of lambs, quality, time of year, or volume of trade. The estimated value of 1,901,500 head of commercial lamb in 2016 was \$366,338,526.

Commercial Mutton Market -- The value of mutton production was estimated by taking the non-lamb portion of federally inspected slaughter and multiplying it by the slaughter ewe average price. In 2016, the estimated value of the adult sheep slaughter market of 108,000 head was \$8,732,013 at an average price of \$60.26 per cwt.

Commercial Cull Sheep Market – Live sheep are historically exported to Mexico and Canada; however, trade flows altered in 2016 with 44 percent of exports going to Mexico, Canadian exports dropping to 1 percent, and 42 percent of exports going to the United Arab Emirates. Over the past 10 years, live sheep exports have dropped sharply due to trade restrictions. In the 5-years, 2007-2011, annual exports were 135,215 head, but fell to 56,398 head per annum in 2012-2016. In 2016, 51,638 head of sheep were exported at an estimated price of \$60.26 per cwt. (cull ewe value) for a total of \$31,118.

⁷ Auction prices were allotted a 79% weight and live, negotiated prices were assigned 21%.

Commercial Pelt Value -- Averaging 8.5 square feet with some skins up to 12 square feet, U.S. lambskins are some of the largest in the world. U.S. lambskins reportedly also have strong leather and have naturally dense wool.⁸ The U.S. lambskin market offers skins at every stage of production, from raw salted skins, ready to begin the tanning process, to wet blue skins, to fully tanned leather and shearlings.

Pelt payments by processors are often passed through feeders to producers. Unshorn Supreme pelts received an average \$8.03 per pelt in 2016. Supreme pelts are nine square feet and larger, do not have discolored fibers, are manure and seed free, have a 1-3 inch staple length of wool, ranging from 22 to 26 micron and display minimal processing defects. Unshorn Premium pelts received \$1.96 per piece in 2016. Premium pelts differ from Supreme pelts primarily in size--seven square feet to 10 square feet. The majority of pelts processed have a minimum of one to three inches of wool. Pelts with less wool are worth less and can be charged a disposal fee by the tannery.

According to USDA/AMS, 62 percent of pelts processed in the formula/grid trade in 2016 were wooled pelts. This brings the total processed pelts to an estimated 1,393,487 head of sheep and lamb. After another 10 percent is deducted for low-quality pelts, the estimated value at \$7 per piece is \$8,778,969.

Wool Market -- The U.S. wool industry produces wool across each micron (average wool fiber diameter) category with finer wools (lower micron reading) receiving price premiums. U.S. wool is characterized from the very fine to the coarsest. Roughly 28 percent of the wool clip is 22 micron and finer. About half of wool production is the mid-micron wools from 22 micron to 31 microns, with the remaining 4 percent being the coarsest wool. American wool is suitable for a wide variety of products including fine worsted suiting, knitwear, woolen velours and coatings, upholstery, bedding materials for futons, mattresses and comforters, and industrial products.

The wool industry contribution valued here is the commercial market, and doesn't capture the contribution of the resurgence of the hobby fiber sector such as spinning and knitting that is often processed by the grower or sold direct to a processor.

In 2016, 25.74 million lbs. of greasy wool were produced, 4-percent lower than its 5-year average. Prices averaged \$1.45 per lb. greasy, down from \$1.47 per lb. greasy over 2012 to 2016. Total wool value produced by growers is an estimated \$37,214,000 for 3.56 million head of sheep shorn.

Breeding Stock -- *The Banner* -- the nation's largest all-breeds sheep magazine -- covers all major sheep sales and produces sale reports of registered purebreds. Most purebred sheep are registered, but they do not have to be registered by law.

In 2016, Katahdin sheep received the highest number of registrations at 9,427 with Dorper, Hampshire, Suffolk, Dorset, Southdown, Shropshire, Shetland, Rambouillet, and Polypay also falling, in order, in the top 10 registered breeds. These breeds also reported sizeable numbers of transfers as well. Transfers of breeding stock represent income to a producer. In 2016, there were a total of 67,669 registrations and 43,123 transfers. Thirty-three sheep breeds were represented in the registry.

⁸ American Sheep Industry Association. n.d. The American Lambskin Advantage. Retrieved from http://www.sheepusa.org/ResearchEducation_Literature_AboutPelts

Prices of breeding stock were also obtained from *The Banner* sales across the U.S. Prices ranged—on average—from \$600 to \$1,000 per head, depending upon type of lamb, ewe, or ram. Prices were unavailable for many breeds perhaps because sheep were traded in private treaty. Therefore, available prices of the breeds that saw the most transfers were used as a proxy for prices of all breeds transferred. An average price of \$627 per head was used to estimate the value of purebred stock for a total value of \$24 million.

Non-traditional Lamb Market – The non-traditional lamb market, or often called ethnic market, is an important component of the sheep industry that mostly falls outside the mainstream, commercial market, and is not well documented. Lamb is common in the diets of many people of ethnic origins, particularly from the Middle East, Africa, the Mediterranean, Latin America, Caribbean, and Asia. In addition, lamb is popular in religious observations for many ethnic groups. It is estimated that for every three lambs that are harvested in commercial market channels, one is harvested in the non-traditional market.

The non-traditional market is often characterized by a lighter-weight lamb, around 100 lbs., but is variable depending upon customer. It is a market characterized primarily by sales direct to consumers. However, some non-traditional lambs are processed by state inspected plants and even some federally-inspected plants. USDA/AMS explained: “Traditional markets refer to lambs that are subjected to USDA carcass grading, and marketed through mainstream outlets. Non-traditional markets refer to lambs destined for slaughter outside of what would be termed as traditional markets.”⁹ The largest non-traditional markets are the livestock auctions at New Holland, Pennsylvania and San Angelo, Texas, but non-traditional markets exists across most livestock auctions.

The volume of lamb going into the non-traditional market is not known. Through a process of deduction, an estimated 756,500 head of lambs were harvested in the non-traditional market in 2016, down 23 percent in 5 years. The total lamb crop is down overall, commercial harvest is up, and non-traditional trade might be increasingly captured in state- or USDA-inspected facilities. This number was derived from a statistical discrepancy between the USDA-reported 2016 commercial slaughter volume and the reported lamb crop (less 8 percent for losses).

The average 2016 price was \$173.63 per cwt. as reported by USDA/AMS at the non-traditional livestock auction at New Holland, Pennsylvania, up from \$161.85 per cwt. over 2012-16. The total estimated value of the non-traditional market was \$1,313,511 in 2016.

Dairy Sheep Industry at the Farm Gate

The U.S. sheep dairy industry is a small, but significant segment of the U.S. sheep industry producing sheep milk, cheese, and yogurt.

Dairy sheep production is primarily found in the northeastern U.S., northern Midwest and California. Large commercial sheep dairies operate in New York and California.¹⁰ Dairy sheep are neither traditional U.S. meat nor wool breeds, but East Friesian and Lacaune sheep. Neither the U.S. government nor trade organizations track data on the number of dairy sheep farms, inventory of dairy sheep, nor sheep milk produced per ewe.

⁹ USDA Agricultural Market News. 2017. “USDA/AMS “LN_LS322, New Holland, PA Mon. Apr. 03, 2017, New Holland Sales Stables - New Holland, PA.”

¹⁰ Shoenian, S. 2015. Sheep 101.info, Got Milk?

Farm gate prices of sheep milk range from \$0.75 to \$1.25 per lb. given an available market.¹¹ Many sheep dairies add value by operating a creamery to produce sheep cheeses and/or yogurt, however, the volume and value of this market segment is unknown. The retail milk market is limited for much of the milk is sold retail as cheese and yogurt.

There are approximately 100 dairy sheep farms in the U.S. running approximately 10,000 milking ewes.¹² For the purposes of this study, it was estimated that ewes produce about 4 lbs. of milk per day over a 230-day lactation period (920 lbs. total per year). Given an estimated farm gate price of \$1.00 per lb., \$9.2 million is generated in milk production per annum.

Sheep Industry Employment at the Farm Gate

Sheep industry employment ranges from ranch hands and wool shearers to truck drivers to meat cutters to chefs in fine dining establishments. Employees paid by sheep, lamb and wool activities contribute to the U.S. economy in induced spending in their respective communities. However, capturing the total amount of employment from farm to table or farm to apparel in the industry is challenging. Thus, an employment estimate at the farm gate was the focus of this study.

Employment is the number of jobs supported by the given level of sales. IMPLAN estimates of jobs are not full time equivalents (FTE), as they include part time and seasonal jobs. Many jobs in the retail and service sector are also part time.

IMPLAN jobs are defined more broadly than a FTEs as defined by the General Accounting Office (GAO). FTEs defined by GAO are the number of hours worked within 2,080 hours per year (40 hour weeks * 52 weeks per year).¹³ A job in IMPLAN = the annual average of monthly jobs in that industry.¹⁴ Thus, 1 job lasting 12 months = 2 jobs lasting 6 months each = 3 jobs lasting 4 months each. A job can be either full time or part time. IMPLAN jobs therefore do not count actual hours worked, but the tenure of the position.

It is possible to estimate employment at the farm gate from USDA/NASS and industry surveys. In the NASS 2012 Census it was reported that there are 88,338 sheep operations in the U.S. The next Census is planned for release in 2019. Detailed data on the breakdown of full time and part time sheep jobs is unavailable. Some sheep producers run sheep full time, but many producers that farm or ranch full time might run sheep part time within a broader hay/crop and livestock enterprise. Many sheep producers work off the farm, generating supplemental income from sheep. In 2015, 3 percent of sheep producers surveyed reported that 100 percent of their income comes from sheep.¹⁵ On average, 19 percent of sheep producers' income comes from sheep, another 18 percent comes from other farming enterprises, and an average 56 percent of sheep producers' income comes from off-farm sources.¹⁶ Hired labor is also important to the industry. A survey of Colorado sheep ranchers' immigrant labor revealed that that

¹¹ Thonney, M. 2017. Director, Graduate Field of Animal Science, Cornell Sheep Program. Personal communication.

¹² Schoenian, S. 2015. Sheep 101.info, Got Milk?

¹³ GAO accessed at <http://www.gao.gov/special.pubs/gao-11-78sp/fte.htm>

¹⁴ This is the same definition used by QCEW, BLS, and BEA nationally. IMPLAN retrieved from http://support.implan.com/index.php?option=com_glossary&Itemid=0&page=9

¹⁵ Miller, L, J. Shiflett, D. March, P. Rodgers, 2016. U.S. Sheep Industry Research, Development, and Education Priorities. Prepared for the American Sheep Industry Association.

¹⁶ Ibid.

sheep operations hire an average of 5 shearers per operation on H2-A visas.¹⁷ IMPLAN counts all jobs, regardless of hours spent in sheep production.

The IMPLAN models part-time employment and not full-time equivalents, so in developing the employment estimate we can use the full 88,338 sheep operations and then add hired labor. We can build our final employment estimate for the IMPLAN model by understanding the size distribution of sheep operations. Seventy-three percent of all sheep operations run anywhere from 1 to 100 ewes.¹⁸ These operations are likely owner-managed with some family help. Eighteen percent of operations are larger, running 100 to 500 ewes. It is estimated that these operations may hire 1 to 2 employees. Nine percent of all sheep operations run 500 ewes or more and these operations will likely hire 2 to 3 additional laborers. Nearly 1 percent of all operations have 5,000 or more ewes and these operations hire a minimum of about 8 additional laborers after counting the owner-operator and family members.¹⁹

Given the distribution of the size of sheep operation and employment patterns, it is estimated that farm gate employment swells by 141,076 jobs – by 60 percent -- to an estimated total employment of 229,414 persons.

Capturing sheep industry employment at the farm gate highlights the importance of the sheep industry in supporting local, rural communities. Many rural communities face emigration, and a vibrant sheep industry can help slow this trend.

Sheep Industry Value at the Processing Plant

This study captured \$486 million in value-added products by the sheep and lamb processing industry. Processors and packers produce wholesale lamb and byproducts. The pelt byproduct is a credit to producers and not valued at this stage in the industry.

Wholesale Lamb – The net carcass value was used to estimate the value of the wholesale lamb market processed by lamb packers.²⁰ Processing and packaging costs of \$33.75 per cwt. in 2016 was estimated by USDA/AMS. In 2016, an estimated 12 percent of the wholesale lamb trade was sold as carcasses; however, this market was not valued due to lack of USDA/AMS price reporting for some weight classes. The marginally higher net carcass value was used to estimate the carcass market.

The value of wholesale commercial mutton was also added as a value-added component of sheep industry impacts. The weighted unit value of 2016 mutton exports was used to value the export and domestic mutton industry. In 2016 six different mutton HS (Harmonized Codes) codes were exported from carcasses to half carcasses to bone-in sheep.²¹ The total estimated value of the 2016 commercial mutton market was \$21,307,751.

Total lamb and mutton at wholesale was \$487,038,797.

¹⁷ Shiflett, J. 2010. The Real Wage Benefits Provided To H-2A Sheep Herders and the Economic Cost to Colorado Ranchers, Prepared for the Colorado Wool Growers Association.

¹⁸ Miller, L., J. Shiflett, D. March, P. Rodgers, 2016. U.S. Sheep Industry Research, Development, and Education Priorities. Prepared for the American Sheep Industry Association.

¹⁹In a survey of Colorado sheep ranchers it was found that sheep operations hire an average of 5 shearers on H2-A visas. (Shiflett, J., 2010).

²⁰ The net carcass value is equivalent as the cutout value. It is a composite value that sums the value of the respective lamb cuts multiplied by their weights. It is also the gross carcass value less processing and packaging costs.

²¹ Data from U.S. Commerce, retrieved from USDA FAS GATS.

Variety Meats -- Lamb processors market variety meats, such as heads, kidneys, and liver to ethnic grocers domestically, overseas, and to the domestic pet food sector. In 2016, this offal credit was valued at \$20.1 million with an average \$9 per head offal credit. Sheep heads are exported primarily to Mexico, but other edibles are often considered a delicacy and sold to domestic ethnic markets. Roughly 74 percent of the value from sheep byproducts comes from marketed edible products while the remainder comes from rendered products.

Hooves are discarded at some plants but not all; bones are sometimes sold or otherwise rendered. Sheep and lamb blood also has value which is included in the offal credit. Dried blood is used in blood meals for fertilizers for plants or applied directly to roses. Blood is sometimes sold as a separate item, but often sold with other rendered products.

Industry Value at the First Stage Wool Processor

While over half the U.S. wool clip is exported, the remainder is processed domestically as value-added products. The U.S. adds value to its greasy wool clip by cleaning the wool, producing wool grease, producing carded wool, and tops and noils. Further processing also occurs in the U.S. including textiles such as wool yarn, thread and fabric, wool apparel, wool home furnishings, and wool floor coverings. Many retail products are produced using 100-percent wool; however, many of the products are blended with other natural and non-natural fibers so it is difficult to value total wool retail sales. This study estimates the value of wool purchased by the military, exported as clean wool, carded wool, tops/noils, and yarn; and the value of the wool grease at wholesale. The study also captures exported wool socks.

Value-Added Wool -- The value added to wool at the first stage processor is estimated by taking its export value. The industry doesn't track the portion of wool yarn and fabric that is used domestically. The value of scoured wool, tops, noils, carded wool, and wool yarn exports produced by first stage wool processors and textile and fabric finishing mills in 2016 was \$33.57 million.

Wholesale Lanolin Market -- Lanolin is a wool byproduct. Wool grease, also called lanolin, is wax secreted by the sebaceous glands of wool-bearing animals, particularly fine woolled sheep in the U.S. The water-repellent properties of lanolin mean its uses are varied and widespread.

Lanolin is increasingly popular in the cosmetic and pharmaceutical industries for it provides moisture and therefore prevents skin from drying and chapping. Common uses range from lipsticks to sunscreen to Band-Aids. The lanolin market is increasingly producing higher purity products such as Medilan (medical grade lanolin). Price premiums are received as the purity of lanolin increases.

Without an officially-published lanolin production figure, some assumptions and estimates were made to value the wholesale wool grease market produced by first stage wool processors. Finer wool clips produce about 4.5 kg of wool grease per 100 kg of clean wool while the coarser wools may produce about 2 kg. An average 3.5 kg of wool grease was used in this analysis. After the volume of wool grease is estimated, it was assumed that another 2 percent is lost in processing wool grease into lanolin. An estimated price of \$2.00 per lb. was used for wholesale wool grease sales bringing the total value to \$90,900.²²

²² Paullier, D. 2017. Chargeurs Wool USA. Personal communication.

Retail and Wholesale Wool Sales

The impact study captured two value-added wool sectors, U.S. military wool purchases and exported wool socks. Data on retail wool apparel, wool carpet and wool hosiery sales are difficult to obtain. Export data is provided by the U.S. Department of Commerce and thus readily available.

Wool Military Purchases – The U.S. military continues to consume around 20 percent of the American wool clip for uniforms each year – making it the single largest consumer of American wool.²³ The Berry Amendment requires that all U.S. military uniforms be made from 100 percent domestic products.

In 2016, the U.S. military utilized 16 percent of clean wool production to fulfill military contracts for wool and wool-blended products. All branches of the military, enlisted men and women, as well as officers wear wool. Annual military purchases of wool products totaled \$117,295,721 in 2016 and an annual average of \$116.3 million over 2012-16.²⁴ Ninety-eight percent of this value is wool and wool-blended clothing. Within this total, the military also purchases wool blankets worth about \$24 million annually. In 2010, there was a significant return to 'organizational/protective' clothing items, particularly fire resistant garments. The garment value for those items is approximately \$25 million.

Wool Hosiery Sales – The U.S. wool hosiery market has grown sharply in the last 10 years. The catalyst for growth is likely the domestic capability to shrink treat wool. In the past, U.S. wool apparel and sock manufacturers would send wool overseas for this washable treatment. In 2010 the continuous wool-top chlorine/polymer treatment equipment line became operational in which wool fiber is altered, allowing products to be machine-washed and dried without shrinking. It is believed that the cost-savings involved in the domestic wool shrink-treatment process helped boost U.S. competitiveness. U.S. wool sock companies such as Farm to Feet and Duckworth report more than doubling sales over the past couple years.²⁵

The total value of domestic hosiery sales is not known; however, export data is available on wool sock exports through the U.S. Census Bureau. In 2016, 1.6 million pairs of wool socks were exported with a total value of \$23 million.

Lanolin at Retail – The lanolin market has experienced growing demand from personal care and cosmetic industries. Lanolin – a soft, yellow, waxy substance is secreted by sheep -- is important to the cosmetic and pharmaceutical industries as an emollient. “The best-known uses of refined wool wax products, primarily, lanolin and its derivatives are in the field of cosmetics, medicine and toiletries. Rising disposable consumer income and growing working women's population is expected to be a major driver for this industry. Increasing awareness regarding feminine hygiene and health has also promoted the adoption of natural products and cosmetics.”²⁶

²³ ASI. *ASI Sheep Industry News*, 1/2017 Vol. 21, Issue 1, p. 16.

²⁴ Mitch Driggers. 2017. Military Consultant, American Wool Council.

²⁵ Grant, W. 2/17/2017. “Your Gear is Saving American Wool Ranchers.” *Outside*.

²⁶ Lanolin Market Analysis by Application and Segment Forecasts to 2024, October 24, 2016, <http://www.prnewswire.com/news-releases/lanolin-market-analysis-by-application-and-segment-forecasts-to-2024-300350095.html>

The value of the global lanolin market in 2015 was USD 135 million, of which North America (U.S. and Canada) accounted for an estimated 20 percent, or USD 27 million.²⁷ In 2016, \$20,839,418 wool grease (including lanolin) was imported into the U.S. The total quantity was 2.59 million kgs and the unit value was \$8.03 per kg (\$3.74 per lb.).²⁸

However, most of the lanolin utilized in the U.S. is imported, with a smaller share produced domestically. In 2016, the U.S. wool industry produced 25.74 million lbs. of wool.²⁹ U.S. typically exports about 60 percent of its wool clip, in 2016 it was 67 percent. Wool exports totaled 17.3 million lbs. on a greasy basis in 2016 with the remaining clip processed domestically for wool grease production totaling 8.4 million lbs. The conversion rate from clean wool to wool grease is 3.5 kgs wool grease per 100 kgs of clean wool.³⁰ The remaining volume of wool grease/lanolin produced was 563,601 lbs. Utilizing the imputed unit rate for imports of \$8.03 per kg (\$3.64 per lb.) the estimated value of the lanolin market at retail is \$2,053,659.84.

Industry Value of Lamb and Mutton at Retail

Lamb packers and meat cutters, transporters, and butchers all play a role in transforming live animals into cuts ready to present in supermarket meat cases or featured on fine dining menus.

Consumer scanner data of national retail lamb prices obtained from the American Lamb Board and from IRI/FreshLook Marketing were used to estimate the value of U.S. lamb sales. The respective market shares of lamb cuts—from the leg to the loin—were used to develop a composite, weighted-average price to value lamb at retail. Figure 1 depicts the market share of lamb cuts in dollar sales with the loin comprising 26 percent of the lamb market in 2016 followed by the leg at 20 percent.

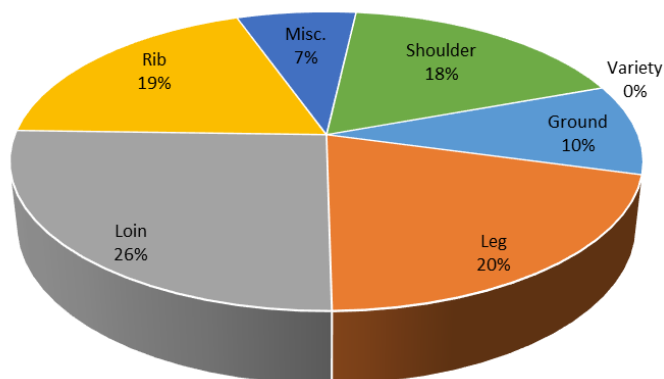
²⁷ Grand View Research. 2016. Lanolin Market Analysis by Application (Personal Care & Cosmetics, Baby Care Products, Pharmaceuticals, Industrial) and Segment Forecasts to 2024. Retrieved from <http://www.grandviewresearch.com/industry-analysis/lanolin-market>.

²⁸ USDA Trade Online, U.S. Census Bureau, HS Code 1505009000 Wool grease ex crude and fatty substances including lanolin (kg).

²⁹ Harmonized System 10-digit code 1505009000, wool grease, except crude, and fatty substances derived therefrom (including lanolin).

³⁰ Finer wool clips produce about 4.5 kg of wool grease per 100 kg of clean wool while the coarser wools may produce about 2 kg.³⁰ An average 3.5 kg was used in this analysis. After the volume of wool grease is estimated, it was assumed that another 2 percent is lost in processing wool grease into lanolin.

Figure 1 Lamb Retail Dollar Sales by Cut Category



Source: IRI/FreshLook Marketing from ALB

In 2016, weighted average prices ranged from \$5.92 per lb. for the leg, \$8.49 per lb. for the loin, \$13.44 per lb. for the rib, and \$5.67 per lb. for the shoulder. The weighted average price of retail sales in 2016 was \$6.97 per lb.

Reportedly, about 65 percent of lamb industry sales are through the food service sector, for which the industry does not track data.³¹ This proportion was maintained in this study—35 percent of sales through retail, with the remaining through food service. It was also assumed that the food service sector commands a 10 percent premium in prices over retail.

The estimated total lamb value at retail was \$405,152,872 for 58.1 million lbs. The value at food service was an estimated \$668,502,239 for 87.2 million lbs. The total value of lamb sales at retail and food service was \$1.07 billion for 145.3 million lbs.

Model Results

Table 3 reports the direct, indirect, induced and total effects for employment, labor income (payroll), value added, and output for the U.S. sheep industry. The total direct effect output captured is \$2.01 billion, which yields \$5.78 billion in total impacts across the U.S. economy.

The Direct Effect Output is lower than the \$2.29 billion entered into the model before impacts were estimated. For retail sectors only (lamb sold at retail), IMPLAN takes a gross margin, not total sales so the direct effect estimated in the model is lower than specified.

³¹ Marsh, D. and J. Shiflett. 2017. "Retail Analysis of Domestic vs. Imported Lamb and Retail Demand Index Update." Prepared for the American Lamb Board.

Table 3 Sheep Industry Impacts

Impact Type	Employment	Labor Income	Total Value Added	Output
Direct Effect	248,691.1	\$761,629,257	\$891,236,619	\$2,018,146,252
Indirect Effect	9,566.3	\$489,581,481	\$802,882,874	\$1,888,704,495
Induced Effect	11,522.9	\$591,427,562	\$1,034,072,727	\$1,894,956,889
Total Effect	269,780.3	\$1,842,638,300	\$2,728,192,221	\$5,801,807,635

The direct effect is the initial contribution specified in the model associated with the subsectors identified in the U.S. sheep industry. The total value of sheep and sheep-related products contributed to the economy is \$2.02 billion (“Direct Effect, Output” in Table 3).³²

The indirect effect captures all the effects—employment, labor income, value added and output—in backward linked industries specified in the model. The indirect effect is the result of sheep production and value-added enterprises buying local goods and services to produce sheep-related goods. In this model, the indirect effects are directly related to the direct effects specified. The economic contribution of any imported goods (e.g. wool) are not captured in this model. The total indirect effect is \$1.89 billion (Table 3).

The induced effect captures personal expenditures by employees, a source of demand for local businesses. Demand for personal goods and services are induced by workers receiving sheep and sheep-related wages. The induced effect is \$1.89 billion (Table 3).

The total impact of the U.S. sheep industry is equal to \$5.80 billion—the sum of the direct, indirect, and induced effects (Table 3).

For each economic parameter—employment, labor income, total value added, and output-- there are impact results.

Employment is full- and part-time jobs for wage and salaried workers as well as for self-employed sole proprietors.

Labor income is employee compensation including wages and benefits and proprietor income. Labor income is total payment to workers, not take-home pay.

Total value added is employee compensation, proprietor income, other property income (dividends and profits), and taxes on production and imports net of subsidies (taxes collected by businesses on behalf of governments).

³² The total output of \$2.0 billion doesn’t exactly equal the \$2.29 billion entered into the model because IMPLAN only accounts for the gross margin for retail sales (Sector 400), not gross sales.

Total output is the total value of production. It is value added plus the cost of goods to make the products. These purchases are also called intermediate expenditures. Value added is a component of output and not to be added to output.

The model estimated that the sheep industry employs 269,780 producers, processors, meat cutters, and wool processors and sock knitters, among others, for a total payroll of \$1.84 billion, \$761.6 million from direct effects, \$489.6 million in indirect effects, and \$591.4 million in induced effects (Table 3).

The industry contributed \$2.73 billion in wages, profit, sales and other related taxes as seen in the total value added estimate (Table 3).

The impact model revealed that 269,724 jobs in the U.S. sheep industry supports 9,566 jobs in backward-linked (indirect) industries and 11,523 jobs in induced industries (Table 3).

The employment ratios of sheep production and other sheep-related enterprises such as meat cutting and apparel sewing is less than the employment multiplier presented on page 7 due to model customization that minimized double counting. The employment multiplier for the sheep sector at the farm gate reveals that 10.4 jobs in the sheep industry supports an additional 3.10 jobs in indirect (backward-linked) industries and another 6.0 jobs in induced enterprises for a total of 19.50 jobs.

One dollar in total sheep output adds an additional \$2.88 to the U.S. economy (derived from Table 4--\$5.78 billion divided by \$2.01 billion). Thus, one dollar invested in sheep has a multiplier effect of nearly 3 times the initial investment.

The top ten industries that the sheep industry supports in terms of employment, labor income, value added, and total output are available in Tables 4-7.

As expected, animal production, except cattle, poultry, and eggs is the largest industry in terms of employment supported by sheep production activities (Table 4). The second-largest supported industry is full-service restaurants. This means that sheep producers and employees,--as well as other employees in sheep-related activities such as knitting wool socks--buy meals in local restaurants, thereby supporting restaurant jobs. Beef cattle ranching, including feedlots, ranks third which means that sheep producers and employees buy beef (therein supporting jobs in the cattle production and feedlot sectors).

Table 4 Top Ten Industries by Employment Supported by the Sheep Industry

Sector	Description	Total Employment	Total Labor Income	Total Value Added	Total Output
14	Animal production, except cattle and poultry and eggs	229,417	\$247,385,633	\$293,686,909	\$506,395,922
501	Full-service restaurants	14,904	\$358,679,134	\$395,211,140	\$730,772,103
11	Beef cattle ranching and farming, including feedlots and dual-purpose ranching and farming	2,641	\$65,275,596	\$91,532,651	\$330,099,956
126	Cut and sew apparel contractors	2,475	\$71,413,845	\$54,690,401	\$121,364,716
400	Retail - Food and beverage stores	1,795	\$56,798,031	\$83,587,812	\$122,753,379
440	Real estate	882	\$22,525,338	\$136,683,746	\$182,640,149
395	Wholesale trade	867	\$76,113,444	\$144,076,768	\$223,603,599
89	Animal, except poultry, slaughtering	718	\$36,407,431	\$72,338,605	\$531,409,727
19	Support activities for agriculture and forestry	678	\$24,971,327	\$34,331,034	\$43,345,336
411	Truck transportation	632	\$36,421,490	\$43,161,475	\$105,337,834

The total labor income is the highest for full-service restaurants among industries supported by the sheep industry (Table 5). Animal production, except cattle, poultry, and eggs ranks second followed by wholesale trade (traders at any wholesale level) as a distant third.

The largest recipients of total value added is again full-service restaurants followed by animal production, except cattle, poultry, and eggs (Table 6).

Table 5 Top Ten Industries by Labor Income

Sector	Description	Total Employment	Total Labor Income	Total Value Added	Total Output
501	Full-service restaurants	14,904	\$358,679,134	\$395,211,140	\$730,772,103
14	Animal production, except cattle and poultry and eggs	229,417	\$247,385,633	\$293,686,909	\$506,395,922
395	Wholesale trade	867	\$76,113,444	\$144,076,768	\$223,603,599
126	Cut and sew apparel contractors	2,475	\$71,413,845	\$54,690,401	\$121,364,716
11	Beef cattle ranching and farming, including feedlots and dual-purpose ranching and farming	2,641	\$65,275,596	\$91,532,651	\$330,099,956
400	Retail - Food and beverage stores	1,795	\$56,798,031	\$83,587,812	\$122,753,379
461	Management of companies and enterprises	438	\$55,580,009	\$67,841,860	\$107,467,664
482	Hospitals	459	\$36,528,601	\$40,761,474	\$70,944,862
411	Truck transportation	632	\$36,421,490	\$43,161,475	\$105,337,834
89	Animal, except poultry, slaughtering	718	\$36,407,431	\$72,338,605	\$531,409,727

Table 6 Top Ten Industries by Value Added

Sector	Description	Total Employment	Total Labor Income	Total Value Added	Total Output
501	Full-service restaurants	14,904	\$358,679,134	\$395,211,140	\$730,772,103
14	Animal production, except cattle and poultry and eggs	229,417	\$247,385,633	\$293,686,909	\$506,395,922
395	Wholesale trade	867	\$76,113,444	\$144,076,768	\$223,603,599
440	Real estate	882	\$22,525,338	\$136,683,746	\$182,640,149
441	Owner-occupied dwellings	0	\$0	\$100,509,536	\$150,133,431
11	Beef cattle ranching and farming, including feedlots and dual-purpose ranching and farming	2,641	\$65,275,596	\$91,532,651	\$330,099,956
400	Retail - Food and beverage stores	1,795	\$56,798,031	\$83,587,812	\$122,753,379
89	Animal, except poultry, slaughtering	718	\$36,407,431	\$72,338,605	\$531,409,727
461	Management of companies and enterprises	438	\$55,580,009	\$67,841,860	\$107,467,664
126	Cut and sew apparel contractors	2,475	\$71,413,845	\$54,690,401	\$121,364,716

The top industry benefitting in Total Output from sheep production activities is full-service restaurants (Table 7). Animal--except poultry--slaughtering ranks second, followed by animal production, except cattle, poultry and eggs.

Table 7 Top Ten Industries by Total Output

Sector	Description	Total Employment	Total Labor Income	Total Value Added	Total Output
501	Full-service restaurants	14,904	\$358,679,134	\$395,211,140	\$730,772,103
89	Animal, except poultry, slaughtering	718	\$36,407,431	\$72,338,605	\$531,409,727
14	Animal production, except cattle and poultry and eggs	229,417	\$247,385,633	\$293,686,909	\$506,395,922
11	Beef cattle ranching and farming, including feedlots and dual-purpose ranching and farming	2,641	\$65,275,596	\$91,532,651	\$330,099,956
395	Wholesale trade	867	\$76,113,444	\$144,076,768	\$223,603,599
440	Real estate	882	\$22,525,338	\$136,683,746	\$182,640,149
441	Owner-occupied dwellings	0	\$0	\$100,509,536	\$150,133,431
400	Retail - Food and beverage stores	1,795	\$56,798,031	\$83,587,812	\$122,753,379
126	Cut and sew apparel contractors	2,475	\$71,413,845	\$54,690,401	\$121,364,716
461	Management of companies and enterprises	438	\$55,580,009	\$67,841,860	\$107,467,664

Conclusion

The U.S. sheep industry represents a significant contributor to economic activity (income) and employment in the U.S. It was estimated that \$2.02 billion in sheep production activities—from farm gate to retail—contributed a total \$5.80 billion to the U.S. economy.

The estimated impact analysis only captured values along the marketing chain from producer to retail that it could reasonably define. Therefore, this impact study is an underestimate of the total sheep industry contribution. As data collection methods improve, the industry will be better able to include more value-added activities to the industry model. For example, this model did not include the value of the wool insulation market, a recommendation for a future impact studies. This model is an improved estimate over the 2008 and 2011 studies in that it added the value of shearing lambskins, captured more of the lanolin market, and captured part of the growing wool hosiery market.

The accuracy of the model is directly impacted by the accuracy of the data used to build the model. The 2016 suspension of slaughter lamb prices sold on a carcass-based formula had multiple adverse effects for lamb marketing, flock rebuilding efforts, and suspended the only lamb risk-management tool, LRP-Lamb, but also hindered sheep industry analyses such as this impact study.

An important segment of the industry that adds value, but is perhaps undervalued in impact analyses, and thus policy discussions, is the non-traditional lamb market. Industry estimates currently validate its existence and importance.

Traditionally an industry dominated by wool and wool/meat breeds, the hair sheep inventory in the U.S. is expanding—another undervalued value added sheep subsector. Dorpers and Katahdin were ranked first and second in terms of new registrations and transfers of breeding stock by *The Banner Sheep Magazine*. These breeds are often considered easy-care -- not needing to be sheared--, often finish at lighter weights than commercial breeds, and are often targeted toward the non-traditional market. In general, the pelts of hair sheep are also thought to be of higher quality compared to lambskins from commercial breeds. Neither the industry nor the government formally track the inventory of hair breeds. Improved data collection could help estimate the hair sheep contribution to the U.S. economy.

This impact analysis reinforces the significance of economy-wide benefits of expanding lamb, wool, and lambskin demand. The return from promotional activities expanding demand—and stimulating an investment in sheep--has a positive return not only for the sheep industry, but for many other industries as well.

References

- American Lamb Board from IRI/FreshLook Marketing. 2017. Retail lamb data.
- American Sheep Industry Association. n.d. "The American Lambskin Advantage." Retrieved from http://www.sheepusa.org/ResearchEducation_Literature_AboutPelts
- The Banner Sheep Magazine*, www.bannersheepmagazine.com accessed 3/11/17.
- Colwell-Mytar, A. 2017. Poultry and Specialty Commodities Section, USDA/NASS. Personal communication.
- Deakin, G., 2017. The Banner Sheep Magazine, Editor/Publisher. Personal communication.
- Department of Animal Science, Cornell University, Dairy Sheep Association of North America Proceedings of the 22nd Annual DAIRY SHEEP ASSOCIATION OF NORTH AMERICA SYMPOSIUM, Ithaca, New York, USA, 2 – 4 December 2016
- Driggers, M. 2017. Military Consultant, American Wool Council, March 2017.
- General Accounting Office (GAO). 2017. Definition of FTEs. Retrieved from <http://www.gao.gov/special.pubs/gao-11-78sp/fte.htm>
- Grant, W. Feb. 7, 2017. "Your Gear is Saving American Wool Ranchers." *Outdoor*. Retrieved from *Outdoor*. Retrieved from <https://www.outsideonline.com/2155176/can-outdoor-apparel-manufacturers-save-american-wool-farmer>
- Grand View Research. 2016. Lanolin Market Analysis by Application (Personal Care & Cosmetics, Baby Care Products, Pharmaceuticals, Industrial) and Segment Forecasts to 2024. Retrieved from <http://www.grandviewresearch.com/industry-analysis/lanolin-market>.
- IMPLAN. 2015. "Using IMPLAN Pro to Estimate the Contribution of a Single," Industry http://support.implan.com/index.php?option=com_content&view=article&layout=edit&id=211
- Kieffer, L. 2017. President and Director, Dairy Sheep Association of North America. Personal Communication.
- Marsh, D. and J. Shiflett. 2017. Retail Analysis of Domestic vs. Imported Lamb and Retail Demand Index Update. Prepared for the American Lamb Board.
- Miller, L, J. Shiflett, D. March, P. Rodgers, 2016. U.S. Sheep Industry Research, Development, and Education Priorities. Prepared for the American Sheep Industry Association.
- Paullier, D. 2017. Managing director and president, Chargeurs Wool (USA) Inc. Personal communication.
- Schmit, T. M., B. B.R. Jablonski, and D. Kay. n.d. "A Practitioner's Guide to Conducting an Economic Impact Assessment of Regional Food Hubs using IMPLAN: a step-by- step approach." Retrieved from <https://apps.ams.usda.gov/MarketingPublicationSearch/Reports/stelprdc5110439.pdf>

Shiflett, J. 2010. The Real Wage Benefits Provided To H-2A Sheep Herders and the Economic Cost to Colorado Ranchers, Prepared for the Colorado Wool Growers. March 2010.

Trumball, D. 2017. Licensed Custom Broker. Personal Communication.

Thoney, M. 2017. Director, Graduate Field of Animal Science, Cornell Sheep Program. Personal Communication.

University of Maryland Sheep 101.info, Got Milk? Retrieved from <http://www.sheep101.info/dairy.html>

U.S. Department of Agriculture, Agricultural Marketing Service. Various dates. Lamb prices, volume, pelt prices.

USDA Agricultural Market News. 2017. "USDA/AMS "LN_LS322, New Holland, PA Mon. Apr. 03, 2017, New Holland Sales Stables - New Holland, PA."

U.S. Small Business Administration, <https://www.sba.gov/contracting/getting-started-contractor/determine-your-naics-code>, Accessed 3/2017.

U.S. Department of Agriculture, National Agricultural Statistical Service, "Sheep" and "Lamb and Mutton" reports on production, sheep and lamb inventory and wool production.

U.S. Department of Agriculture, Economic Research Service. 2016. Population and Migration Overview. Retrieved from <https://www.ers.usda.gov/topics/rural-economy-population/population-migration/>

Wheeler, M. 2017. President, Nugget International. Personal communication.