

2014 Economic Contribution Analysis of the Washington Beef Industry

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Executive Summary and Project Overview

Although the beef industry is widely recognized as an important agricultural commodity few studies exist evaluating its economic importance. The purpose of this study is to evaluate the economic contribution of Washington's beef industry to the state economy for 2014. This study provides a comprehensive review of the structure of the beef industry in Washington tracing through the stages of production from cattle production on cow-calf ranches, and in feedlot operations to cattle processing in slaughter plants in Washington. The study reviews regional cattle inventories and provides a historical trend analysis of Washington's cattle inventory production, prices and values. The study conducted surveys of cow-calf and feedlot operations and reviewed USDA data and cattle research reports to develop modeling parameters needed for the economic contribution model. This report describes the importance of Washington's beef industry by estimating the industry's contribution to the Washington economy including the multiplier effects from input purchase, labor salaries and owner profits. Measures of economic contribution are estimated using an input-output (I/O) analysis, which explicitly recognizes interrelationships between industries. It measures how an economic sector affects other sectors within an economy in terms of output, income, and employment. The economic contribution model was estimated using the IMPLAN input-output modeling program which is the most advanced software available for this type of analysis. The beef industry's contribution to total output, value added, employment and labor income were estimated.

What are the Issues:

- Little detail is known about the economic importance of Washington's beef industry.
- USDA statistics often combine dairy and beef cattle which complicates interpreting the data. For example in ranking Washington commodities by value of production beef and dairy calf sales are combined and ranks 6th in the state in importance by value. This factor does not recognize the economic contributions of the feedlot and packing sectors which greatly increases the beef industry's economic importance.
- Little is known about the regional importance Washington plays in the cattle industry as the feedlot and packing sectors must source (purchase) cattle from outside Washington to supply their production inventory needs. This magnifies the state's cattle production levels and in-turn its economic contribution to the state's economy.
- Although cattle prices have been on an increasing trend, Washington's cow herd inventory is in a declining trend and is at a 30 year low.
- As mentioned the USDA ranks beef and dairy cattle and calf production 6th and potato and hay production 4th and 5th respectively. The beef cattle industry plays a vital role in supporting these industries. Feedlots purchase potato processing by-products as a feedstuff converting a potentially high cost potato waste management issue into a valued feed product. Cattle producers strongly support the hay industry not only in directly purchasing hay, but in being the primary market outlet for damaged low quality hay which is critical for clearing the hay market and supporting hay prices.

- The beef industry economic impact goes beyond production by cow-calf ranches and feedlot operations. It also includes cattle slaughter processing. The beef industry purchases inputs from other sectors of Washington's economy and wages and profits are spent on Washington goods and services. This means that the beef industry has economic effects that extend too many different sectors of the state's economy.

Major Study Findings:

- The modeled 2014 Washington cattle production inventories based on the most current USDA reports were 209,000 calves produced, 488,000 finished feedlot steers and heifers sent to slaughter, and 1,072,000 head of cattle slaughtered.
- USDA data on beef cow inventory shows that the U.S. herd peaked at 39.229 million head in 1982 and declined to 29.085 million head in 2014. This represents a 26% decline from peak to current for the U.S. beef herd. Comparatively Washington's decline from its peak inventory in 1984 to current is 52%, approximately double the rate of decline of the U.S. herd level.
- Cattle production increases value at each step of the production phase. By having more feedlot cattle than calves produced, and having more cattle slaughtered than produced by feedlots magnifies the economic contribution of the industry at each sector.
- Cattle prices have been increasing for all sectors with recent year over year record high prices. Cow-calf producers have realized the greatest increase in value produced from 2010 to 2014 at a 115% increase in value produced followed by feedlots with a 66% increase in value produced and packers with a 49% increase in value produced over this time period.
- Washington's packing sector is the primary driving factor in the cattle industry's vertical supply chain. The packer is the market outlet for the feeding sector and in turn the feedlots are the primary market outlet for the cow-calf producers. Washington's packing sector has been very stable in terms of the number of cattle slaughtered since 2007. This market stability has provided confidence in market outlets and strongly contributes to Washington feedlots steadily increasing the number of cattle marketed since 2007. The average annual growth rate in the number of feedlot cattle marketed in Washington is 4.87% from 2007 to 2014. This growth occurred during a highly competitive market for feeder cattle and has increased the feedlot sectors economic contribution to the state.
- For 2014 the direct total output for the cow-calf sector was \$324.7 million dollars. For the feedlot sector it was \$976.6 million dollars. For the packer sector it was \$2,338 million dollars. **The combined beef industry's direct total output is \$3.639 billion dollars.**
- Direct cattle sales represent only part of the economic contribution of the beef industry. Input-output analysis was used to estimate the indirect and induced effects that result from the beef industries input purchases, labor and profits. **The total economic contribution of the beef industry to Washington is \$5.691 billion.**

- The 2014 direct employment in the beef industry is 4,294 jobs. IMPLAN estimates jobs as a 0.857 FTE basis. This means the FTE job estimate is 3,680 jobs. Most of the jobs are in the processing sector. The beef industry generates additional jobs in the state in industries that provide goods and services to the beef industry and from workers spending their wages in the state. The total employment in the state due to the beef industry is 13,933 jobs. Each job in the beef industry creates an additional 2.2 jobs in the state.
- The beef industry's economic multiplier on total output is 1.6. The employment multiplier is 3.2.
- The beef industry contributed \$1.587 billion to Washington's Gross State Product, GSP. This is analogous to GDP for the nation.
- Washington's beef industry economic contribution is led by the packing sector because of its large inventory of production, it is the highest value of production and it by far employs the most people. The Washington beef industry total economic contribution is \$5.691 billion dollars and the packing sector accounts for sixty-one percent of the total economic contribution. The packing industry is highly concentrated and highly competitive economically processing a large inventory of cattle with low margins. There are two major beef packers in the state. Any economic threat to the packing sector could have an enormous impact to the beef industry in the state.

2014 Economic Contribution Analysis of the Washington Beef Industry

Economic change is a complex process as industries respond to impacts that occur quickly such as the 2014-2015 West Coast port slow down impacting trade flows and agricultural commodity prices, or change that occurs sequentially over time such as the dynamic response to the 2006 Renewable Fuel Standard that changed the demand for ethanol and corn which had indirect effects on the cattle industry by impacting feed costs for corn and ethanol byproduct corn distillers grains. The economic methodology to best analyze an industry's magnitude and importance to the regional economy is called an economic contribution study. The term economic contribution is defined as the amount of a region's existing economy that can be attributed to a given industry, (Miller and Blair, 1985). Once the results of an economic contribution study are known, industry impacts from changes in policy, regulations, or market events can be better evaluated in economic terms. An economic contribution study also provides a demographic baseline from which to measure future industry growth. This is the first comprehensive economic contribution study completed for Washington's beef industry.

The major objective of this study is to estimate the total economic contribution of the beef cattle industry to Washington's economy for 2014. These contributions are made by taking into account the linkages between Washington's cattle production sectors with other economic activities in the state where cattle production takes place. In order to determine the contribution of the beef industry to the Washington economy the study must take a comprehensive look at the industry and incorporate the economic activities of industries directly and indirectly related to beef production. A detailed discussion of the economic methodology used in this study is provided in the section describing the input-output IMPLAN model developed for this study. The first section of the report provides a background analysis of each beef production sector to evaluate trends, production capacity and to place 2014 beef production levels into historical perspective. The second section reports the data collection results from the cow-calf sector survey. The third section reports the results from the IMPLAN model.

I. Background and An Economic Overview of Washington's Beef Sectors

Regional Cattle Inventories

Washington's beef industry is unique in the Pacific Northwest. No other Pacific Northwest state has all three production sectors: cow-calf, feedlot and packers as large collectively as Washington does. Washington has several competitive cattle production advantages in forage and crop aftermath grazing resources, a strong hay production industry, grain production and byproduct feedstuffs, and a good transportation system for cattle movements to grazing, feedlots, and packers as well as beef products to both export and domestic markets. Figures 1, 2 and 3 provide maps showing the inventory number of cows that calved, cattle on feed and commercial cattle slaughter respectively. The maps provide a regional perspective of the size of each sector.

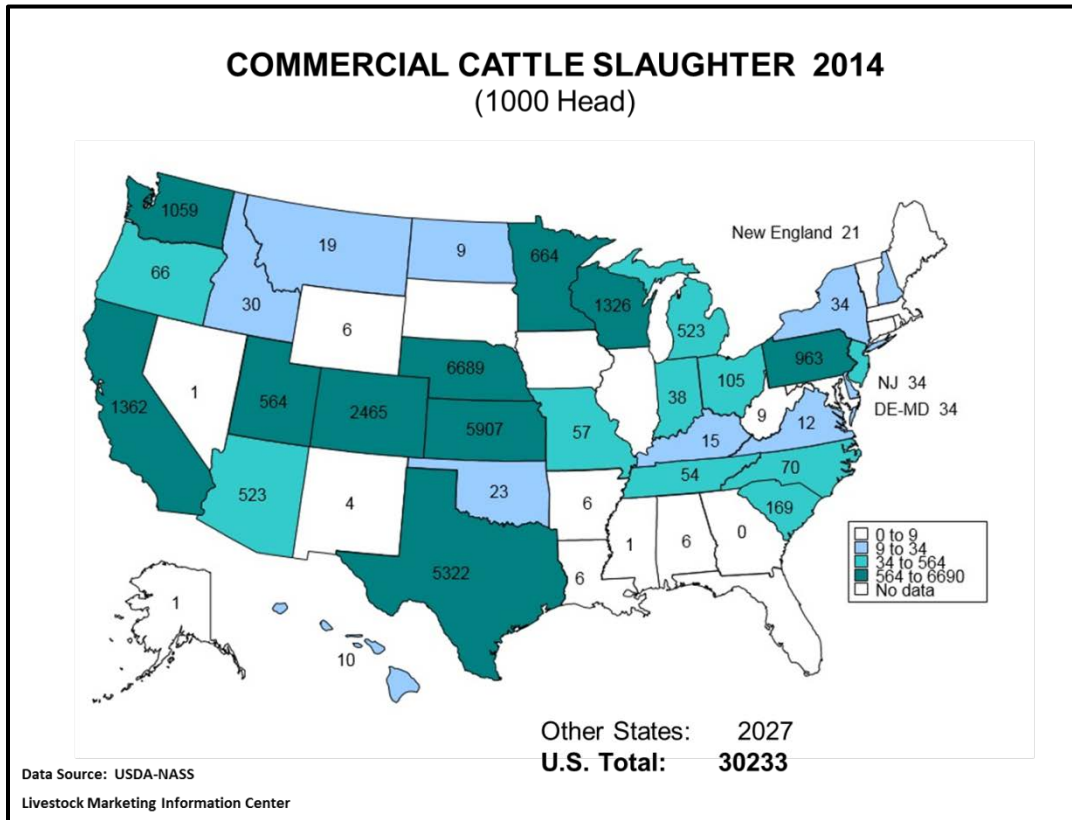


Figure 3. Commercial Cattle Slaughter.

The three figures show that Washington has the Pacific Northwest region’s smallest cow-calf inventory; a regionally large cattle feeding sector that is slightly smaller than Idaho, and by far the largest commercial cattle slaughter sector. Washington is a regional cattle industry driver because it purchases cattle from outside Washington to supply its cattle feeding and commercial slaughter sectors. The maps also provide a rough indication of the regional flow of cattle.¹ Considering the Pacific Northwest to include Washington, Oregon and Idaho, the cow-calf sector combined to produce about 1.2 million head of calves. The number of cattle on feed is about 0.5 million head. The number of cattle slaughtered is about 1.15 million head. If you add Montana to the Northwest region the combined inventory of calves produced increases dramatically to about 2.7 million head of calves but there is little increase in feeding and packing capacity to about 0.58 million head of cattle on feed and 1.17 million head slaughtered. If you consider that the cattle feeders get about two turns of cattle through their feedlot the number of cattle fed approaches the number of cattle slaughtered with Canadian imports contributing to the supply of feeder and slaughter cattle. Figure 4 illustrates the number of Canadian live cattle imports into Region 10 which includes Washington, Oregon and Idaho from 2010 to 2014.

¹ It is a rough approximation because of the production time differences between calf production and weaning, placing cattle on feed and the number of days on feed and the slaughter age each have different calendar years.

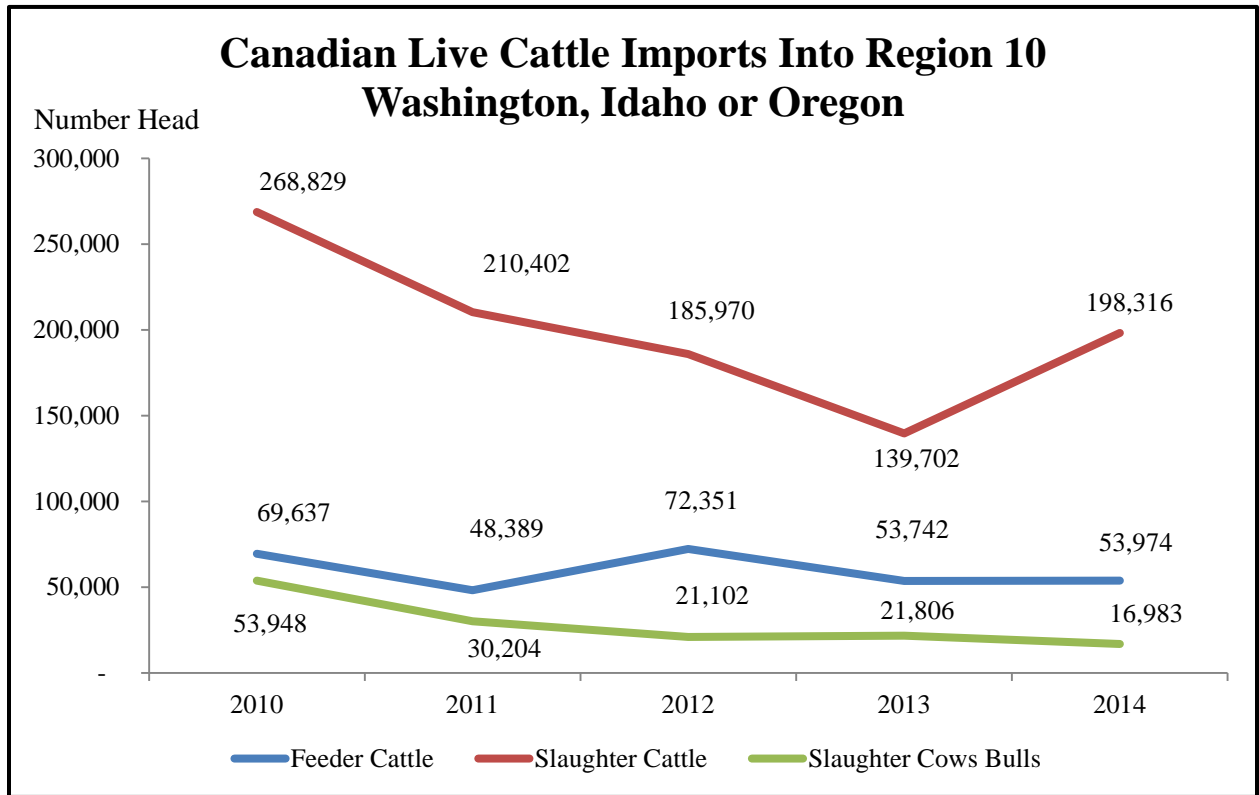


Figure 4. Number of Canadian Live Cattle Imports into Washington, Idaho or Oregon.
 Source: USDA Weekly Canadian Live Animal Imports into U.S. by Destination (WA_LS637)

Live cattle imports include slaughter cattle, feeder cattle and slaughter cows and bulls. The data does not identify a specific destination state, just Region 10. Overall each cattle type shows a declining trend in the number of imports which reflects a declining trend in the Canadian cow herd. In 2014 Canadian slaughter cattle imports into Region 10 were almost 200,000 head. Slaughter cows and bulls have the largest percent decline in the number imported over the 2010 to 2014 time frame declining to about 17,000 head imported. Feeder cattle imports were about 54,000 head in 2014.

Value of Production Rank

Washington is widely recognized as a rich agricultural state with a broad diversity of high valued horticulture, field grains and livestock production operations. Table 1 presents the most recent available ranking of Washington's top agricultural commodities by farm gate value of production. Cattle and calves combine beef and dairy calves, breeding stock and culls. It does not include the value of production from feedlots or the packer production sectors. Table 1 identifies the need to develop an economic contribution study focusing on the beef industry,

because the ranking of top commodities does not recognize the high combined economic value of the total beef industry. Therefore the commodity ranking under reports the beef industry's economic importance. Other commodities also have post farm gate processing, as does beef, but the increase in post farm gate is much higher for beef than compared to wheat and apples.

Table 1. Top 10 Washington Commodities by Value of Production

Commodity	2012 Value of Production ¹ (1,000 dollars)	Rank
Apples	\$2,250,850	1
Wheat	\$1,180,182	2
Milk	\$1,159,524	3
Potatoes	\$700,362	4
Hay	\$678,664	5
Cattle and Calves ²	\$623,534	6
Cherries	\$499,148	7
Nursery and Greenhouse	\$304,898	8
Grapes	\$235,875	9
Pears	\$205,734	10

¹ Latest available data for commodity ranking value of farm production

² Includes both beef and dairy calves

Source: USDA NASS Statistics by States

http://www.nass.usda.gov/Statistics_by_State/Washington/Publications/Annual_Statistical_Bulletin/annual2013.pdf

Also many of the USDA statistical reports combine beef and dairy production. It takes a concentrated effort to disentangle the beef and dairy production statistics. Having a study that reports only the beef statistics will be a resource to those interested in the beef industry.

Washington Cow-Calf Sector

Washington's cow-calf sector is highly diverse in terms of the size of operation and geographic location across the state. Washington cow-calf operations range in size from a large number of small operations to a small number of large operations. Table 2 presents data on Washington's beef cow operations using data from the 2012 USDA Agriculture Census. The data reports that there are 5,938 beef cow-calf operations with an inventory of less than 10 beef cows. This represents 65% of the number of operations and accounts for about 3% of the inventory of beef cows. Conversely operations with a herd size to above 500 beef cows represents only about 0.5% of the number of operations but account for about 63% of the inventory of beef cows. This demographic breakdown of operation size and inventory is typical across states.

Table 2. Washington Number of Operations by Size of Operation

Inventory of Beef Cows	Number of Operations	Percent of Operations	Percent of Inventory
1 TO 9 Head	5,938	65.0%	3%
10 TO 19 Head	1,338	14.6%	2%
20 TO 49 Head	1,170	12.8%	6%
50 TO 99 Head	435	4.8%	5%
100 TO 499 Head	213	2.3%	21%
500 TO 999 Head	34	0.4%	14%
1,000 Or More Head	11	0.1%	49%
Total	9,139	100%	100%

Source: USDA Quick Stats, 2012 Census of Agriculture

The inventory of beef cows in Washington has declined over time. Figure 5 shows the January 1 inventory number of beef cows from 1980 to 2014. Washington’s beef cow inventory peaked in 1984 at 436,000 cows and has declined to 209,000 cows in 2014. Washington’s beef herd has declined at a much higher rate than the rest of the U.S. The same source of data over the same time frame shows that the U.S. herd peaked at 39.229 million head in 1982 and declined to 29.085 million head in 2014. This represents a 26% decline from peak to current for the U.S. beef herd. Comparatively Washington’s decline from peak to current is 52%, approximately double the rate of decline of the U.S. herd level.

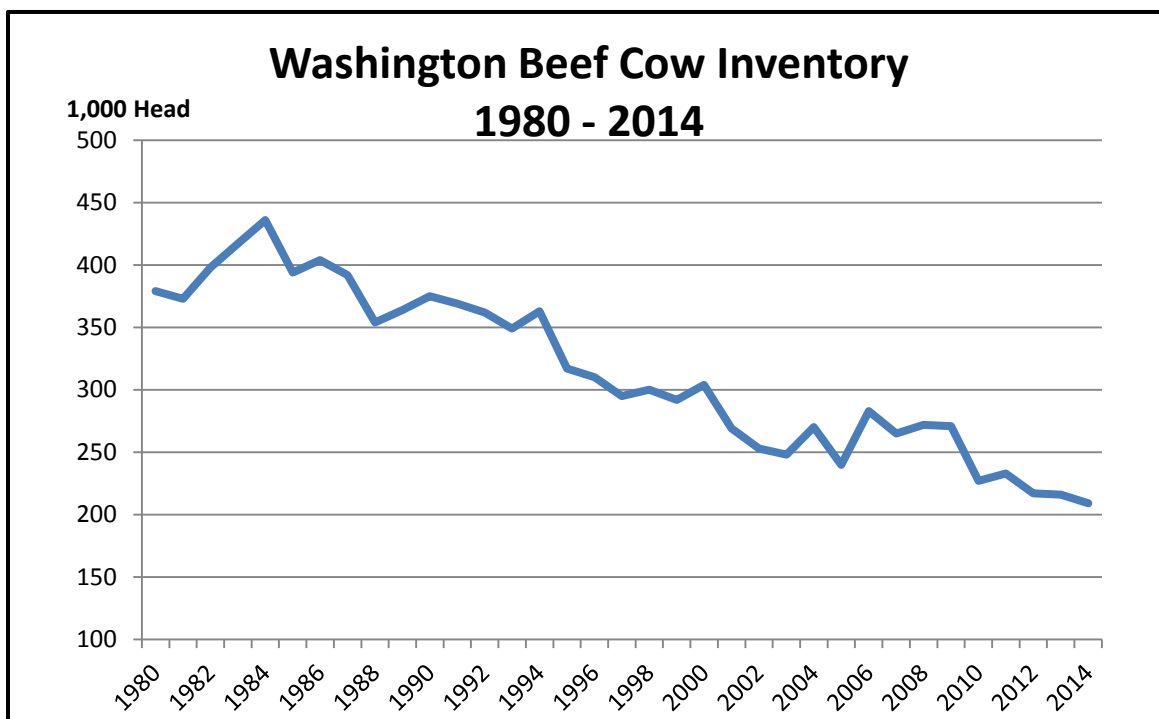


Figure 5. Washington Beef Cow Inventory 1980 to 2014.

Calf prices have been increasing since the 2008 economic recession. Figure 6 presents average 500-600 lbs feeder steer prices. The prices represent Washington auction prices reported to the USDA. Prices have increased year over year since 2009. Since 2011 they have set year over year record high nominal prices.

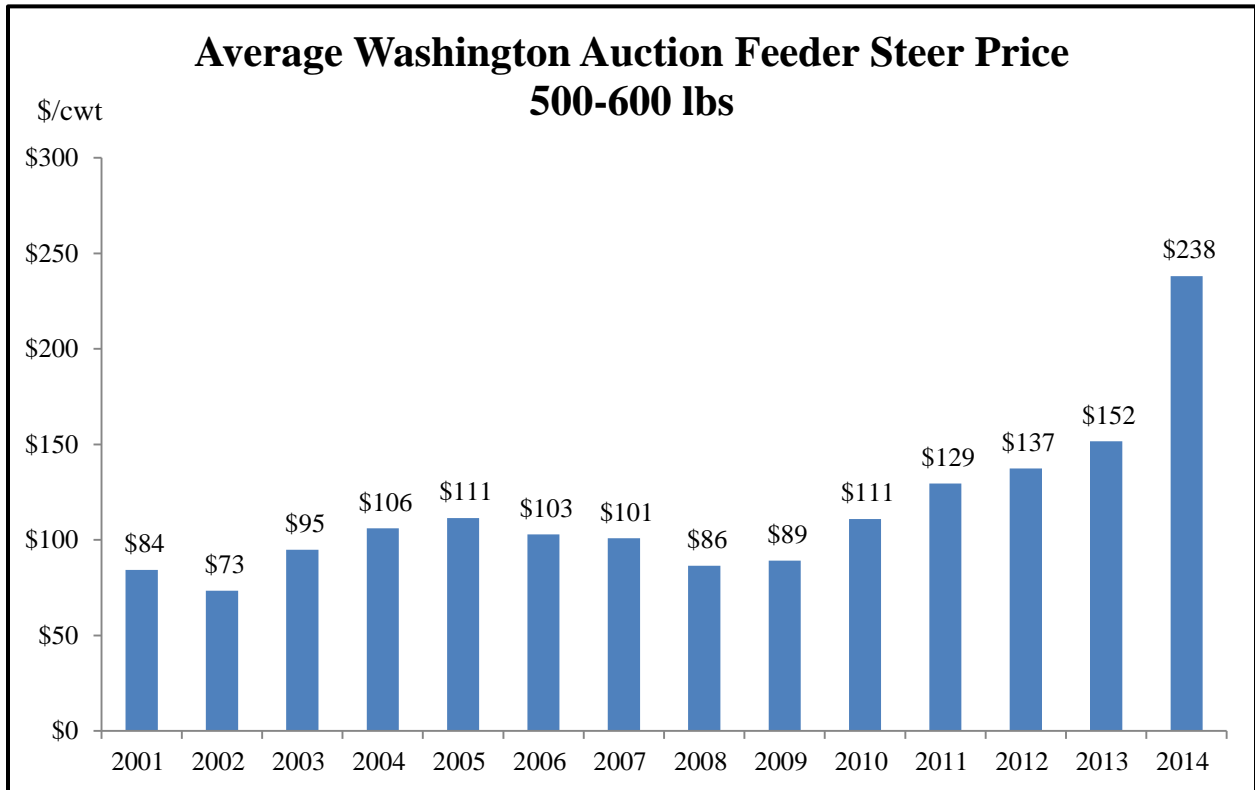


Figure 6. Washington Fall Feeder Steer Price.
 Source: USDA/AMS Weekly Combined Cattle Report - ML_LS795

The record high prices correspondingly set record high calf values. Based on the survey data collected for the study the average weight of steers and heifers sold were 645 and 598 pounds respectively. These calf weights correspondingly compound the increase in calf value to record high values. Figure 7 converts the fall prices reported in Figure 6 to the value of a 600 pound steer. As shown in Figure 7 the 2014 calf value reached a record high at \$1,429. This is an average \$519 increase in calf value per head over 2013.

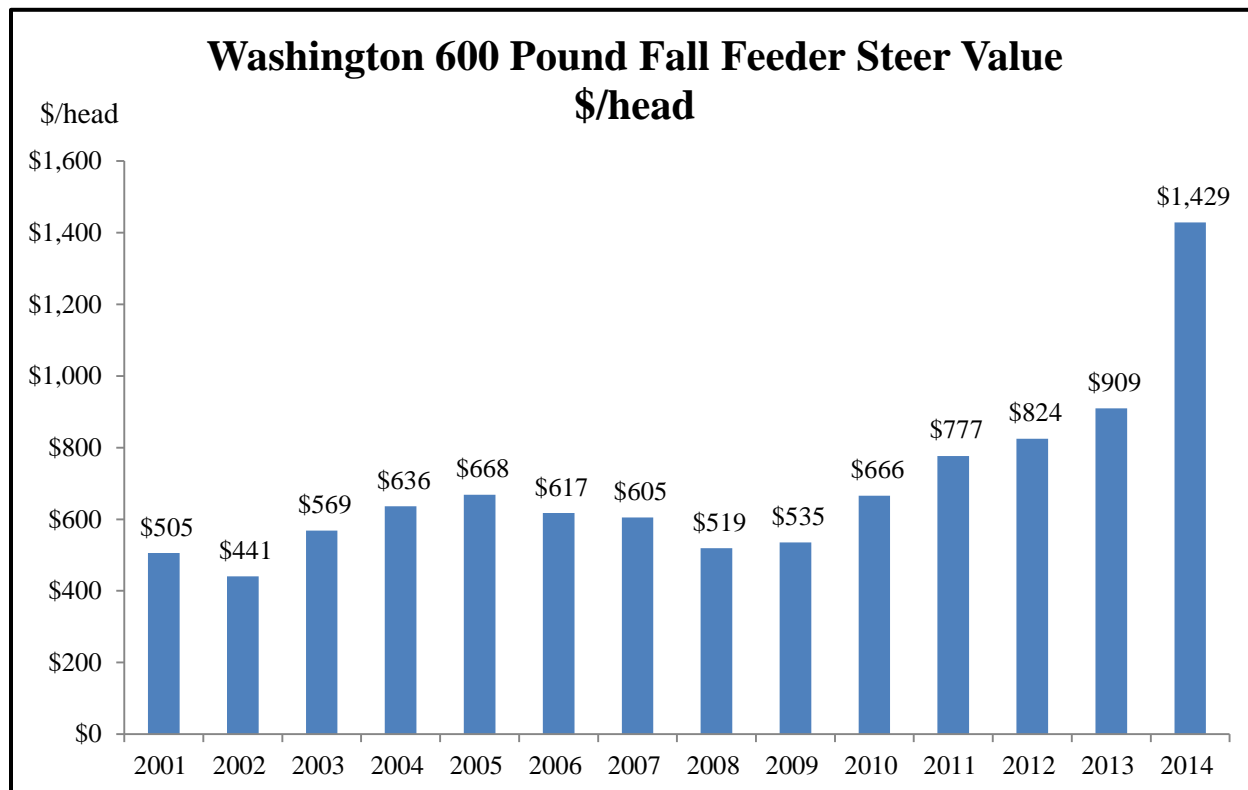


Figure 7. Washington 600 Pound Fall Feeder Steer Value.

Washington Feedlot Sector

Beef feedlots are a highly competitive sector with strong economies of scale which means that the production cost per head decreases as feedlot size increases. This has led to an increase in feedlot size, reduced the number of feedlots, and concentrated ownership of feedlots meaning that an owner has multiple feedlots at different locations. The USDA no longer reports the number of feedlot operations due to difficulties in defining a feedlot versus a backgrounding operation and revealing competitive feedlot information. It is currently estimated that there are about 20 to 30 feedlot operations in Washington. The number of feedlots does not impact the economic contribution study which uses the inventory of cattle on feed marketed that is reported by the USDA and representative production costs data that was obtained through a feedlot survey as part of this study.

Defining and describing feedlots is difficult because feedlots manage cattle as an inventory flow and the in-weights of cattle placements vary widely within a year and across years depending on cattle market conditions and cattle availability which are impacted by feed costs, drought and pasture quality conditions. In terms of the cattle on feed inventory report on January 1, 2015

Washington ranked 14th largest in the nation in terms of the number of cattle on feed at 210,000 head which is substantially lower than the top 3 states that have over two million head on feed, see Figure 2.

One statistic that can be used to analyze feedlots is tracking the number marketed. This represents the number sold and can be used to estimate the feedlot sectors total revenue. Figure 8 presents the number of cattle marketed by Washington feedlots from 2000 to 2013 which is the latest year available for this data series.

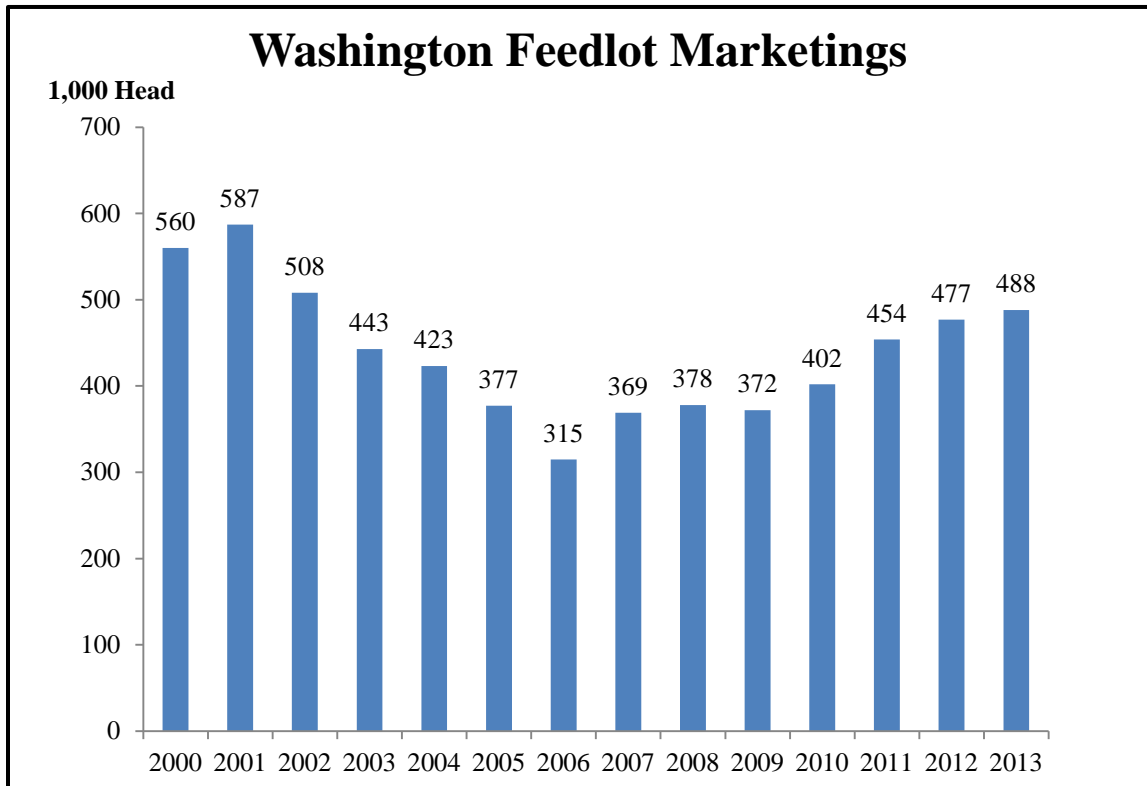


Figure 8. Washington Feedlot Marketings 2000-2013.

Source: USDA NASS, Washington Annual Statistical Bulletin, http://www.nass.usda.gov/Statistics_by_State/Washington/Publications/Annual_Statistical_Bulletin/index.asp

The data shows quite a bit of variation from a peak of 587,000 head marketed in 2001, to a low of 315,000 head marketed in 2006 to the most current data reported at 488,000 head marketed in 2013.

Figure 9 presents the Washington fed cattle sold average live weight per year. This is also often referred to as finished weight. The finished live weight is both the weight sold by the feedlot and purchased by the packer. Finished weight is impacted by a variety of factors including market price, feed costs, animal genetics, cattle prices, growth promotants, and environmental conditions

for example. Washington has followed the national trend for heavier finished weights primarily due to high beef prices and low supply so higher finished weights provide greater economic return. The average finished weight for fed cattle in Washington was 1,338 pounds in 2013, the latest year of data available.

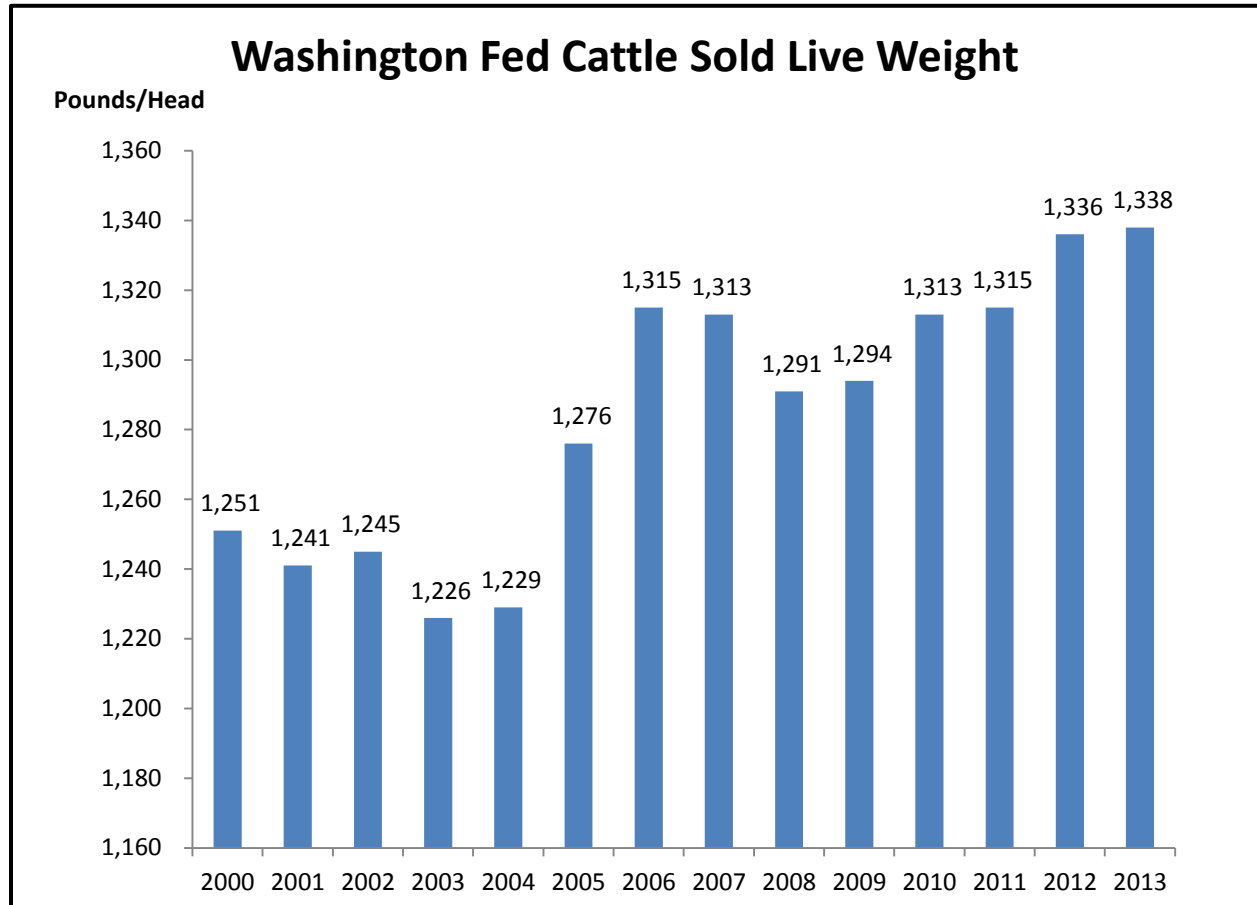


Figure 9. Washington Fed Cattle Sold Average Live Weight.

The USDA does not report a finished fed cattle price for Washington. Data from the feedlot survey for this study and discussing cattle prices with the Washington packers for this study, the available 5 Area Average (Texas-Oklahoma, Kansas, Nebraska, Colorado, and Iowa-Minnesota) closely represents Washington finished cattle prices. Figure 10 presents the average annual finished cattle price and Figure 11 presents the average per head finished value. As with prices and values for calves, 2014 were record high values for price \$150/cwt² and value \$2001 per head.

² Rounded from \$149.57

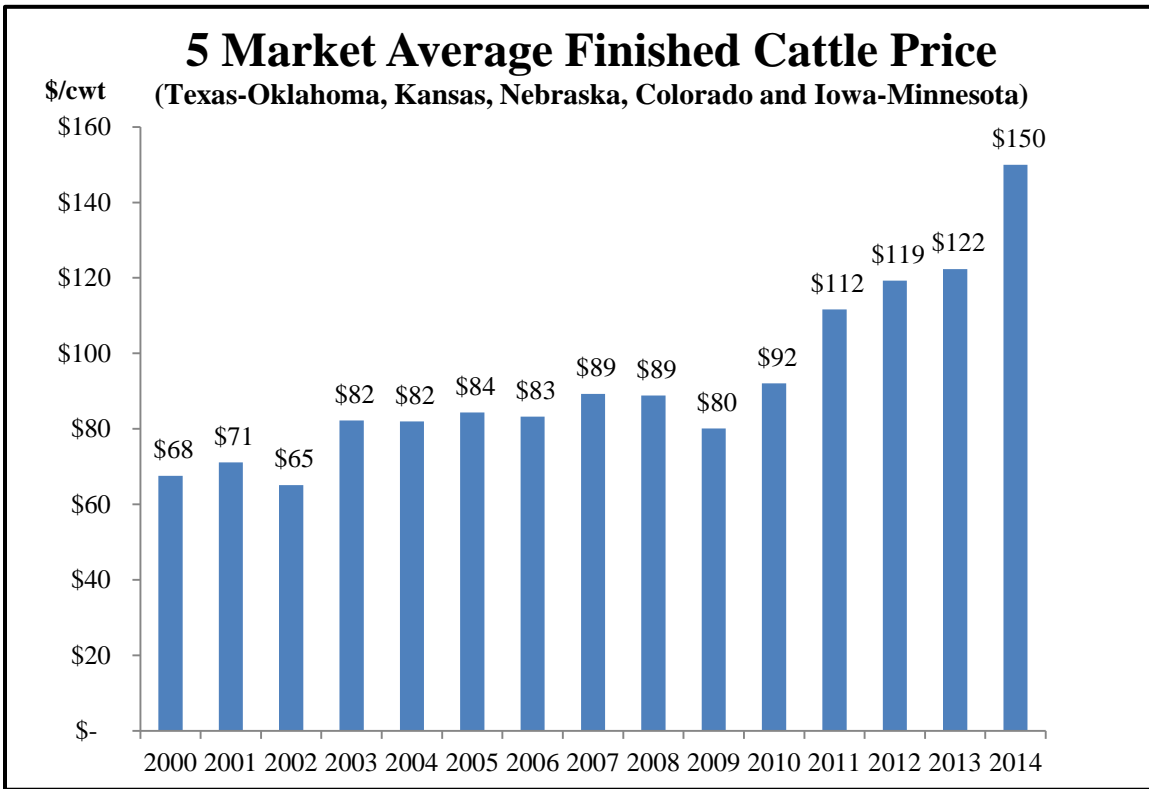


Figure 10. 5 Market Annual Average Finished Cattle Price. Source: www.LMIC.info

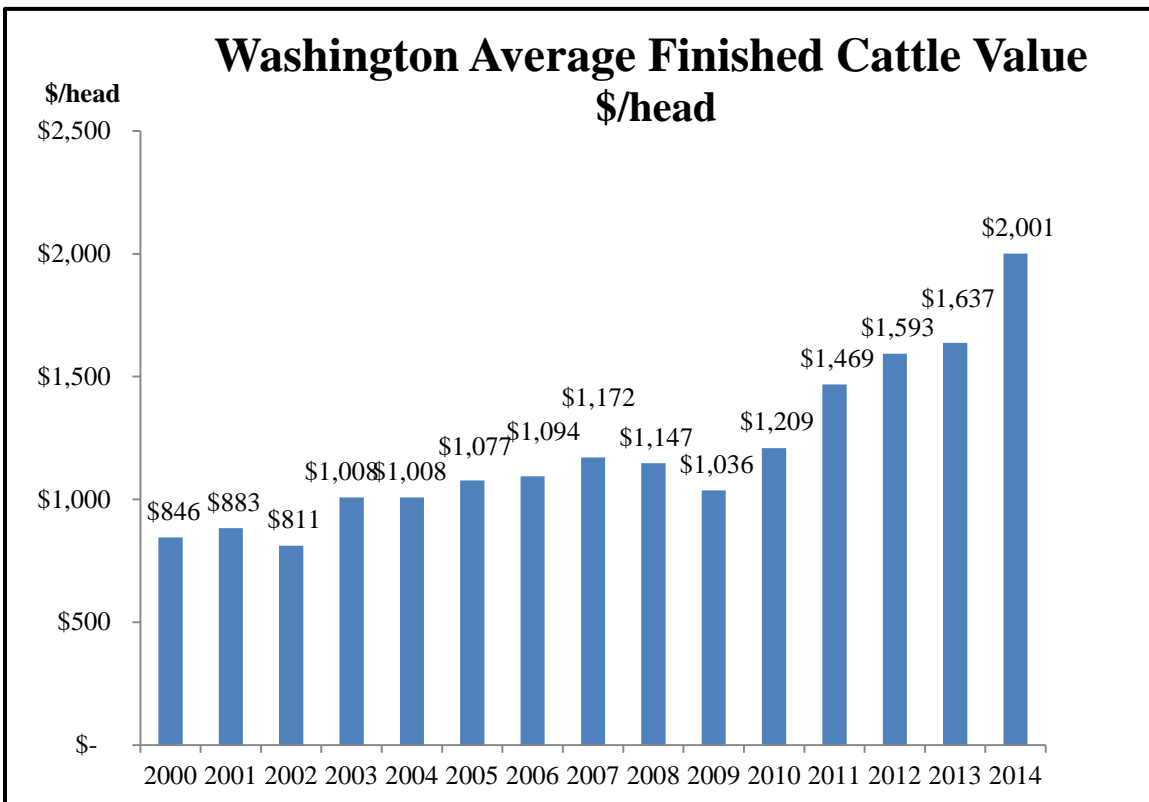


Figure 11. Washington Finished Cattle Value.

Washington Packer Sector

Livestock packers operate in a highly competitive economic environment relative to purchasing cattle, labor and selling beef products. A high majority of Pacific Northwest feedlot cattle are processed in one of Washington's two packing plants: Agri Beef Foods, LLC in Toppenish WA, or Tyson Foods Inc. Wallula, Washington. The nearest operating commercially competitive beef packing plant to the Washington plants is the JBS Hyrum Utah beef processing facility. There have been news announcements of constructing a new packing plant in Kuna Idaho in a joint venture between J.R. Simplot Company and Texas-based Caviness Beef Packers called CS Beef Packers, LLC. The plant is expected to finish construction in fall 2016. The primary purpose of the plant is reported to be to harvest cull cows and bulls from both cattle and dairy operations (http://www.simplot.com/news/jr_simplot_company_and_caviness_beef_packers_to_build_new_idaho_beef). This will not compete with Agri Beef Foods or Tyson Foods because they process feedlot cattle. Washington has a few relatively small cull cow processing plants such as Schenk Packing Co. and Walt's Meats. The cull cow packing capacity is limited in Washington and services both dairy and beef cull cattle. A large number of culls are shipped out of the state for processing.

Figure 12 presents the number of commercial cattle slaughtered in Washington. Since 2007 the number of cattle slaughtered has been highly stable ranging between 1.0 and 1.1 million head. Over this time the variation in the number slaughter compared to the average is no different than zero and four percent was the largest variation observed in 2008. There were 1.072 million head of cattle slaughtered in Washington in 2013, the latest year of available data and is very similar to the number slaughtered in 2010 and 2011.

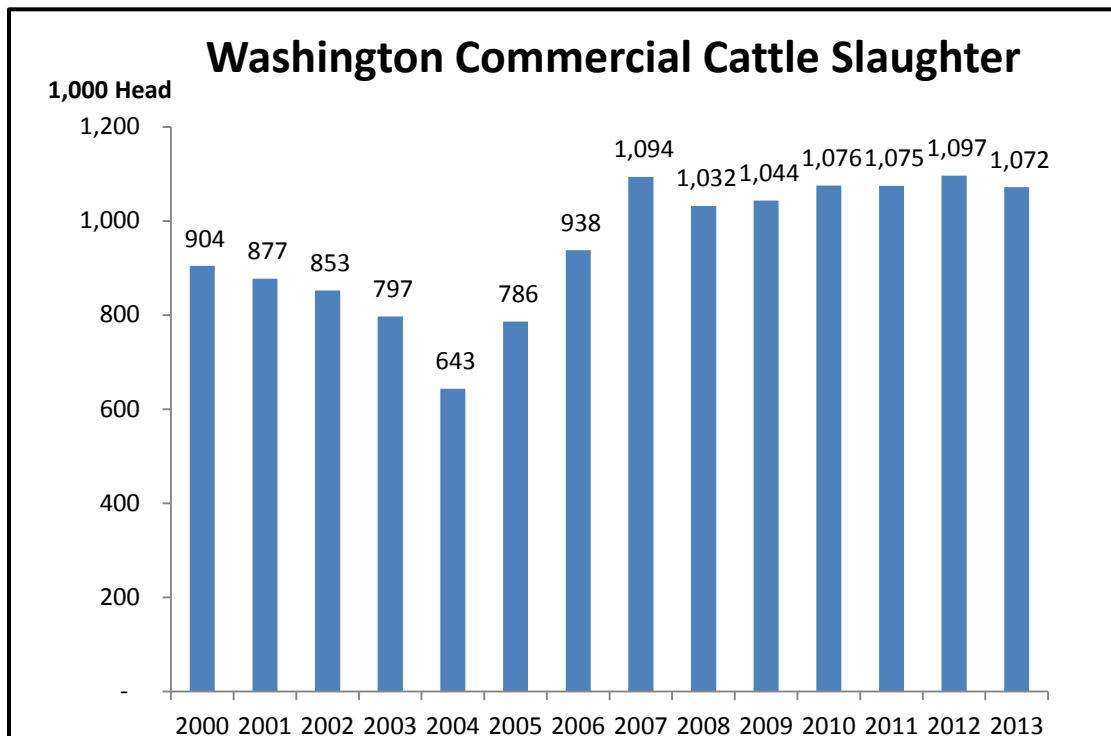


Figure 12. The Number of Commercial Cattle Slaughtered in Washington.

Source:

http://www.nass.usda.gov/Statistics_by_State/Washington/Publications/Annual_Statistical_Bulletin/2014/bulletin_wa_2014.pdf

Packers purchase live finished cattle and process them into wholesale boxed beef cuts. Although packers sell boxed beef, a common method to report wholesale meat value relative to per head value is boxed beef cut out value. In data discussions with the Washington packers for this study the USDA boxed beef cut out values was determined to be an accurate estimate of their wholesale meat values. Figure 13 presents annual average boxed beef cut out values. Since 2010 there has been year over year increases in cut out value with 2014 setting a record high at \$239.50 per cwt of boxed meat.

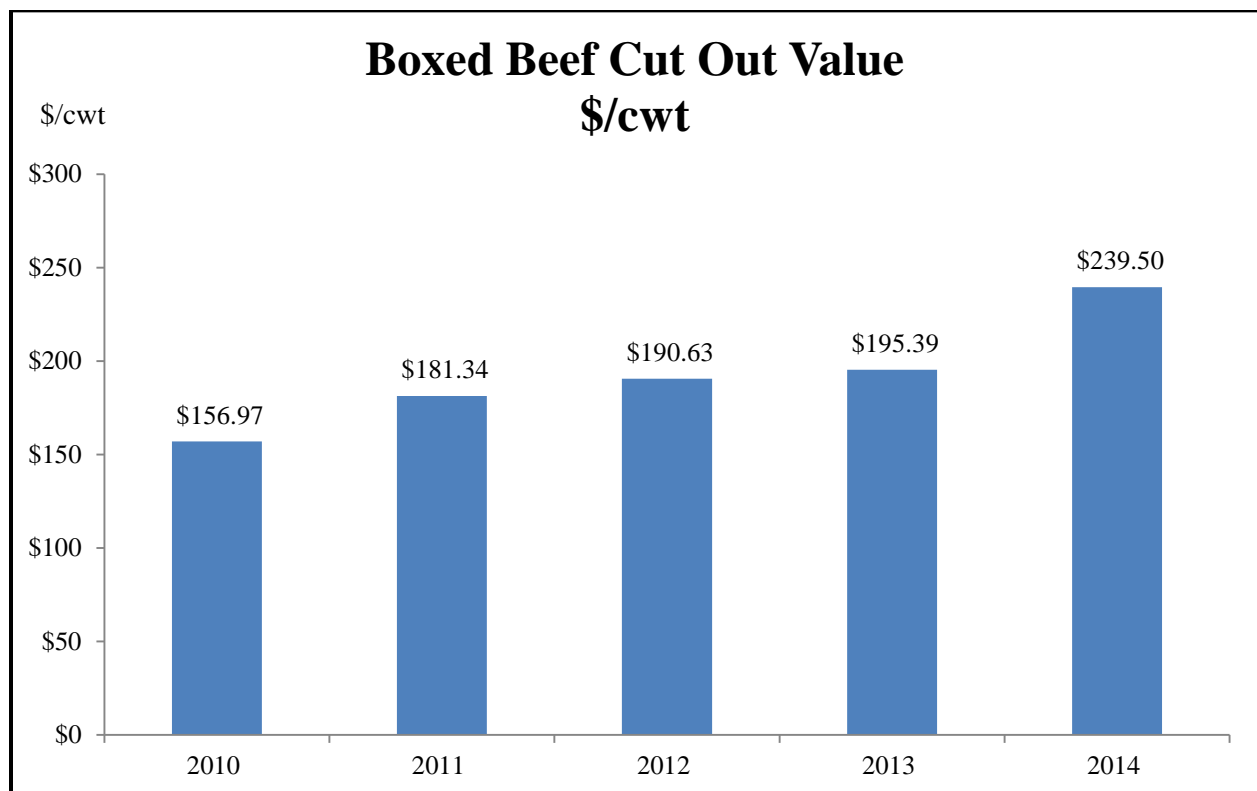


Figure 13. Annual Average Boxed Beef Cut Out Values.

Source: USDA AMS daily report LM_XB403

Dressing percent is the conversion factor from live weight to carcass weight. The industry accepted dressing percentage for a typical beef animal harvested in the United States is 62%. The drop credit is the value packers receive for hides and variety meats. The drop credit is reported by the USDA on a live weight basis, see www.ams.usda.gov/mnreports/lsddb.pdf. Figure 14 presents the calculated per head wholesale value of a processed beef animal using the average finished weight of Washington feedlot cattle as reported in Figure 9, a 62% dressing percentage, a drop credit of \$14.52/cwt live weight and the boxed beef cut out values reported in Figure 13.

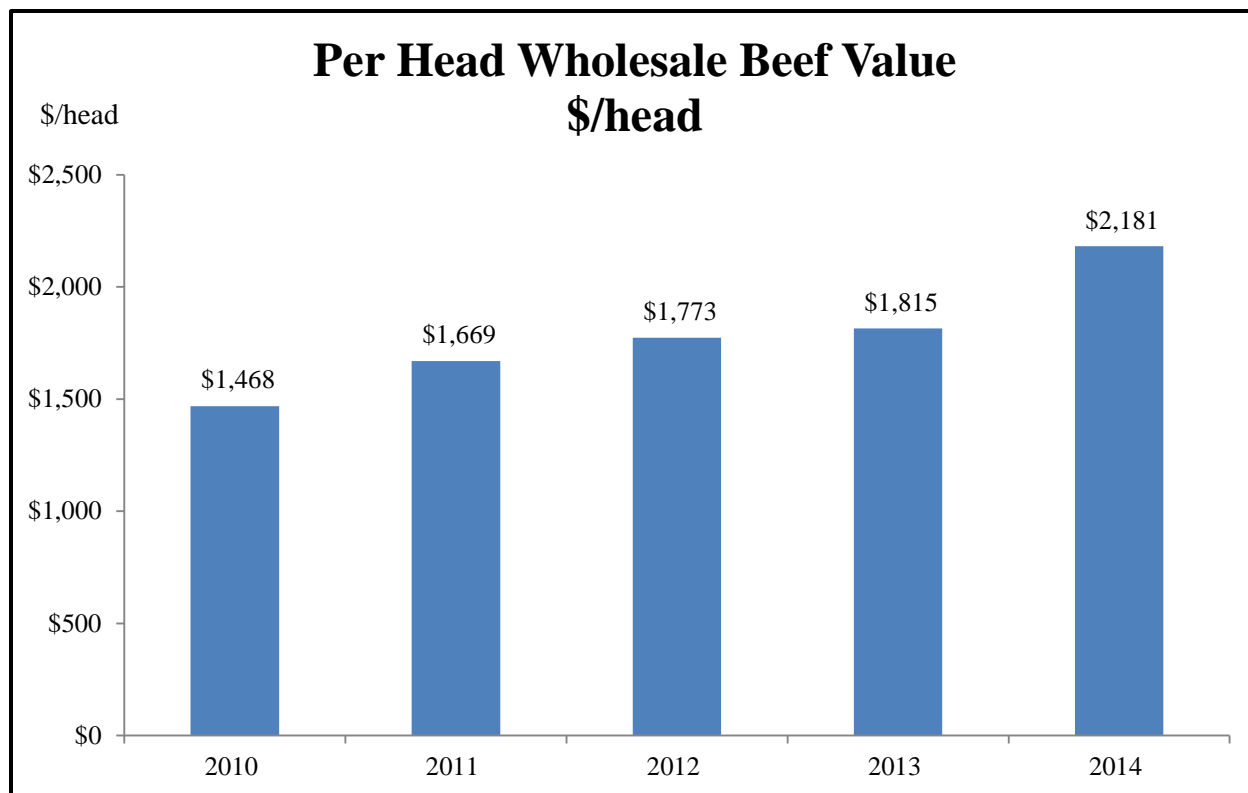


Figure 14. Calculated Washington Per Head Beef Wholesale Value.

Consistent with the cow-calf and feedlot sectors the packer sector has seen year over year increases in value. The calculated per head wholesale beef value set a record high value in 2014 at \$2,181 per head.

The percent year over year value increases for each sector annually and over a 5 year period are reported in Table 3. The cow-calf sector experienced the largest percent increases over the five-year reported time frame at 115% followed by the feedlot sector at 66% and the packer sector at 49%. The cow-calf sector's annual increase in beef value was appreciably higher than the other sectors both in 2012 to 2013 and in 2013 to 2014.

Table 3. Percent Increase in Beef Values by Sector

Sector	2010 to 2011	2011 to 2012	2012 to 2013	2013 to 2014	5 year 2010 to 2014
Cow-calf	17%	6%	57%	57%	115%
Feedlot	22%	8%	3%	22%	66%
Packer	14%	6%	2%	20%	49%

The increase in values are important relative to the economic contribution study. An industry generates economic activity by purchasing inputs from supplying industries in the region. The beef industry purchases cattle inputs backward from the packer sector back through the feedlot and then the cow-calf sectors. There has been a relatively large transfer of economic value to the cow-calf sector as cow-calf value has the greatest relative increase in value.

Summary of the Economic Condition of Washington's Beef Industry

Washington's packing sector is the primary driving factor in a vertically integrated production such as the beef industry as packer is the market outlet for the feeding sector and in turn the feedlots are the primary market outlet for the cow-calf producers. Washington's packing sector has been very stable in terms of the number of cattle slaughtered since 2007. This market stability has allowed the Washington feedlots to steadily increase the number of cattle marketed since 2007. The average annual growth rate in the number of feedlot cattle marketed in Washington is 4.87%. This growth occurred during a highly competitive market for feeder cattle and has increased the feedlot sectors economic contribution to the state. The cow-calf sector has enjoyed year over year increases in calf sale price since 2009 and record high year over year market prices and calf values since 2011. Cattle prices have been increasing for all cattle production sectors but has increased the most for the cow-calf sector. The high profitability helps increase the economic contribution of the cow-calf sector but Washington's cow herd inventory is in a declining trend and is at over a 30 year low.

II. 2014 Washington Beef Economic Contribution Survey Results

The study's basic framework is built around an economic model to identify the annual revenues and costs of production for each cattle production sector. Estimating an industry's economic contribution requires data on income, expenses, source of inputs purchased, capital improvements, taxes and regional purchase coefficients. This study utilizes the data acquired through surveys developed for the cow-calf and feedlot sectors, and interviews with the two major packers in Washington to supplement USDA statistical reports, University enterprise budget reports, and cattle industry literature to adjust the IMPLAN model's default production parameters. Evaluating and utilizing all sources of information improves the economic modeling accuracy in representing Washington's economic conditions.

Cow-Calf Survey

The cow-calf sector survey was sent to all addresses on the Washington brand list. This represents the most comprehensive list of potential cow-calf producers. Surveys were sent in February, 2015 and the data was collected until April 2015. Respondents could complete the printed mail survey or an on-line version at <http://www.opinion.wsu.edu/beef>. There were about 5,000 addresses on the brand list. In many cases brand owners that were on the list are no longer producing cattle, but maintain their brand for personal reasons. Those that returned surveys with this notation were removed from the results as well as a number of responses that stated they would not provide their revenue, cost and inventory numbers requested. This is sensitive information for cattle producers. There were 122 completed surveys representing 8,506 cows and heifers that calved in 2014. This is about four percent of the state inventory of cows and heifers that calved, and about two percent of the number of operations. Although this response rate is low the quality of the data returned is high and provided information in addition to other sources of data to establish the revenue and cost data needed for the IMPLAN model. The cow-calf budget model is provided as Appendix Table 1.

Washington cow-calf ranches have a long history of operating at their home location. On average cow-calf operations have been at their home location for 47 years with 14 respondents identifying their family have operated their ranch for over 100 years. Figure 15 provides the respondents herd size demographics. The herd size demographics follow the overall USDA herd size demographics with a large number of small producers ranging to a low number of large producers (see Table 2 to see state totals). The survey respondents have relatively more herds in the 100 to 600 cows range because these producers are highly committed to the cattle industry and were willing to provide the survey data. Overall the survey provides a representation of Washington's cow-calf sector from small to large herds. Of the reporting herds, about 86 percent declared they were spring calving herds.

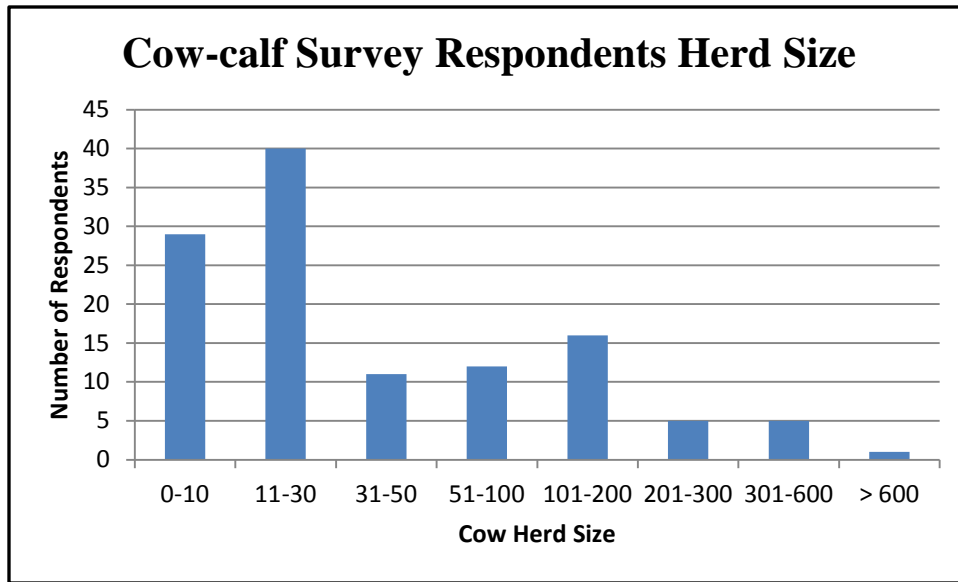


Figure 15. Cow-calf survey herd size demographics.

Table 4 presents the survey results on evaluating method of sale for the calves and if known if the calves remain in Washington after the sale. Almost half, 49%, of the calves are sold by private treaty and 77% of those calves remain in Washington. The second most common method of sale was calves sold at live auction, with 29% of the calves sold and 44% reported as remaining in Washington. Retained ownership through the feedlot was reported by 5 ranches and all of those calves remained in Washington.

Table 4. Cow-calf Survey - Method of Sale and Calves Staying in Washington

Method of Sale	Number of Ranches	Number of Calves	Percent of Total	Percent of Calves Staying in WA
Sold at Live Auction	73	2,691	29%	44%
Sold on Video Auction	1	80	1%	0%
Sold by Private Treaty	46	4,658	49%	77%
Retained Ownership Stocker	21	434	5%	70%
Retained Ownership Feedlot	5	809	9%	100%
Kept for ranch beef	47	257	3%	100%
Death Loss	55	238	3%	
Sold as Bulls	20	81	1%	62%
Sold as Heifers	8	177	2%	92%
Total	276	9,425	100%	67%

Table 5 reports average sale weights. The average reported weight of steers sold was 635 pounds with a standard deviation of 95 pounds. The average reported weight of heifers sold was 611 pounds with a standard deviation of 92 pounds. The average reported sale weight of cull cows was 1,293 pounds with a standard deviation of 178 pounds. Forty ranches reported that they precondition their sale calves. The preconditioning period ranged from 10 days to 100 days with an average of 47 days and a standard deviation of 24 days.

Table 5. Cow-calf Survey Results – Sale Weights

Description	N	Average (Pounds)	Standard Deviation (Pounds)
Steer calves	101	635	95
Heifer calves	93	611	92
Cull cows	95	1,293	178

Cow-calf operation productivity is directly linked to grazing resources. Cow-calf operations use grazing resources as a low cost feed source and a land management resource. Well managed grazing provides numerous environmental benefits such as managing vegetation to reduce fuels that contribute to wildfire, controlling some invasive plant species, and preserving open space. Healthy rangelands provide ecosystem services such as wildlife habitat, water purification, carbon sequestration and recreational opportunities (Kerna, 2014). Table 6 provides the survey responses to grazing types and costs. Privately owned pasture had by far the largest number of AUMs followed by leased pasture and privately owned crop aftermath.

Table 6. Annual Grazing Type AUMs and Cost¹

Grazing Type	Annual AUMs	Average Cost per AUM \$
Privately owned pasture and range	67,690	\$25
Privately owned crop aftermath	10,381	\$16
Leased privately owned pasture	12,399	\$17
Leased privately owned crop aftermath	1,782	\$29
Federal land lease	4,339	nr
State land lease	1,690	nr
County/other land lease	-	nr
Other lease	809	\$20
Total AUMs	99,090	

¹ The total annual AUMs reported matches closely to the total expected AUMs based on the total reported number of cows and heifers that calved. But, the data reported on average cost per AUM had an n of 26 or less for each grazing type and no reports were provided for federal, state, and county grazing lease costs.

Information on the number of employees and labor and benefit costs are reported in Table 7. The survey asked for the number of people hired in full time, part time, seasonal and family labor positions and the annual hired labor and labor benefit expenses. Given the size herd size distribution with many small ranches and most cow-calf ranches had family, part-time and seasonal labor employees there is not a large number of hired employees. On average there were 0.0051 FTE per cow that were paid \$23,837 on average and had a benefit cost of \$3,374.

Table 7. Cow-calf Survey Results – Employment

Description	n	Average	Standard Deviation
FTE employees per cow	110	0.0051	0.0202
Annual Labor Cost	110	\$23,837	\$5,244
Annual Benefits Cost	105	\$3,374	\$1,147

The survey asked questions to determine regional purchase coefficients for their cow-calf operation expenses. The results are reported in Table 8. The ranches predominantly purchase inputs within Washington and locally. The survey estimates that 48 percent of cow-calf operating purchases are local within 30 miles of their operation. Forty percent of the inputs are purchased regionally in Washington. Out-of-State purchases were estimated to be twelve percent.

Table 8. Cow-calf Survey Results – Regional Purchase Coefficients

	Percent
Locally (within 30 miles)	48
Regionally (over 30 miles but in Washington)	40
Out-of-State (mail order for example)	12

Feedlot Survey

A feedlot survey was also developed to collect data from Washington feedlots. To preserve the confidentiality of their feedlot data, the survey responses were sent to the Washington Cattle Feeders Association and the aggregated results were provided for analysis.

Table 9 presents the survey results on 2014 placements. The predominant number of placements, about 60 percent, were purchased in partnership. The survey accounted for a total of 297,247 placements. This is about 64 percent of total placements reported for Washington by the USDA. The survey questions combined asking for the placements that were sourced from Washington. In total 162,669 of the reported placements, or 55%, were sourced from Washington. The survey result on the number of head finished and shipped to the packer in 2014 was 245,625 head.

Table 9. Feedlots Survey Results – Cattle Placements

	Number of head
Number of head purchased without partnership	24,483
Number of head purchased in partnership	177,894
Number of placements to be custom fed	79,695
Number of placements owned	8,525
Other placements	6,650
Total	297,247

The survey asked about 19 questions on revenues and expenses that addressed cattle purchases, capital expenses, repairs, trucking, purchased and raised feed costs and animal pharmaceutical expenses. The responses to these questions were used to develop the feedlot revenue and cost budget provided as Appendix Table 4. The employment survey responses are provided in Table 10. The number of feeders per FTE is about 1,121 at a labor cost of \$31.27 and benefit cost of \$10.18 per feeder.

Table 10. Feedlot Survey – Employment

Description	
Feeders per FTE employee	1,121.8
Labor cost per feeder	\$31.27
Benefits cost per feeder	\$10.18

The survey asked questions to determine regional purchase coefficients for the feedlot operating expenses, see Table 11. The ranches predominantly purchase inputs within Washington and locally. The survey estimates that 45 percent of feedlot operating purchases are local within 30 miles of their operation. Forty-nine percent of the inputs are purchased regionally in Washington. Out-of-State purchases were estimated to be six percent.

Table 11. Feedlot Survey Results – Regional Purchase Coefficients

	Percent
Locally (within 30 miles)	45
Regionally (over 30 miles but in Washington)	49
Out-of-State (mail order for example)	6

III. Washington Beef Industry Economic Contribution Model

The agricultural sector in general and the beef industry specifically, represents basic industries to Washington. Basic industries provide income to a region by producing an output, purchasing production inputs, services and labor. The production of calves, finished feedlot animals and beef processing products represent the direct economic contribution of the beef industry to Washington.

The beef industry also generates indirect economic contributions as the revenues from the sales of beef animals and products are re-spent in the local economy. The indirect impact of the beef industry on local economies includes purchases of a variety of agricultural inputs and professional services in the process of producing beef. For example, the packers purchase cardboard packing products that generates economic activity from the firm producing the cardboard packing products. Indirect effects represent additional economic activity in Washington's economy driven by beef product sales. These effects appear as jobs and income in local industries serving the beef industry (e.g., veterinarians, feed suppliers, implement suppliers, packaging, trucking and transport).

In addition to the direct and indirect impacts of the production and sales of beef products, the beef industry is responsible for induced economic impacts in the form of the local goods and service purchased by people using the salaries and wages earned contributing to the productivity of the beef industry. These induced expenditures translate into jobs and income for retailers, bank tellers, grocery store clerks, restaurant employees, and gas station attendants and so on.

The income generated directly by the beef industry adds to this interdependency; cow-calf, feedlot and beef processing employees spend their wages and salaries on groceries, housing, entertainment, and a range of other consumer goods and services. Typically these expenditures occur locally that generates rural economic development. These additional linkages, beyond the beef industry and indirectly related sectors of the economy, create induced effects, which help to form a complex intertwining of industries within Washington. So the relevant question to ask is not only what beef adds to the Washington economy directly, but also how much do beefy farms contribute to Washington's economy through this complex networking of industries.

Methods

While the term impact is often associated with studies that consider the role of an entire industry or a set of industries in a region, this is improper terminology. A preferred nomenclature is economic contribution analysis Winter et al. (2007). An impact analysis considers the increase or reduction in total economic activity in a region due to some event like a new environmental regulation, a change in tax policy, or entrance of a new business. An economic contribution analysis is appropriate when considering the role that a set of industries play in a region's economy. This entails tracking all the economic activity that occurs downstream of an industry that can be attributed to that industry's presence in the region.

Input-Output (I/O) models calculate the economic impact of an industry through backward linkages. An industry generates economic activity by purchasing inputs from supplying industries in the region. If Industry A provides inputs into Industry B then the Industry B activity is not included in Industry A's contribution to the regional economy.

In order to be consistent with standard I/O accounting, all expenditures in the beef production enterprise budget must be converted to producer prices rather than purchaser prices. Margin tables were used to convert the enterprise budgets purchaser prices to producer prices. The final products that producers bought in purchaser price were separated into transportation, wholesale, retail margin, and producer price as is standard practice for Input-Output analysis. This was done by using information from the IMPLAN margin tables. Appendix Tables 1 to 6 provide I/O conversion information developed for the cow-calf and feedlot sectors. Conversion for the packer sector was based on the default conversion parameters available in the IMPLAN software.

Results

The IMPLAN software and the 2013 IMPLAN model for Washington were used to estimate the economic contributions of the beef industry, consisting of the cow-calf sector, feedlot sector and beef processing sector. The contribution of the industry to the Washington economy is measured by different types of impact: direct effects, the immediate effects related to the production and processing of cattle; indirect effects, changes arising from inter-industry transactions as supplying industries respond to the demand from the directly affected industry; and induced effects, the effects due to the local spending on goods and services by employees in the directly and indirectly affected industry sectors. Table 12 shows these effects measured in terms of employment, labor income, value added and total output. In estimating the economic contributions of individual sectors, the backward linkages between the cow-calf and feedlot sectors, and between the feedlot and processing sectors were broken in order to avoid double counting when aggregating the effects for the beef industry.

Table 12. Economic Contribution of the Washington Beef Industry by Type of Impact.

Variables and Sectors	Impact Type			Total Effects
	Direct Effects	Indirect Effects	Induced Effects	
Employment				
Beef Industry	4,294	6,735	2,903	13,933
Ranch sector	1,059	1,219	887	3,166
Feedlot sector	435	2,316	221	2,972
Processing sector	2,800	3,200	1,795	7,795
Labor income				
Beef Industry	\$326,980,360	\$371,205,345	\$162,088,441	\$860,274,146
Ranch sector	\$139,764,152	\$64,023,998	\$49,510,157	\$253,298,307
Feedlot sector	\$62,578,192	\$111,195,418	\$12,374,402	\$186,148,012
Processing sector	\$124,638,016	\$195,985,929	\$100,203,882	\$420,827,827
Total Value Added				
Beef Industry	\$540,518,056	\$750,997,157	\$295,227,803	\$1,586,743,016
Ranch sector	\$184,039,130	\$99,350,850	\$90,129,280	\$373,519,260
Feedlot sector	\$73,990,560	\$231,105,271	\$22,586,725	\$327,682,556
Processing sector	\$282,488,366	\$420,541,035	\$182,511,798	\$885,541,200
Total Output				
Beef Industry	\$3,639,429,784	\$1,552,728,282	\$498,570,862	\$5,690,728,928
Ranch sector	\$324,708,670	\$162,212,555	\$152,228,799	\$639,150,023
Feedlot sector	\$976,610,000	\$537,649,898	\$38,122,451	\$1,552,382,348
Processing sector	\$2,338,111,114	\$852,865,829	\$308,219,612	\$3,499,196,556

Labor income consists of employee compensation (wages, salaries and benefits) and proprietor income. The direct income of \$326.9 million to the beef industry resulted in an additional \$533.2 million (indirect and induced effects) of income within the state's economy, for a total impact of about \$860.3 million of personal income (Table 12).

The value added is comprised of employee compensation, proprietor income, other property type income and taxes. The estimated \$0.54 billion of direct value added for the beef industry generated an additional \$1.05 billion indirect and induced value added, thus bringing the beef industry's total value-added contribution of \$1.59 billion to the Washington State economy.

In 2014, the Washington beef industry generated about \$3.64 billion in direct output (total sales), of which about 64% came from the beef processing sector. The total sales from the beef industry generated an additional \$2.05 billion of economic output from other sectors within the state.

Table 13 provides the associated multipliers. The multipliers calculate the impact that is expressed as a rate of change. A multiplier describes how for a given change in an industry the resultant change that occurs in the overall economy. The employment multiplier describe the jobs generated per million dollars of production. The beef industry's employment multiplier is

3.2, which means that every direct beef industry job creates 3.2 jobs in the total economy: the original job plus 2.2 additional jobs. A labor income multiplier of 2.6 indicates that for every dollar of direct labor income in the beef industry, an additional \$1.6 of labor income is generated in the local economy. The total output multiplier for the beef industry is 1.6. These estimates imply that for every dollar of cattle production and processing, \$1.6 is generated in the local economy; that is for each cattle industry dollar, an additional \$0.40 is generated in sectors providing inputs to the beef industry (indirect effects), and an additional \$0.20 earned by businesses providing goods and services to employees of the beef industry and indirectly affected sectors (induced effects).

Table 13. Economic Contribution of the Washington Beef Industry by Type of Impact.

Variables and Sectors	Multiplier		
	Type I*	Induced	Type SAM*
Employment			
<i>Beef Industry</i>	<i>2.6</i>	<i>0.6</i>	<i>3.2</i>
Ranch sector			
Feedlot sector			
Processing sector			
Labor income			
<i>Beef Industry</i>	<i>2.1</i>	<i>0.5</i>	<i>2.6</i>
Ranch sector			
Feedlot sector			
Processing sector			
Total Value Added			
<i>Beef Industry</i>	<i>2.4</i>	<i>0.5</i>	<i>2.9</i>
Ranch sector			
Feedlot sector			
Processing sector			
Total Output			
<i>Beef Industry</i>	<i>1.4</i>	<i>0.2</i>	<i>1.6</i>
Ranch sector			
Feedlot sector			
Processing sector			

*Accounts only for the impacts of business-to-business transactions. Calculated as: (Direct Effects + Indirect Effects)/Direct Effects.

**Accounts for the impacts of inter-business transactions and local household spending. Calculated as: (Direct Effects + Indirect Effects + Induced Effects)/Direct Effects

Employment, as defined in IMPLAN, refers to the number of jobs, including full time, part time and temporary jobs. Table 12 shows that the beef industry provided an equivalent of 13,933 jobs in 2014. There were 4,294 people directly employed, and an additional 9,639 jobs supported in other industry sectors in the state. Thus, for every job directly related to the beef industry, about 2.2 additional jobs are created due to indirect effects (facilitation of business-to-business transactions) and induced effects (provision of privately demanded goods and services). The top ten sectors with employment supported by the beef industry are shown in Table 14. The top two sectors are those within the beef industry, while other employments occurred in sectors providing goods and services to the beef industry such as truck transportation, support activities for agriculture and forestry (e.g., breeding services, branding), all other crop farming (e.g., source of livestock feed for cattle production like hay farming), and wholesale trade (e.g., miscellaneous supplies). Employment in animal production, except cattle and poultry and eggs could be due to the mix of livestock enterprises on some farms (e.g., use of horses, combination livestock production). Real estate employment is mainly attributed to large amounts of grazing land for cattle production, and could also be related to housing and other business-related spaces. Employment is also supported through induced effects, generated by employees and proprietors spending their income on goods and services; for example, the food and beverage retail stores and full service restaurants where a total of about 283 jobs are supported through the induced effects.

Table 14. Employment Impacts of the Beef Industry in Washington, Top 10 Sectors.

Sector	Direct Effects	Indirect Effects	Induced Effects	Total
Beef cattle ranching and farming, including feedlots and dual-purpose ranching and farming	1,494	1,736	2	3,232
Animal, except poultry, slaughtering	2,800	36	2	2,838
Animal production, except cattle and poultry and eggs	0	953	1	954
Truck transportation	0	754	23	777
Support activities for agriculture and forestry	0	675	3	678
Wholesale trade	0	353	93	446
Retail - Food and beverage stores	0	250	91	342
All other crop farming	0	280	2	282
Real estate	0	129	132	260
Full-service restaurants	0	35	150	185

Discussion

Comparing these results with a similar study of Arizona's beef industry published by Kerna et al. (2014) are similar. Arizona has a larger feedlot sector than Washington but a smaller packing sector. Arizona's beef industry's total economic contribution was \$1.705 billion compared to Washington at \$5.691 billion. Arizona's total output multiplier is 1.4 versus Washington at 1.6. Arizona's employment multiplier was 1.6 versus Washington at 3.2. Given Washington's larger packing sector these differences seem reasonable.

Washington's beef industry economic contribution is led by the packing sector because of its large inventory of production, it is the highest value of production and it by far employs the most people. The Washington beef industry total economic contribution is \$5.691 billion dollars and the packing sector accounts for sixty-one percent of the total economic contribution. The packing industry is highly concentrated and highly competitive economically processing a large inventory of cattle with low margins. There are two major beef packers in the state. Any economic threat to the packing sector could have an enormous impact to the beef industry in the state.

IV. References

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Appendix Table 1. Cow-Calf Annual Revenues and Costs per Cow¹

Income	\$ per cow
Calf sales (15% replacement retention)	1,290.30
Cull cow (7 year life)	189.60
Cull replacement heifers	52.96
Cull bull (3 years - 30 cows)	20.77
Gross Income	1,553.63
Variable Costs	
Hay	270.00
Grain	20.55
Salt and Minerals	23.35
Leased grazing fees	34.50
Veterinary health pharmaceuticals	25.58
Veterinary services	18.74
Reproduction - bulls	61.15
Trucking Services	17.84
Fuel	32.33
Repairs	86.63
Supplies, misc	29.66
Check-off and Brand Inspection	2.38
Sales commission	35.59
Interest	5.61
Labor	120.78
Labor benefits	17.1
Professional services	3.82
Total Feed and Variable Costs	\$805.61
Fixed Costs	
Annual capital cost	86.62
Taxes	79.13
Insurance	5.33
Total Fixed Costs	\$171.08
Total Cost	\$976.69
Income over all costs	\$576.94

¹ Source 2014 Economic Contribution Study Cow-Calf Sector Survey

Appendix Table 2. Washington Cow-Calf Production Function in Input Output Accounting

Sector Names	Cow-Calf per Cow	Cow-Calf Ranch Aggregation
Inputs	\$	\$
Hay	270.00	56,430,000
Grain	20.55	4,294,950
Salt and Minerals	23.35	4,880,150
Leased grazing fees	34.50	7,210,500
Veterinary health pharmatecuticals	25.58	5,346,220
Veterinary services	18.74	3,916,660
Reproduction - bulls	61.15	12,780,350
Trucking Services	17.84	3,728,560
Fuel	32.33	6,756,970
Repairs	86.63	18,105,670
Supplies, misc	29.66	6,198,940
Check-off and Brand Inspection	2.38	497,420
Sales commission	35.59	7,438,310
Professional services	3.82	798,380
Insurance	5.33	1,113,970
 Total Inputs	 667.45	 139,497,050
Value Added		
Employee compensation	137.88	28,816,920
Proprietary income	535.34	111,885,224
Other income	133.8	27,971,306
Indirect business taxes	79.13	16,538,170
 Total Value Added	 886.18	 185,211,620
Total Industry Outlay	1,553.63	324,708,670

Appendix Table 3. Washington Cow-Calf Production Function Input and Their Associated IMPLAN Sector.

Sector Names	IMPLAN		State Aggregation
	Sector Number	IMPLAN Sector Description	
Inputs			\$
Hay	10	All other crop farming	56,430,000
Grain	47	Animal Food Manufacturing	4,294,950
Salts and minerals	47	Animal Food Manufacturing	4,880,150
Veterinary inputs medicines,	160	Pharmaceutical and medicine	5,346,220
Veterinary Services	449	Veterinary Services	3,916,660
Trucking Services	455	Business Support Services	3,728,560
Fuel	142	Petroleum Refineries	6,756,970
Reproduction Bulls	18	Agriculture support activities	12,780,350
Repairs	42	Maint. of Farm and non farm	18,105,670
Supplies, misc	257	Farm Equip and Mach. Mnfc.	6,198,940
Sales Commissions			7,438,310
Check-off and marketing	447	Advertising and Related Services	497,420
Insurance	428	Insurance agencies	1,113,970
Professional services			798,380
Rents and Leases			7,210,500
Value Added			
Employee compensation			28,816,920
Proprietary income			111,885,224
Other property income			27,971,306
Indirect business taxes			16,538,170
Total			324,708,670

Appendix Table 4. Feedlot Annual Revenues and Costs per Feeder¹

Income	\$ per feeder
Feeder steer/heifer	2,001.25
Gross Income	2,001.25
Variable Costs	
Cattle Purchases	1,265.32
Hay and roughages	134.17
Corn and grains	240.05
By products (potatoes, distillers corn, etc.)	119.19
Salt and Minerals	11.63
Veterinary health pharmaceuticals	22.04
Veterinary services	4.11
Trucking Services	11.59
Fuel	12.18
Repairs - maintenance	15.66
Supplies, misc	4.28
Check-off and Brand Inspection	2.00
Interest	4.37
Labor	31.27
Labor benefits	10.18
Professional services	2.47
Sub-Total Variable Costs	\$1,890.51
Fixed Costs	
Annual capital cost	83.57
Taxes	1.69
Insurance	0.57
Total Fixed Costs	\$85.83
Total Cost	\$1,976.34
Income over all costs	\$24.91

¹ Source 2014 Economic Contribution Study Feedlot Sector Survey

Appendix Table 5. Washington Feedlot Production Function in Input Output Accounting

Sector Names	Feedlot per Head	Feedlot Aggregation
Inputs	\$	\$
Cattle Purchases	1,265.32	617,476,160
Hay and roughages	134.17	65,474,960
Corn and grains	240.05	117,144,400
By products (potatoes, distillers corn, etc.)	119.19	58,164,720
Salt and Minerals	11.63	5,675,440
Veterinary health pharmaceuticals	22.04	10,755,520
Veterinary services	4.11	2,005,680
Trucking Services	11.59	5,655,920
Fuel	12.18	5,943,840
Repairs - maintenance	15.66	7,642,080
Supplies, misc	4.28	2,088,640
Check-off and Brand Inspection	2.00	976,000
Professional services	2.47	1,205,360
Insurance	0.57	278,160
 Total Inputs	 1,845.26	 900,486,880
Value Added		
Employee compensation	41.45	20,227,600
Proprietary income	90.28	44,056,640
Other income	22.6	11,014,160
Indirect business taxes	1.69	824,720
 Total Value Added	 155.99	 76,123,120
Total Industry Outlay	2,001.25	976,610,000

Appendix Table 6. Washington Feedlot Production Function Input and Their Associated IMPLAN

Sector Names	IMPLAN		State Aggregation \$
	Sector Number	IMPLAN Sector Description	
Inputs			
Feeder cattle purchases			617,476,160
Hay	10	All other crop farming	65,474,960
Grain	47	Animal Food Manufacturing	117,144,400
Salts and minerals	47	Animal Food Manufacturing	5,675,440
By product feeds			58,164,720
Veterinary inputs medicines,	160	Pharmaceutical and medicine	10,755,520
Veterinary Services	449	Veterinary Services	2,005,680
Trucking Services	455	Business Support Services	5,655,920
Fuel	142	Petroleum Refineries	5,943,840
Repairs	42	Maint. of Farm and non farm	7,642,080
Supplies, misc	257	Farm Equip and Mach. Mnfc.	2,088,640
Check-off and marketing	447	Advertising and Related Services	976,000
Insurance	428	Insurance agencies	278,160
Professional services			1,205,360
Value Added			
Employee compensation			20,227,600
Proprietary income			44,056,640
Other property income			11,014,160
Indirect business taxes			824,720
Total			976,610,000