Final Report

Economic Impacts of Alternative Changes to the FDA Regulation of Animal Feeds to Address the Risk of Bovine Spongiform Encephalopathy

Contract No.
223-98-8002
Task Order 12

Submitted to:
Economics Staff
Office of Policy and Planning
Office of the Commissioner
Food and Drug Administration
Rockville, MD 20857

Submitted by:
Eastern Resarch Group, Inc.
110 Hartwell Ave.
Lexington, MA 02421

July 25, 2005

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EXECUTIVE SUMMARY

FDA considered modifying its rules governing animal feed by supplementing or expanding the 1997 rule restricting the feeding of mammalian protein (except for porcine and equine protein) to ruminant animals. As one alternative, FDA considered prohibiting the following:

- Specified risk materials (SRM),
- Mechanically separated (MS) beef,
- Materials from dead or non-ambulatory cattle or from cattle that died by means other than slaughter at an inspected slaughter establishment, and
- Tallow containing more than 0.15 percent hexane-insoluble impurities from inclusion in any animal feed.

This study examines the impacts of these items on the affected agricultural and food industries.

THE SRM BAN IMPACTS

Slaughterers. The SRM prohibition (and encompassing the other prohibited bovine products) will require slaughterers to separate SRM from other ruminant offal and dispose of the material. Table ES-1 summarizes the revenue losses and costs incurred by slaughterers for SRM removal during slaughtering, and the revenue losses and disposal costs applicable for handling dead and downer cattle.

Slaughterers will need to invest in substantial plant modifications to construct separate material handling systems for SRM that are being sent for disposal. They will also hire additional labor to remove SRM during animal processing. Smaller facilities are much less mechanized and will undertake modest capital investments.

The processing and disposal of SRM might occur in several different ways. For this analysis, ERG assumed that SRM will be rendered, and the tallow recovered. The meat and bone meal (MBM) produced by the rendering process will then be landfilled or burned for fuel value.

- Slaughterers are forecast to make capital investments of $26.5 million, which translates to $3.8 million in annualized capital costs (annualized at 7 percent over 10 years), in order to separate SRM and send them for rendering/disposal. Further, slaughterers will require additional labor for the kill floor and fabrication operations, incurring the relevant incremental labor costs. These costs will add $9.2 million in annual expenses. The combined incremental capital and labor costs for in-plant changes at slaughtering plants will generate incremental costs estimated at approximately $13.0 million per year.

Table ES-1. Prospective Annual Costs for Slaughtering Modifications, Rendering-for-Disposal, and Disposal of Deads and Downers

Quantity and Cost Factors	SRM from Slaughterers	Deads and Downers	Total
Unprocessed SRM quantity (000 lbs)	1,423,044	692,150	2,115,194
Prospective MBM yield (000 lbs)	223,959	150,225	374,184
Incremental annualized in-plant slaughter costs ($)	$12,986,429	NA	$12,986,429
Approximate rendering for disposal processing cost, per cwt of raw material (a)			
Minimum ($)	$4.00	$4.00	$4.00
Maximum ($)	$7.00	$7.00	$7.00
Incremental SRM transportation cost per cwt (b)			
Minimum ($)	$1.00	$1.00	$1.00
Maximum ($)	$1.75	$1.75	$1.75
Incremental transportation cost per cwt for non-SRM rendering inputs (c)			
Minimum ($)	$0.05	$0.05	$0.05
Maximum ($)	$0.10	$0.10	$0.10
Aggregate rendering and transportation estimates			
Minimum ($)	$71,863,710	$29,154,913	$101,018,623
Maximum ($)	$125,939,373	$51,093,263	$177,032,636
Landfill cost per rendered MBM cwt (d)			
Minimum ($)	$2.00	$2.00	$2.00
Maximum ($)	$4.00	$4.00	$4.00
Aggregate landfilling cost			
Minimum ($)	$4,479,183	$3,004,500	$7,483,683
Maximum ($)	$8,958,366	$6,009,000	$14,967,366
Disposal costs for deads and downers ($)	NA	$2,107,967	$2,107,967
Recovered tallow value (from Table 2-2)	$38,409,484	$17,889,930	$56,299,414
Net costs, all category costs less recovered tallow value			
Minimum ($)	$50,919,838	$16,377,449	$67,297,287
Maximum ($)	$109,474,684	$41,320,299	$150,794,983

(a) Estimated by ERG. See text.
(b) Estimated by ERG based on information assembled from industry. See text.
(c) Incremental costs for material disposal from SRM facilities. See text.
(d) Incremental transportation costs for moving material from the dedicated SRM renderer to the landfill are assumed to be included in the landfill cost assumption.
NA=Not available Source: ERG estimates, with inputs as described.

- Slaughterers will also lose payments from renderers for the raw material value of SRM for rendering and will need to pay for SRM disposal. ERG has judged that it is likely that they will also pay to have the material rendered prior to disposal. To approximate these combined costs, ERG estimated the transportation, processing, and landfilling costs associated with disposal of SRM. These losses will cost slaughterers $50.9 million to $109.5 million per year (see slaughterer column of table ES-1).

- Rendering for disposal is forecast to cost less than alternative SRM disposal methods. If alternative methods are used, such as where there are no cost-effectively located rendering-for-disposal services, the alternatives might increase the overall societal expense of disposal.

- If slaughterers are unable to pass costs either backward to cattle producers or forward to consumers, approximately 9 to 17 slaughterers, mostly small establishments, are forecast to cease operations. However, slaughterers will have considerable potential for passing costs backward to animal producers and forward to consumers.

- If all costs are passed forward, the SRM option is forecast to generate a $0.0024 to $0.0053 per lb increase in beef prices and a reduction in the annual slaughter of 18,900 to 40,600 head out of the roughly 35.3 million annual kill.

Renderers. FDA's possible SRM option requires the use of separate rendering facilities for SRMs, prohibits the inclusion of MBM feed in animal feed, sets standards for tallow use, and requires renderers to keep records, label products appropriately, and mark rendered SRM products with a dye to prevent its use in animal feed. These requirements will impact renderers in the following ways:

- Under the SRM option, ERG forecasts that renderers will convert some facilities to handling of only SRM. They will presumably be paid for this service by slaughterers. Because landfilling of raw cattle parts is prohibited in many states, much SRM material is likely to be rendered first. These SRM rendering facilities will replace their normal rendering revenues with those from dedicated SRM rendering charges.

- The SRM option also prohibits the inclusion of MBM from dead or downer cattle in animal feed. Renderers now routinely pick up many such animals from animal producers, feed lots and other locations, with the cost of removal partially or fully offset by the value generated by MBM and tallow production from the carcasses. With the elimination of productive use for the animals, renderers will increase pickup fees and many more animal producers will seek to dispose of dead animals on their own property.

- The removal of SRM (including dead and downer cattle) from productive rendering flows will reduce aggregate MBM volumes (excluding poultry) by 6.1 percent. If tallow from SRM were also to be excluded from productive use, total tallow production from renderers is estimated to decline by 3.5 percent.

- The forecast that renderers will dedicate facilities to SRM rendering for disposal is important. In regions where such facilities are not dedicated and SRM are not rendered, these raw materials will be lost from productive use. Relevant processing and disposal charges are likely to exceed those estimated here.

- FDA's SRM option does not prohibit the use of tallow produced from SRM source materials as long as the tallow impurities are below 0.15 percent. While this specification is widely used in the industry, some renderers have not yet upgraded their operations to meet the specification. To achieve compliance with this option, ERG estimated that some renderers would need to buy polishing centrifuges at an aggregate annualized cost of $2.4 million per year.

- Recordkeeping and labeling costs of the SRM option language are estimated to cost about $62,000 a year, while the marking of rendered SRMs are expected to cost renderers between $20,000 and $146,000 annually.

- One rendering facility is expected to close as a result of the incremental costs due to tallow restrictions combined with the requirements for recordkeeping, labeling, and SRM marking.

Farmers and animal producers. The loss of value of MBM generated from deads and downers will reduce the number of carcasses rendered for disposal. As a result, 149,000 animals previously rendered for disposal will now be buried on-site. This will cost farmers and other animal production operations $2.1 in annual costs.

4D and mechanically separated (MS) beef. Approximately twenty renderers and "4-d" companies supply red meat and mechanically separated (MS) beef to the pet food industry. These firms collect dead and dying and remove the most valuable meat. They might also operate mechanical separation equipment to produce beef from the animal carcass. The SRM option would prohibit the sale of beef from animals that died other than from the slaughtering process at an inspected slaughterer. The loss of meat sales (both hand-carved and MS beef) will adversely affect these operations. The loss of both main products is estimated to subtract $75 million per year from the agricultural economy.

Consumer impacts. ERG used a market model of the meat market to forecast the price changes for consumers, and impacts on the various components of industry as a result of incremental costs for slaughterers. The SRM option compliance costs range from $0.0024 per pound (wholesale weight) under the minimum cost estimate, to $0.0053 per pound under the maximum cost estimate. This will result in a price increase ranging from 0.09 percent to 0.19 percent in the price of beef, and a 0.05 percent to 0.11 percent decrease in domestic beef consumption.

Total Costs. Table ES-2 presents the combined costs of the SRM option. Adding recordkeeping, labeling and other cost components to the slaughtering and rendering costs generates a compliance cost total estimated to range from $144.8 million to $228.4 million per year.

Table ES-2. Total Cost Impacts of the SRM Option ($/yr)

Cost Element	Minimum	Maximum
SRM restrictions (including deads and downers)	$67,297,287	$150,794,983
Other regulatory elements		
Tallow impurity restrictions	$2,433,699	$2,433,699
Recordkeeping and labeling	$62,333	$62,333
SRM marking	$19,889	$146,312
4D meat and MS beef bans	$75,000,000	$75,000,000
Total	$144,813,209	$228,437,328

SECTION ONE

POTENTIAL FEED RULE CHANGES AND INTRODUCTION TO AFFECTED AGRICULTURAL AND INDUSTRIAL SECTORS

As of August 2004, the US Food and Drug Administration is considering new restrictions on animal feed ingredients. Any new requirements will supplement restrictions on animal protein implemented in August 1997, which restricted certain mammalian protein (excluding porcine and equine protein) from being used in feed to ruminant animals. Feed manufacturers were also required to ensure that restricted proteins were not commingled with other feed materials given to ruminant animals.

FDA considered a new requirement (21 CFR 589.2001) whereby bovine materials will be prohibited in animal feed. Bovine materials include specified risk materials (SRM), mechanically separated (MS) beef, materials from dead or non-ambulatory cattle or from cattle that died by means other than slaughter at an inspected slaughter establishment, and tallow containing more than 0.15 percent hexane-insoluble impurities from inclusion in any animal feed.

For presentation purposes, ERG refers to the principal regulatory requirements of the prohibited materials under the common term of an “SRM ban” or “SRM option.” Included in the list of prohibited materials would be tallow with impurities exceeding a new specification, MS beef, and materials from non-ambulatory disabled cattle and dead cattle. Because the most significant impacts spring from the ban on SRM use, however, the term “SRM ban” is used in this report to refer to a possible regulation that encompasses all these elements. Nevertheless, each of the individual elements mentioned above are also discussed and analyzed separately.

ERG also investigated the requirements of two alternative forms of the regulation. One alternative requires the prohibition of blood and blood products from use in ruminant feed. The second alternative requires that dedicated equipment and facilities be used to manufacture, process, blend, or distribute products containing ruminant or non-ruminant materials in order to prevent cross-contamination.

This section introduces basic data on participants in the affected agricultural sectors. The analysis covers both the regulatory elements described above and the sectors affected by the alternative regulatory options.

1.1 Producers of Ruminant and Non-ruminant Animals

A range of large and small animal producers will be either favorably or adversely affected by an SRM ban. The bulk of animals slaughtered in the US are now produced in large operations, although numerous medium and small corporate and family-owned farms still exist. Tables 1-1 and 1-2 present information on animal production levels at farms of various sizes. Many large operations are integrated through animal producing, slaughtering, and rendering.

In general, the extension of prohibitions on ruminant protein will reduce the value at slaughter of cattle, and increase the value at slaughter of pork and poultry.

Table 1-1. Cattle and Calves Production and Slaughter, By Size of Farm

Farms with	Number of Farms, 1997		No. of Animals Sold, 1997		Farms in 2002	Animals Slaughtered (2002)
	Total	% of Total	Total	% of Total		
1 to 9	333,951	15.1%	1,631,739	2.2%	320,892	814,228
10 to 19	220,749	10.0%	3,004,501	4.1%	212,117	1,499,228
20 to 49	254,101	11.5%	7,735,683	10.4%	244,165	3,860,061
50 to 99	107,245	4.8%	7,231,639	9.8%	103,051	3,608,546
100 to 199	51,676	2.3%	6,928,595	9.4%	49,655	3,457,328
200 to 499	29,612	1.3%	8,693,181	11.7%	28,454	4,337,846
500 to 999	8,451	0.4%	5,631,577	7.6%	8,121	2,810,124
1,000 to 2,499	4,115	0.2%	5,977,068	8.1%	3,954	2,982,522
2,500 to 4,999	944	0.0%	3,150,800	4.3%	907	1,572,231
5,000 or more	965	0.0%	24,104,263	32.5%	927	12,027,886
Total	**1,011,809**	**45.7%**	**74,089,046**	**100.0%**	**972,243**	**36,970,000**
All Farms	**2,215,876**	**100.0%**			**2,129,226**	**-**

Note: Totals might not add due to rounding
Source: Farm and animals sold data from USDA 1999a. The slaughter totals are from USDA 2003a. Farm totals are from USDA 2004.

Table 1-2. Hogs and Pigs Production and Slaughter, By Size of Farm

Farms with	Number of Farms, 1997		No. of Animals Sold, 1997		Farms in 2002	Animals Slaughtered (2002)
	Total	% of Total	Total	% of Total		
1 to 24	26,538	1.2%	235,511	0.2%	25,500	165,765
25 to 49	8,501	0.4%	301,092	0.2%	8,169	211,924
50 to 99	8,706	0.4%	608,499	0.4%	8,366	428,293
100 to 199	9,597	0.4%	1,325,335	0.9%	9,222	932,839
200 to 499	15,037	0.7%	4,745,557	3.3%	14,449	3,340,168
500 to 999	11,967	0.5%	8,378,741	5.9%	11,499	5,897,390
1,000 to 1,999	9,863	0.4%	13,381,312	9.4%	9,477	9,418,458
2,000 to 4,999	6,784	0.3%	20,225,092	14.2%	6,519	14,235,463
5,000 or more	5,113	0.2%	93,410,743	65.5%	4,913	65,747,300
Total	**102,106**	**4.6%**	**142,611,882**	**100.0%**	**98,113**	**100,377,600**
All Farms	**2,215,876**	**100.0%**			**2,129,226**	**-**

Note: Totals might not add due to rounding
Source: Farm and animals sold data from USDA 1999a. The slaughter totals are from USDA 2003a. Farm totals are from USDA 2004.

1.2 Animal Slaughtering

This section presents a profile of the slaughtering industry. First, ERG uses Census data to characterize the entire animal slaughter industry by establishment size, geographical concentration, and product output. In the second section, ERG focuses specifically on cattle slaughtering and processing using data presented in a preliminary BSE analysis conducted by USDA's Food Safety and Inspection Service (FSIS). In the final section, ERG presents the distribution of federally inspected plants classified by the number of head slaughtered as reported by USDA's Livestock Slaughter 2003 Summary.

Establishments engaged in the slaughter of cattle, hogs, sheep, lambs, calves, and horses for human consumption fall in the NAICS industry 311611, Animal (Except Poultry) Slaughtering.[1] Animal slaughterers primarily slaughter livestock and process meat into products for further processing or for final sale to consumers. These establishments may also cook, can, cure, and freeze the meat after slaughtering. Some industry establishments manufacture prepared feeds and feed ingredients for animals (except dogs and cats). These establishments may perform slaughtering operations to manufacture the animal feed as well.

Establishments engaged in processing or preserving meat and meat byproducts (but not poultry or small game) from purchased meats are classified in NAICS 311612. Many of the processing and canning operations are essentially identical to those undertaken in the animal slaughter industry (NAICS 311611). Processors, however, do not slaughter animals but purchase its meat inputs from other facilities. The meat processors are presumed not to handle SRM and are excluded from the analysis.

In 2001, the animal slaughtering industry comprised of over 2,100 establishments, employing almost 156,000 workers with payroll expenditures of over $4.1 billion (U.S. Census Bureau, 2004). The industry's value of shipments for that year was over $60 billion (U.S. ITA, 2004).

Table 1-3 presents the establishments by employment size class for NAICS 311611 in 2001. Almost 50 percent of establishments in the animal slaughtering industry have between 1 and 4 employees. More than 80 percent of establishments employ fewer than 20 workers. According to the Small Business Administration's (SBA) size standard data, establishments in the animal slaughtering industry are classified as small if they employ fewer than 500 employees (U.S. SBA, 2004). Only 4 percent of establishments in NAICS 311611 are large; the remaining 96 percent of establishments (2,042 establishments) are small businesses.

The 1997 Economic Census presents detailed data on value of shipments and value added by employment size class, as well as data on geographical distribution and output by product class. Since 2002 Economic Census data is not yet available, ERG used 1997 data to characterize the animal slaughtering industry by size, location, and product.

[1] For this industry, the *1997 Economic Census* did not fully implement the conversion from the SIC to the NAICS system. Therefore the 1997 Census data for NAICS 311611 does not include SIC 0751, which consists of establishments engaged in custom slaughtering. Nevertheless, the SIC and NAICS data for this industry are comparable (within 3 percent).

Table 1-3. Number and Percent of Slaughtering Establishments by Employment Size Class in NAICS 311611, 2001

Establishment Size Class	Number of Establishments	Percent of Total
1 to 4 employees	1,035	49.03%
5 to 9 employees	428	20.27%
10 to 19 employees	243	11.51%
20 to 49 employees	164	7.77%
50 to 99 employees	77	3.65%
100 to 249 employees	57	2.70%
250 to 500 employees	38	1.80%
500 to 999 employees	13	0.62%
More than 1,000 employees	56	2.65%
Total	**2,111**	**100.00%**

Source: U.S. Census Bureau, 2004.

Table 1-4 portrays the relative importance to the industry of different establishment size categories. In 1997, more than a thousand establishments—72 percent of the total—had fewer than 20 employees each, employed less than 5 percent of the industry workforce, and contributed an even smaller percentage of value added and value of shipments to the industry. Conversely, while the 39 establishments employing between 1,000 and 2,500 workers made up only 3 percent of the total number of establishments, they provided 43 percent of industry employment and 55 percent of value added by manufacture. Forty-six percent of the value of shipments in this industry also came from these facilities.

Table 1-4. Statistics by Employment Size, NAICS 311611, 1997

Employment Size Class	Number of Establishments[2]	Number of Employees	Value Added by manufacture ($ millions)	Value of Shipments ($ millions)
1 to 19 employees	1,007	5,990	220	1,081
20 to 99 employees	220	10,324	602	2,758
100 to 249 employees	64	9,833	729	4,133
250 to 999 employees	54	26,926	1,936	10,047
1,000 to 2,499 employees	39	61,833	4,706	24,892
More than 2,500 employees	9	27,468	331	11,590
Total	**1,393**	**142,374**	**8,525**	**54,501**

Source: U.S. Census Bureau, 1999.

Table 1-5 presents the value of shipments for selected animal slaughter industry primary products in 1997. Beef products made up approximately 55 percent of total shipments; boxed beef represents over half of all beef production (30 percent of total shipments). Pork products made up 34 percent of shipments; of $17 billion in total pork product shipments, products requiring further processing such as curing and sausage making accounted for approximately 30 percent. The remainder of shipments consisted primarily of veal and lamb products, with a small fraction accounted for by hides, skins, and pelts. Miscellaneous byproducts of meatpacking

[2]Custom slaughterers (SIC 0751) are not included in the 1997 Economic Census but are included in the 2001 County Business Patterns. Therefore the number of establishments reported for 1997 and 2001 differ significantly.

plants, including tallow, stearin, killing floor offal, scrap, and bones, and animals slaughtered for pet food comprised 1.8 percent of value of shipments in 1997.

Table 1-5. Output by Selected Product Codes, NAICS 311611, 1997

NAICS Product Code	Product Description	Value of Product of Shipments ($ millions) [a]
311611	**Animal slaughtering products, except poultry**	**50,781**
3116111	**Fresh and frozen beef, not canned or made into sausage, made from animals slaughtered in this plant**	**28,209**
31161111	Fresh and frozen whole carcass and half carcass beef, not canned or made into sausage, made from animals slaughtered in this plant	6,734
31161113	Fresh and frozen subprimal and fabricated cuts packaged in plastics (boxed beef), not canned or made into sausage, made from animals slaughtered in this plant	15,465
31161115	Fresh and frozen boneless beef, including hamburger, not canned or made into sausage, made from animals slaughtered in this plant	3,272
311611A	**Fresh and frozen pork, not canned or made into sausage, made from animals slaughtered in this plant**	**11,812**
311611A121	Fresh and frozen primal and fabricated cuts (including trimmings), not canned or made into sausage, made from animals slaughtered in this plant	10,249
311611G	**Pork, processed or cured (not canned or made into sausage), made from animals slaughtered in this plant**	**3,305**
311611J	**Sausage and similar products (not canned), made from animals slaughtered in this plant**	**1,998**
311611P	**Hides, skins, and pelts**	**2,068**
311611T	**Miscellaneous byproducts of meat packing plants**	**906**

Source: U.S. Census Bureau, 1999.
[a] Value of shipments by product class is not the same as value of shipments by industry. Value of shipments by industry includes all products from establishments classified as animal slaughtering plants, whether those products are primary to the industry or not; value of shipments by product class includes all shipments of that product regardless of the industry classification of the establishment.

1.2.1 Cattle Slaughtering and Processing – FSIS Data

FSIS's Preliminary Analysis of Interim Final Rules And An Interpretive Rule to Prevent the BSE Agent from Entering the U.S. Food Supply profiles the cattle slaughter and processing industry (USDA/FSIS, 2004).

According to the report, 98.7 percent of cattle in 2003 were slaughtered and processed at federally inspected establishments. FSIS estimates that 84 percent of the 4,033 slaughtering and processing establishments under federal and state inspection deal with SRM. Table 1-6 characterizes these 3,388 establishments by inspection status and size using information from the FSIS analysis.

As can be seen from the table, 26 percent of cattle slaughtering or processing establishments dealing with SRM are state inspected while the remaining (74 percent), are federally inspected. Of the federally inspected establishments, approximately 700 establishments perform only slaughter or have slaughtered and further processed at least one head of cattle. Sixty-three percent of these inspected establishments have less than 10 employees and 36 percent have between 10 and 499 employees. Together, these very small and small establishments account for only 6 percent of slaughtered and processed cattle. Less than 2 percent of establishments have more than 500 employees. These large establishments slaughter and process 94 percent of all cattle processed.

1.2.2 Number of Plants and Head Slaughtered

USDA's National Agricultural Statistical Service publishes annual Livestock Summary reports. According to the latest report, there were almost 700 federally inspected cattle slaughter plants in 2003 and almost 300 calf slaughter plants. Together these plants slaughtered more than 36 million head.

Table 1-7 presents the number of cattle slaughter plants by the number of head slaughtered and Table 1-8 presents the same data for calves. While 74 percent of cattle slaughter plants slaughtered less than 1,000 head each, this size group accounted for less than 1 percent of cattle head slaughtered. Plants slaughtering more than 300,000 head each accounted for 84 percent of all head slaughtered. Similarly, for calves, 75 percent of plants slaughtered less than 100 head each, only accounting for 0.25 percent of head slaughtered. The larger plants, slaughtering more than 10,000 head per plant slaughtered more than 90 percent of calves.

1.3 Integrated Packer/Renderers

Many of the largest animal slaughtering operations are integrated with rendering operations. Thus, the same entity captures the meat value and the value of animal by-products. At these operations, the slaughtering operation removes meat and other valuable animal parts from the carcass and then transfers the animal offal (parts not used for human food) to the rendering operation. The integrated facilities are specialized in slaughtering and rendering of a single animal species.

Integrated facilities also capture blood from slaughtered animals and process it into blood meal. The blood meal consists primarily of dried blood that is then used as a protein additive in feed. Some integrated facilities also host other companies that separately manufacture plasma-based protein products.

Integrated packer/renderer operations have several economic advantages over independent rendering operations. The on-site slaughtering operations provide a consistent, single-species source of raw materials to the renderer. The rendering operation incurs essentially no transportation costs to acquire raw materials. Also, the larger volume of these operations sometimes allows more cost-effective capture of animal by-product materials for relatively specialized operations. For example, cattle by-products used for specialized pharmaceutical uses are more likely to be harvested at integrated operations than at independent renderers.

Table 1-6. Cattle Slaughtering and Processing Establishments, 2003

	Number of Establishments	Percent of Total	Percent of Cattle
Establishments performing slaughtering or further processing beef	3,388	100%	100%
Inspection Breakdown			
State inspected slaughtering only establishments [a]	888	26%	NA
Federally inspected slaughtering or further processing establishments	2,500	74%	NA
Federally inspected slaughtering only establishments [a]	711	21%	NA
Size Breakdown			
Very small establishments (fewer than 10 employees)	2,128	63%	1%
Small establishments (10 to 499 employees)	1,203	36%	5%
Large establishments (more than 500 employees)	57	2%	94%

[a] Number of establishments that annually slaughtered only or slaughtered and further processed at least 1 head of cattle (including calves).
Note: Totals may not sum due to rounding.
Source: USDA/FSIS, 2004.

Table 1-7. Number of Federally Inspected Plants and Head Slaughtered, Cattle, 2003.

Size Group	**Number of Plants**	**Percent of Total**	**Number of Head (1,000)**	**Percent of Total**
1 – 999	508	73.73%	163.7	0.46%
1,000 – 9,999	89	12.92%	299.0	0.85%
10,000 – 49,999	26	3.77%	624.4	1.77%
50,000 – 99,999	11	1.60%	790.1	2.24%
100,000 – 199,999	12	1.74%	1,792.7	5.08%
200,000 – 299,999	8	1.16%	2,016.6	5.72%
300,000 – 499,999	11	1.60%	4,409.6	12.50%
500,000 – 999,999	9	1.31%	5,344.2	15.15%
1,000,000 – 1,499,999	13	1.89%	16,492.2	46.76%
More than 1,500,000	2	0.29%	3,338.7	9.47%
Total	**689**	**100.00%**	**35,271.3**	**100.00%**

Note: Totals may not sum due to rounding.
Source: USDA/NASS, 2003.

Table 1-8. Number of Federally Inspected Plants and Head Slaughtered, Calves, 2003.

Size Group	Number of Plants	Percent of Total	Number of Head (1,000)	Percent of Total
1 – 99	218	75.17%	2.5	0.25%
100 – 999	33	11.38%	10.8	1.09%
1,000 – 9,999	18	6.21%	71.0	7.17%
10,000 – 24,999	7	2.41%	104.1	10.51%
25,000 – 49,999	6	2.07%	233.4	23.56%
50,000 –749,999	5	1.72%	309.6	31.26%
More than 750,000	3	1.03%	259.1	26.16%
Total	**290**	**100.00%**	**990.5**	**100.00%**

Note: Totals may not sum due to rounding.
Source: USDA/NASS, 2003.

1.3.1 Independent Renderers

The typical independent operations collect and process multi-species raw materials from a variety of sources including medium and small slaughterhouses (packers), deadstock from animal producers, including medium and small farms, meat processing plants, grocery store butcher shops and large restaurants, pet food manufacturers, and other sources that provide protein-rich raw materials. The independent render generally operates a fleet of collection trucks and provides an essential animal or waste product disposal service for its customers. Many independent renderers sell a mixed-species MBM product or a partially processed protein mix, which usually includes or is presumed to include ruminant protein, to feed mills or to protein blenders. The latter might mix protein sources from several sources and perform further processing.

Independent renderers might produce blood meal, but do so only at selected locations, such as where they have a relatively large and stable source of animals from whom blood can be extracted and where they have established a market for their output. For example, among contacts made for this study, one independent renderer that operates a string of rendering facilities reported producing blood meal at only one plant. At least three other large independent renderers do not produce blood meal.

As producers of ruminant-containing MBM, the independent renderers operate at an economic disadvantage to the much larger scale of the integrated packer/renderers. They must support the costs of a collection truck fleet (often operating over a service radius of several hundred miles), they have less consistent raw material inputs to their processes, and the number of small and medium packers have been declining.

Prior to the development of concerns over BSE in the 1990s, it had been common for renderers to pay many of their suppliers for their raw materials, with the size of the payment varying with market conditions. Competition among renderers and the value of the raw material as a processing input generated positive values for raw material suppliers. ERG presumes that with reduced ruminant protein values, however, renderers are generally charging suppliers for raw material pickups. Some suppliers of raw material, however, might be paid for supplying large quantities of raw material to renderers.

As renderer pick-up charges for dead animals have increased over time, and some small independent renderers have closed operations, renderers collections of fallen animals have declined since the early 1990s. While exact statistics do not exist, various renderers estimated for ERG that renderers pick up only 30 to 60 percent of dairy cow deadstock and a much smaller percentage of beef cattle deadstock.

Over the last decade, there has been considerable consolidation in the industry and the number of independent rendering facilities has declined. In the mid 1990s, this figure was approximately 280. A more current database, the FDA database of inspection reports, indicates that there are 238 rendering facilities, including all packer renderers and independent renderers. ERG has also made use of the 2001 County Business Patterns data for the economic analysis. This source posits 228 rendering facilities.

1.4 Plasma Protein Producers

Among a number of specialized users of animal-based raw materials, approximately ten firms produce blood plasma-based products from animal sources. According to the membership of the Spray-Dried Blood and Plasma Protein Producers Association, these firms manufacture therapeutic products, specialized milk replacers, and feed additives from animal blood. These operations capture blood immediately upon the killing floor of the slaughterhouse and refine the material to separate plasma from the red blood cells. Most of these entities are distinct from the large integrated packer/renderer operations.

1.5 Transporters of Agricultural Products

Agricultural companies use their own trucks or contractors to move commodities for processing or to final use. This analysis considers an alternative FDA requirement for dedicated facilities and equipment, which could apply to transportation operations as well, generating impacts for transporters.

The US Census of Transportation provides data on the number of trucks registered in agriculture and, more specifically, on the trucks transporting animal feed. Animal feed in this instance includes MBM. A truck is designated as an animal feed carrier if that use accounts for a majority or a plurality of its trips. Trucks are also counted according to the sector of ownership. ERG examined data for trucks in the agricultural sector and trucks in the for-hire category. The data presented from the US Census in this report is derived from the 1997 Census. The 2002 Census will be published later in 2004.

Overall, there were 3.4 million trucks in the agricultural sector and an additional 1.1 million for-hire trucks that are considered in the analysis in Section Three. Table 1-9 summarizes the truck census information. The data indicate that a large number of trucks of various types are affected, although some further questions about the population remain to be considered. For example, while the designation of “animal feed use” is pertinent, there are likely to be many additional trucks that sometimes carry animal feed but are used predominantly for other uses. The share of all trucks falling into this category is not known.

The coverage of pickup and panel trucks in the agricultural sector is uncertain because these vehicles might be carrying either bulk or bagged animal feed.[3] The possible FDA requirements for dedicated equipment are presumed only to apply to vehicles carrying bulk feed. In the course of conversations with industry personnel about transportation impacts, ERG inquired about the frequency with which farmers use their personal pickups for transporting bulk feed. (These conversations are summarized in Section Three.) While responses varied, respondents noted that farmers in some areas transport bulk animal feed in their pickups. No data specific to panel trucks was obtained. Overall nearly 400,000 vehicles are potentially affected by the FDA regulation.

1.6 Feed Mills

Feed mills combine various ingredients into a variety of formulae for consumption by animals. They may handle prohibited ruminant and/or non-prohibited protein sources along with many other feed ingredients. Commercial animal feeds are generally engineered to maximize animal growth or production while minimizing feed costs. Nutritionists employed by commercial mills frequently revise feed mixes in light of ongoing scientific analysis of feed effectiveness and changing commodity prices. The palatability of feed components is also a limiting factor to the inclusion of some ingredients in feeds.

Feeds are also a vehicle for the delivery of medications to animals. FDA licenses mills wishing to include certain categories of medications in animal feed. A majority of mills, however, are not licensed.

Table 1-9. Trucks Potentially Engaged in Agricultural and Animal Feed Uses

Truck Category	Agriculture Sector		For-Hire		Total Carrying Animal Feed Total
	Animal Feed Use	Total	Animal Feed Use	Total	
Pickup trucks	280,953	2,181,581	None reported	39,861	280,953
Panel vans, etc.	24,666	316,798	None reported	83,435	24,666
Single unit (<26,000 lbs)	59,055	607,412	None reported	135,330	59,055
All other single unit (>26,000 lbs)	7,998	108,213	560	55,814	8,558
Truck tractors	14,270	163,759	8,504	744,952	22,774
Total	**386,942**	**3,377,763**	**9,064**	**1,059,392**	**396,006**

Source: US Census Bureau, 2000.

Feeds for dairy cattle generally contain the highest concentrations of protein, although a large share of dairy feeds consist of grain and other materials. Young dairy cattle get especially large

[3] The panel trucks classified as carrying animal feed are assumed to be carrying bagged feed only.

quantities of protein in their feed. Some cattle might be left to roam on grass plains and might not receive any prepared feeds.

The companies mixing animal feed vary in size from multinational agricultural giants to individual farm mixers. The largest feed companies, such as Land o' Lakes and Cargill, operate dozens of mills across large regions of the country. Further, many large animal feeding operations mix feeds for their on-site animal populations, and might be integrated with slaughtering, rendering, and other operations. Many smaller feed companies operate a handful of mills, or even only one. Agricultural cooperatives also operate feed mills, and there are numerous commercial/retail mills that handle a diverse array of farm feeds and supplies. Many individual farms, including some modest-sized operations, are called "on-farm" mixers because they combine their on-farm production (such as their grain harvest) with purchased feed components for the feeds their animals require.

Table 1-10 summarizes a number of feed mill characteristics, as derived from an industry publication's annual survey. The data is based on a voluntary mail survey of feed mill operators and is not based on a statistical survey design. As a result, the accuracy of the survey's portrayal of the feed industry is uncertain. Of particular concern is the potential for uneven participation among very large mills. As the recent years of survey data indicate, such participation appears to have increased over time as the average production per mill has risen substantially (Gill and Lobo, 2004).[4] Further, the survey probably overestimates the scope of activities of numerous very small mills. Despite the apparent imperfections in the survey, ERG has used this survey to indicate the frequency of certain mill practices and for relabeling cost estimates, as needed for the impact analysis. As the table indicates, a majority of mills prepare feed for dairy and beef cattle, a basic parameter for describing mill impacts. (The data does not indicate how many mills feed any ruminant animal.)

The FDA database of inspections has identified approximately 6,100 mills, of which approximately 85 percent are unlicensed mills. Other government data sources, such as the Census of Manufactures, cover feed mills but do not isolate the animal feed producers potentially affected by the FDA regulation. No sources reliably describe the number of on-farm mixers.

[4] Further, FDA reviewers for this report commented that very small mills are underrepresented in the survey. ERG acknowledges a lack of data on the statistical accuracy of the survey results but has not estimated how the survey weaknesses might affect the survey results.

Table 1-10. Feed Mill Characteristics – 1999-2003

	2003 Average	2002 Average	2001 Average	2000 Average	1999 Average
Age of plant, years	26.4	27.0	31.6	31.5	30.5
Capacity, tons/year (tpy)	187,080	186,106	113,692	122,981	89,459
Percent utilization, %	73.0	78.6	69.0	70.5	71.3
Number of employees	17.8	20.8	22.1	23.8	20.9
Shifts per day	2.1	2.1	1.9	2.1	1.9
Number of formulas	291	394	495	573	628
Types of feed [1]					
Beef, %	60.7	61.9	76.8	81.0	87.3
Dairy, %	64.3	58.3	79.3	84.1	93.0
Swine, %	58.9	67.9	81.7	76.2	84.5
Poultry, %	82.1	71.4	84.1	79.4	90.1
Sheep, %	46.4	42.9	67.1	58.7	71.8
Horse, %	44.6	51.2	67.1	69.8	74.6
Pet, %	12.5	10.7	9.8	9.5	11.3
Fish, %	10.7	9.5	12.2	11.1	15.5
Ratite, %	19.7	21.4	32.9	38.1	47.9
Production efficiency, man-hours/ton	0.45	0.47	0.63	0.54	0.77

[1] Percent of feed plant operators who report manufacturing feed by livestock class.
Source: (Gill and Lobo, 2004).

SECTION TWO

REGULATORY IMPACTS ON AGRICULTURAL SECTORS

This section examines impacts of the SRM Ban. ERG generated much of the information for this section through discussions with slaughterers, renderers, and manufacturers of other affected agricultural products. In order to avoid revealing facility plans or any other potentially confidential business information, the individuals contacted are not identified. ERG gratefully acknowledges the assistance of numerous agricultural industry executives.

2.1 Defining the SRM Quantities Generated in Slaughtering

In January 2004, USDA's FSIS issued an interim final rule prohibiting the use of SRM in human food (USDA, 2004). Under this rule, slaughterers are required to remove SRM, segregate them from meat products used for human food, and arrange for their disposal. Under FDA's possible regulation, SRMs are prohibited from use in animal feed. Hence, FDA will be requiring slaughterers to further separate SRM from other offal that may be used for animal feed. To comply with this requirement, slaughterers will have to modify their animal killing operations to arrange for the separation of SRM from other animal offal and delivery of the materials to a disposal or disposal/rendering operation. This change will require investments in modifications to the kill floor, additional labor during slaughtering, changes in the transport of animal byproducts through the slaughtering facility, and payments for disposal or disposal/rendering of the materials.

Until now, most SRM have gone to rendering and contribute to the production of meat and bone meal (MBM) and tallow. Part of the regulatory impact of an SRM ban from rendering is, therefore, the loss of value for SRM from these productive process flows.

FDA's possible regulatory alternative language defines SRM as:

(1) The brain, skull, eyes, trigeminal ganglia, spinal cord, vertebral column (excluding the vertebrae of the tail, the tranverse processes of the thoracic and lumbar vertebrae, and the wings of the sacrum), and dorsal root ganglia of cattle 30 months of age and older.
(2) The tonsils of all cattle;
(3) The distal ileum of all cattle. To ensure effective removal of the distal ileum, the establishment shall remove the entire small intestine, and shall dispose of it.

Under this definition, cows over 30 months of age generate considerably more SRM. To quantify the SRM generation, ERG used estimates provided by Dave Harlan, Byproducts Marketing Manager for Cargill Taylor Beef Business Unit (Harlan, 2004a). [Other sources provide slightly different estimates of SRM weight per cow. ERG judged that the Harlan estimates were reasonably consistent with other estimates and were consistent with other useful elements in his analysis. Some of the other estimates of SRM weights are somewhat higher, such as sources estimating 100 lbs for SRM in older cattle. Weight estimates for specific SRM components are also variable, depending partly on the interpretation of the definition of each SRM component.]

In the estimates presented in Table 2-1, slaughterers are forecast to extract on average 28.3 lbs of SRM from cattle less than 30 months of age and 88.5 lbs from cattle over 30 months of age. The average total cattle weight at slaughter was calculated in 2003 at approximately 1,250 lbs, of which hides and skin represent approximately 5 percent and for which cattle offal represents 34.1 percent (Sparks International, Inc, 2001). This translates to approximately 425 lbs of offal per animal before SRM are removed. Based on these calculations, SRM will represent 6.7 or 20.8 percent of offal of the animal.

The pre-regulatory value of SRM was estimated using a four-year average of byproduct market prices. Thus, MBM was valued at $0.09 cents per lb ($180 per ton) and tallow was estimated at $0.18 cents per lb (Harlan, 2004a). With these assumptions, Table 2-1 also shows the average value of these ingredients in the rendering uses at slightly under $1 for cattle less than 30 months of age and approximately $4.50 for cattle over 30 months of age.

Table 2-1. Estimated Volumes and Value of Specified Risk Material, per Ambulatory Cow Slaughtered

Cattle part	Pounds	MBM Yield (%)	Tallow Yield (%)	MBM Yield (lbs)	Tallow Yield (lbs)
Brain	0.936	6%	5%	0.06	0.05
Spinal cord	0.374	7%	5%	0.03	0.02
Eyes	0.220	15%	10%	0.03	0.02
Dorsal root ganglia	NA	NA	NA	NA	NA
Tonsils	0.300	5%	15%	0.02	0.05
Skull (including trigeminal ganglia)	15.200	44%	11%	6.69	1.67
Vertebral column	36.500	48%	13%	17.52	4.75
Small intestine (incl. distal ileum) - < 30 months (a)	28.000	5%	16%	1.40	4.48
Small intestine (incl. distal ileum) - > 30 months (a)	35.000	5%	16%	1.75	5.60
Total - for cattle not over 30 months (Includes only tonsils and small intestine) (lbs)	28.3	NA	NA	1.42	4.53
Lost value for previously rendered byproducts ($)				$0.13	$0.81
Total - for cattle over 30 months old (lbs)	88.5	NA	NA	26.09	12.15
Lost value for previously rendered byproducts ($)				$2.35	$2.19
Price per lb for byproducts ($)				$0.09	$0.18

NA=Not applicable or not available

(a) The source estimates different values for cattle below or over 30 months of age

Source: Harlan, 2004a. Other sources provide different average weights for various cow parts, with some estimates as high as 100 lbs of material for older cattle.

Table 2-2 presents the estimated quantities of SRM produced per year, adding the quantities of dead and downer cattle to the SRM from slaughtered animals. The SRM calculations were based on the 2003 annual cattle slaughter of approximately 35.3 million animals (USDA, 2004). The table implicitly includes several important assumptions about the current share of dead and downer animals now rendered (Harlan, 2004a). The table also includes ERG's forecasted share of deads and downers that will be rendered as a result of an SRM ban (discussed further in Section 2.3). Aggregating these values over the total volume of cattle offal under an SRM restriction, the calculations show that SRM previously valued at $33.7 million for MBM production will now be sent for disposal. If SRM are not rendered prior to disposal, then $56.3 million worth of tallow will also be sent for disposal. (In general for this analysis, it is assumed that SRMs are rendered and that tallow is recovered for productive use.) With no tallow recovery, the combined lost product value is $90.0 million per year.

The quantity of cattle offal material disposed is not entirely a function of the physical characteristics of the cattle but will itself be affected by the costs and logistics of the SRM separation, processing and disposal systems. With an SRM prohibition, the economics of separating materials might deteriorate sufficiently in some slaughter facilities that there will be insufficient incentive to continue separating usable offal from the SRM. A large slaughterer/renderer commented, for example, that one of their plants handles numerous older cows and might not invest in new capabilities to allow separation. The executive commented that MBM prices will need to exceed $180 per ton in order for separation investments at that facility to be profitable. If they forecast lower prices for MBM, they might choose not to invest in the ability to separate materials. In that case, considerably larger quantities of animal offal will be mixed with SRM and need to be disposed.

Similarly, small slaughterers might have difficulties encouraging their renderers to visit them twice as often. Assuming that FDA requires renderers to use dedicated equipment (i.e., separate trucks) to handle SRM, then the number of renderer transportation stops to cattle slaughterers will need to double, while the combined quantity of raw material has not increased. In lieu of separate collection visits, small slaughterers must discard all animal offal as SRM and the quantity of SRM being sent for processing/disposal will increase beyond the estimates presented here. These estimates are based only on the physical specifications of the cattle.

2.2 Slaughtering Investments and Operating Costs for Removal of SRM

Cattle slaughterers will have to consider modifications to separate SRM from the rest of animal offal for incoming cattle. For costing capital investments, ERG assumed that all slaughterers will separate SRM from other offal. (As noted above, some might choose not to separate material.) To the extent that some slaughterers do not separate SRM and other offal, capital investment and incremental labor costs will be lower but the loss of product value for rendered material will be higher than estimated here.

Table 2-2. SRM Quantities from Dead, Downer and Antemortem Condemned Cattle

	Number of Head (000)(a)	Current Percent Rendered(b)	Forecast Percent Rendered (c)	Number Rendered (000)	Avg. Wt. Per Head (lbs)	Total Wt. (000 lbs)	MBM Yield (%)	Tallow Yield (%)	Total MBM Yield (000 lbs)	Total Tallow Yield (000 lbs)
Cattle SRMs										
For cattle over 30 months of age	7,054	100%	100%	7,054	88.5	624,508	(d)	(d)	184,032	85,705
For cattle under 30 months of age	28,217	100%	100%	28,217	28.3	798,535	(d)	(d)	39,927	127,681
SRM totals	35,271			35,271	116.8	1,423,044			223,959	213,386
Deads and Downers										
All deads under 500 lbs	2,365	5%	2.5%	59	200.0	11,825	20%	18%	2,365	2,129
Feedlot deads	300	90%	90%	270	750.0	202,500	20%	20%	40,500	40,500
Beef cow deads & downers	1,400	10%	5%	70	1,100.0	77,000	28%	18%	21,560	13,860
Dairy cow deads & downers	400	60%	55%	220	1,300.0	286,000	30%	15%	85,800	42,900
Deads and downer totals	4,465	17%	14%	619		577,325			150,225	99,389
Total - All SRMS and dead and downer animals						2,000,369			374,184	312,775
Value of animal byproduct/per lb if rendered ($)									$0.09	$0.18
Value of cattle SRM, if rendered ($)									$20,156,323	$38,409,484
Value of deads and downers, if rendered ($)									$13,520,250	$17,889,930
Total market value of byproducts ($)									$33,676,573	$56,299,414

(a) ERG assumed that 20 percent of cattle slaughtered are over 30 months of age. This estimate is within the range defined by various industry and literature estimates. The total slaughter figure for cattle is based on the 2003 slaughter statistics (USDA, 2004). Dead and downer estimates were derived from Harlan, 2004a.
(b) Estimated by Harlan, 2004a.
(c) ERG estimates.
(d) See calculations in Table 2-1.
Source: Information provided by Harlan, 2004a, except where otherwise specified.

Large, mechanized and highly automated slaughter facilities will seek the most mechanized and automated approaches to removing SRM and transporting them from the kill floor to a holding bin or truck trailer. Small "locker" plants, such as those that might kill fewer than 100 head of cattle in a day, and perhaps only on certain days of the week, are expected to choose largely manual approaches to separation and SRM removal. At such operations workers might remove SRM and dump them into portable bins that are then wheeled to an SRM collection area for removal by the eventual processor/disposer.

ERG sought information on the cost of slaughter facility modifications from slaughtering facilities of all sizes. Among the firms contacted, only a few had prepared preliminary estimates of the costs to renovate their facilities. Thus, the estimates are quite speculative and ERG has used the available estimates to create an assumed range for capital costs across the range of slaughterer sizes, as presented in Table 2-3. ERG's contacts indicated that costs for large slaughtering facilities would be in the vicinity of $500,000-$750,000. Capital investment costs for large facilities will generally involve several new conveyor and other material transport systems. While some contacts reported that costs will vary directly with the age of the facility, others noted that many newer plants have very little available space for renovations and might be very expensive to renovate. [One large slaughter reported that capital costs might exceed $1 million in several of their facilities. This observation was based partly on concerns about physical constraints in slaughtering facilities that might make modifications exceedingly expensive. Other respondents appeared to face less severe constraints, however, and a somewhat lower range for the average estimates was used in the analysis.] Middle-sized facilities reported costs of $100,000-$300,000, with the largest expenditures expected for new conveyor and material transport systems. For smaller facilities, such as those killing fewer than 40 animals per day, firms are expected to use largely manual means to separate SRM for disposal/processing. Modest incremental costs are estimated to cover purchase of additional barrels or offal carts that the establishments can use to collect offal for the renderer pickup.

The slaughterers' need to separate SRM from other animal offal for older cattle at several points in the slaughtering process generates most of the renovation requirements. If slaughterers could ensure that all their cattle are less than 30 months of age, only modest renovations would be needed. Nevertheless, slaughterers reported that they can only tell cattle age reliably from postmortem observations of cattle teeth. For example, a large slaughterer reported that while their buyers seek only younger cattle, their typical kill includes 1 to 2 percent older cattle. None of those slaughterhouse executives reported that they planned to implement any system that could reliably exclude the older animals from their facilities. If better processes are developed for cattle identification, there should eventually be the means for slaughterers to pre-identify cattle ages and therefore avoid many of the SRM removal and segregation costs. Given the incentives implicit in the FDA SRM option, many large slaughterers might implement new systems of cattle identification or screening and avoid most of the costs estimated here. Nevertheless, because such systems are not yet available, ERG assumed that all facilities will implement the renovations.

Table 2-3. Estimated Investment Costs for Slaughter Facility SRM-Related Modifications

Annual Slaughtering Rates Per Facility	Number of Slaughtering Plants	Midpoint of Slaughter Rate		Estimated Capital Cost ($)	Aggregate Capital Expenditures	Annualized Capital Expenditures	Addit. Staff per Facility	Incremental Payroll		Aggregate Incremental Payroll	Agg. Incremental Annual Costs ($)
		Annual	Per Day					Per Facility (b)	Per Cow		
1-999	508	500	2	$500	$254,000	$36,164	0.0	$0	$0.00	$0	$36,164
1,000-9,999	89	5,500	20	$2,500	$222,500	$31,679	0.1	$2,859	$0.52	$254,433	$286,112
10,000-49,999	26	30,000	110	$50,000	$1,300,000	$185,091	0.5	$14,294	$0.48	$371,644	$556,735
50,000-99,999	11	75,000	275	$100,000	$1,100,000	$156,615	1.5	$42,882	$0.57	$471,702	$628,317
100,000-199,999	12	150,000	549	$250,000	$3,000,000	$427,133	3.0	$85,764	$0.57	$1,029,168	$1,456,301
200,000-299,999	8	250,000	916	$300,000	$2,400,000	$341,706	4.0	$114,352	$0.46	$914,816	$1,256,522
300,000-499,999	11	400,000	1,465	$400,000	$4,400,000	$626,461	5.0	$142,940	$0.36	$1,572,340	$2,198,801
500,000-999,999	9	750,000	2,747	$500,000	$4,500,000	$640,699	6.0	$171,528	$0.23	$1,543,752	$2,184,451
1,000,000-1,499,999	13	1,250,000	4,579	$600,000	$7,800,000	$1,110,545	7.0	$200,116	$0.16	$2,601,508	$3,712,053
Over 1,500,000	2	1,750,000	6,410	$750,000	$1,500,000	$213,566	8.0	$228,704	$0.13	$457,408	$670,974
Total					**$26,476,500**	**$3,769,658**		**$1,003,439**		**$9,216,771**	**$12,986,429**

(a) Approximate average slaughter rate per day assuming facility operates 5.25 days per week or 273 days per year.
(b) Based on an assumed payroll per worker of $28,588, derived by calculating BLS' Occupation Employment Statistics data for production workers in the slaughtering and meat packing industry. The estimate includes a 40 percent markup from a base wage of $20,420.
(c) USDA/NASS, 2003.
Source: Costs estimated by ERG based on discussions with slaughter facility and judgments of ERG staff.

ERG also collected estimates of the labor costs to separate SRM from the rest of animal offal during slaughter operations. (The FDA requirement requires not only removal of SRM from the carcass being processed but also separation of the SRM from the rest of the animal offal being processed for potential use in animal feed.) Industry estimates from large slaughterhouses estimated the SRM removal and separation labor costs at around 50 cents per cow. More detailed estimates showed considerably lower estimates, such as 20 cents per cow in labor for SRM removal from younger cattle and up to 70 cents for older animals. Table 2-4 presents a breakdown of the costs for SRM removal and separation from cattle less than or more than 30 months of age. The large slaughterers forecasted that they would add several workers per shift to the cutting line on the kill floor and in the fabrication area. The smallest slaughterers, however, did not anticipate adding any staff and were planning only minor changes to operations. ERG generated a graduated set of estimates of the additional personnel that will be added that approximately matches the industry's estimates of the per-cow costs of removing cattle SRM, as reflected in Table 2-3. In aggregate, the incremental labor removal costs are estimated at $9.2 million per year.

Table 2-4. Removal and Disposal Costs for SRM, per Ambulatory Cow Slaughtered

Cattle part	**Pounds**	**Incremental Labor**
Brain	0.936	NA
Spinal cord	0.374	NA
Eyes	0.220	NA
Dorsal root ganglia	NA	NA
Tonsil	0.300	$0.100
Skull (including trigeminal ganglia)	15.200	$0.100
Vertebral column	36.500	$0.400
Small intestine (including distal ileum) – under 30 months (a)	28.000	$0.100
Small intestine (including distal ileum) – over 30 months (a)	35.000	$0.100
Total - for cattle not over 30 months (Includes only tonsils and small intestine) (lbs)	28.3	$0.200
Total - for cattle over 30 months old (lbs)	88.5	$0.700

NA=Not applicable or not available
(a) The source estimates different values for cattle below or over 30 months of age
Source: Harlan, 2004a.

Table 2-5 summarizes the average incremental cost per slaughter facility, by slaughtering category. After annualizing capital costs (over ten years at a 7 percent discount rate), per facility costs range from $71 to $335,000. Average incremental costs per cow killed range from $0.14 to $0.81.

Table 2-5. Estimated Annual Costs for Slaughter Facility SRM-Related Investments and Shipments

Annual Slaughtering Rates Per Facility	Midpoint of Annual Slaughter Range	Number of Slaughtering Plants	Per Facility Shipments (000) (a)	Per Facility Incremental Annual Costs ($)	Costs as % of Shipments	Avg. Incremental Annual Costs Per Cow
1-999	500	508	$468	$71	0.015%	$0.14
1,000-9,999	5,500	89	$1,347	$3,215	0.239%	$0.58
10,000-49,999	30,000	26	$2,827	$21,413	0.757%	$0.71
50,000-99,999	75,000	11	$8,959	$57,120	0.638%	$0.76
100,000-199,999	150,000	12	$23,950	$121,358	0.507%	$0.81
200,000-299,999	250,000	8	$73,984	$157,065	0.212%	$0.63
300,000-499,999	400,000	11	$171,358	$199,891	0.117%	$0.50
500,000-999,999	750,000	9	$279,788	$242,717	0.087%	$0.32
1,000,000-1,499,999	1,250,000	13	$721,953	$285,543	0.040%	$0.23
Over 1,500,000	1,750,000	2	$1,518,618	$335,487	0.022%	$0.19
Total		689		$18,848		

Source: Costs estimated by ERG based on discussions with slaughter facility and judgments of ERG staff.
(a) Shipment data is from the 1997 Economic Census for NAICS 311611, Animal Slaughterers. USDA/NASS slaughter rate size groups are matched to Census employment-based size groups. BLS's Consumer Price Index is used to inflate shipments to 2003 dollars.

2.3 Disposal Alternatives and Relative Costs

Slaughterers have various theoretical possibilities for disposing of SRM. The cost estimates attributable to these strategies are dependent upon important assumptions about:

- processing disposal facility size,
- operating characteristics,
- permitting and siting requirements,
- environmental requirements,
- transportation distances (i.e., SRM suppliers),
- recovery and market value of process end products for productive use or fuel,
- eventual federal or state regulatory requirements beyond environmental or permitting requirements,
- mix of raw materials, including SRM flows and/or entire animal carcasses,
- on-farm or dedicated commercial operation.

Given the importance of defining assumptions and the lack of industry experience with the disposal alternatives, the cost analysis includes some speculative elements. Economic principles would require that the lowest cost allowable disposal option predominate. It is also likely that industry will develop approaches that are more cost-effective than can be determined from the available literature. Given the limited basis for assessing the available disposal options, however, ERG has relied on various published and industry-developed cost estimates. The options examined include:

- Landfilling – In this option, cattle SRM are separated at slaughter and sent directly to disposal with no processing. Actual disposal costs could vary substantially with local conditions and the county and/or state willingness to accept materials.

- Rendering for disposal – In this scenario, SRM material is rendered and tallow is recovered. The rendered SRM (now processed into MBM) are then disposed of or burned for their fuel value. In one industry estimate, a processing fee of $6 per hundred weight (cwt) of material was assumed (Harlan, 2004a).

- Disposal through alkaline hydrolysis digesters – Digesters are estimated to cost $1 million or more for relatively substantial units (Meat News.com, 2004). Due presumably to their relative expense and the limited industry experience with them, these units have only been examined. Operating costs have been estimated at roughly 3 cents per lb, before transportation costs and profits.

- Incineration – Incineration might be accomplished in centralized facilities or (for animal producers) in small on-farm incinerators. Based on one set of industry estimates, the variable (operating) costs of incinerating dead cattle in small on-farm incinerators are $9.33 per cow (Sparks International, Inc. 2002). The fixed investment costs are $4,500 for units sized for individual farms, but considerably higher for industrial-size units. Permitting and siting for incineration units might generate considerable political opposition. The significance of such issues has not been quantified.

- Composting – Sparks estimates the operating costs per dead cow for on-farm composting at over $34 per cow (Sparks International, Inc., 2002). Large commercial-scale operations would incur smaller per cow operating costs. Investment costs are estimated at $7,000 per farm. Larger capital investments for land and other inputs are needed for industrial-size units.

For the cost analysis, ERG assumed that cattle SRM are processed via rendering and then sent for disposal. Alternatively, other disposal technologies might be used, but ERG judged that other options are unlikely to generate lower costs and that the lower cost options will predominate. In presuming a reliance on rendering and landfilling for SRM disposal, ERG is assuming that this process and disposal option is considered adequate by all relevant regulatory authorities.

Landfilling alone would be considerably less costly for SRM. But several industry executives noted that state regulations prohibit disposal of unprocessed dead animal parts or carcasses in landfills. For example, several midwestern states prohibit disposal of animal carcasses in landfills. Given the potential for regulatory opposition to landfilling of cattle, ERG did not consider this a viable option for SRM disposal.

In order to consider costs from the slaughterer viewpoint, ERG assumed that slaughterers will now pay a rendering-for-disposal processing cost, which was estimated at $4-$7 per cwt of raw material. As noted above, one industry estimate places the processing costs at $6 per cwt (Harlan, 2004a). Industry sources indicate that the cost of processing is highly dependent upon the volume of material received at each rendering-for-disposal facility. At a cost of $6 cwt, industry executives are expecting that SRM volumes will be well below facility capacity and the processing costs per cwt will be correspondingly higher than the industry historical average (for a given range of energy costs and other input costs). The executives also note the inefficiency of dividing animal offal from a single slaughter line into two separate offal processing lines, which will increase industry costs. Over time, industry efficiency in handling SRMs will probably increase as plants are relocated and/or reconfigured. Nevertheless, ERG judged that the industry anticipation of relatively high processing costs was justified.

[Section Three considers the potential costs of a different dedication-related regulatory alternative in which renderers and feed mills must be dedicated to either handling of ruminant protein or manufacturing feed for ruminant animals.]

ERG also assumed that transportation costs range from $1 to $1.75 per cwt based on information provided by industry (e.g., Harlan, 2004a and other discussions). The transportation costs represent an implicit assumption that there will be relatively few rendering-for-disposal plants, and that slaughterers will often need to ship SRMs a substantial incremental distance beyond existing transportation distances. The transportation costs are assumed to also cover the costs to move the rendered MBM to the ultimate landfill site. The quantity of rendered MBM to be transported is much smaller than that of the SRM raw materials, and landfill sites are much more numerous than dedicated rendering-for-disposal facilities. Thus, the costs to transport the rendered MBM are judged to be a small fraction of this total.

The dedication of some rendering plants to SRM rendering will eliminate some existing rendering locations. This will cause some non-SRM rendering inputs to be transported farther than at present. ERG added a transportation cost increase of $0.05 to $0.10 to reflect this incremental transportation.

In an SRM regulation, FDA will require that SRM rendering facilities and equipment be "dedicated" to disposal rendering. The dedication requirement will increase costs by disallowing joint use of facilities or vehicles (i.e., SRM and non-SRM uses) for processing or transportation. Industry has no experience at present with such a requirement. The processing and incremental transportation costs presented here are significantly above average costs for the industry. Nevertheless, ERG used these relatively high processing and transportation costs to reflect the potential for incremental costs related to the dedication requirement.

ERG used landfill cost assumptions of $2 to $4 per cwt of MBM, corresponding to $40 to $80 per ton. Most state and local authorities have little experience with disposal of large volumes of MBM and there remains uncertainty about the size of the final landfill charges. Landfilling charges at this level will add $8.1-$16.2 million to the total cost impacts.

The disposal of deads and downers will generate incremental costs for farmers and other animal operations. Table 2-6 presents the incremental disposal costs for dead and downer animals resulting from the prohibition of deads and downers from use in animal feed. Currently, about 17 percent of deads and downers are being rendered for MBM and tallow. As a result of the SRM ban, fewer animals will be rendered because of the post-regulatory economics of renderer pickups. With the loss of value of rendered MBM from deads and downers that is caused by an

SRM ban, renderers will charge higher fees for picking up deads and downers, especially from small suppliers of carcasses in remote areas. Consequently, more farmers will now dispose of their animals on the farm itself. ERG did not estimate any disposal costs for dead and downer animals that are not currently rendered since the costs are already being incurred by farming operations.

ERG forecast the plausible change in rendering levels caused by the increase in pickup charges, as shown in Table 2-6. ERG judges that for some operations, namely those with deads weighing less than 500 pounds and beef cows, half of the deads and downers previously being rendered will now be disposed off on-site. The impact on the disposal methods for dairy cow operations and feedlots is forecast to be smaller because these operations have fewer onsite disposal options. These operations do not have significant amount of physical space or the resources to carry out on-site disposal of animals. ERG estimates that all feedlots will still render for disposal and only a small fraction of dairy cow operations will discontinue disposal-rendering practices. In sum, an estimated 3 percent of all deads and downers, or 149,000 animals that were previously rendered will now be disposed.

While farming operations will select the method of disposal for dead and downer animals most appropriate to their practices, for this analysis ERG assumes that all operations will choose to bury dead animals. As reported in a Sparks International, Inc. study of disposal methods, total costs for burial are cheaper than costs for incineration or composting, largely because burials don't require capital investments in specialized facilities (Sparks, 2002).

ERG used the methodology presented in the Sparks (2002) report to estimate the costs of burials. In the report, the time requirement for burials is estimated to be 10 minutes for animals under 500 pounds and 20 minutes for animals over 500 pounds. ERG converted these time estimates to costs using a loaded labor rate for all occupations in animal production support activities as reported by BLS's Occupational Employment Survey (BLS, 2004). For equipment costs, ERG used the estimates reported by Sparks (2002) for the rental or depreciation of a backhoe ($35 per hour). Total disposal costs for dead and downer animals that will be disposed of instead of rendered as result of the SRM ban is estimated to be $2.1 million per year.

ERG's final cost adjustment is to reduce the total costs by the estimated value of the tallow recoverable from disposal rendering. Because the FDA regulation does not prohibit the recovery of tallow from rendered SRM, it is appropriate to assume continued tallow recovery. In so doing, ERG implicitly assumes that tallow from SRM is not judged by ultimate consumers to be a tainted or adulterated product. (If the marketplace is not accepting of tallow in commercial uses, it might retain considerable value as a fuel sources for the rendering process itself, as has been speculated by some in industry.) Nevertheless, in a competitive market, renderers will charge less for rendering-for-disposal to the extent they can recover the tallow value. The estimate of a representative market value for recovered tallow, as presented in Table 2-2, is therefore used as an offset to the rendering-for-disposal processing costs.

Table 2-7 summarizes the unit and aggregate incremental slaughtering, transporting, and landfilling costs, and the loss of MBM value. Using the ranges described and offsetting for recovered tallow value, totals could range from approximately $67.3 million to $150.8 million

Table 2-7. Prospective Annual Costs for Slaughtering Modifications, Rendering-for-Disposal, and Disposal of Deads and Downers

Quantity and Cost Factors	SRM from Slaughterers	Deads and Downers	Total
Unprocessed SRM quantity (000 lbs)	1,423,044	692,150	2,115,194
Prospective MBM yield (000 lbs)	223,959	150,225	374,184
Incremental annualized in-plant slaughter costs ($)	$12,986,429	NA	$12,986,429
Approximate rendering for disposal processing cost, per cwt of raw material (a)			
Minimum ($)	$4.00	$4.00	$4.00
Maximum ($)	$7.00	$7.00	$7.00
Incremental SRM transportation cost per cwt (b)			
Minimum ($)	$1.00	$1.00	$1.00
Maximum ($)	$1.75	$1.75	$1.75
Incremental transportation cost per cwt for non-SRM rendering inputs (c)			
Minimum ($)	$0.05	$0.05	$0.05
Maximum ($)	$0.10	$0.10	$0.10
Aggregate rendering and transportation estimates			
Minimum ($)	$71,863,710	$29,154,913	$101,018,623
Maximum ($)	$125,939,373	$51,093,263	$177,032,636
Landfill cost per rendered MBM cwt (d)			
Minimum ($)	$2.00	$2.00	$2.00
Maximum ($)	$4.00	$4.00	$4.00
Aggregate landfilling cost			
Minimum ($)	$4,479,183	$3,004,500	$7,483,683
Maximum ($)	$8,958,366	$6,009,000	$14,967,366
Disposal costs for deads and downers ($)	NA	$2,107,967	$2,107,967
Recovered tallow value (from Table 2-2)	$38,409,484	$17,889,930	$56,299,414
Net costs, all category costs less recovered tallow value			
Minimum ($)	$50,919,838	$16,377,449	$67,297,287
Maximum ($)	$109,474,684	$41,320,299	$150,794,983

(d) Estimated by ERG. See text.
(e) Estimated by ERG based on information assembled from industry. See text.
(f) Incremental costs for material disposal from SRM facilities. See text.
(d) Incremental transportation costs for moving material from the dedicated SRM renderer to the landfill are assumed to be included in the landfill cost assumption.
NA=Not available
Source: ERG estimates, with inputs as described.

per year. The ultimate cost range is fairly wide, reflecting the substantial uncertainty in all of the cost variables. The midpoint of the range is $109.0 million per year.

The two cost columns shown in Table 2-7 also define the approximate distribution of costs incurred most immediately by slaughterers and by others. (The ultimate distribution of impacts is complicated as slaughterers and others pass costs on to their suppliers or customers.) Thus, the first column of costs shows the costs incurred for SRMs removed during slaughtering. These costs will be distributed by slaughterers backward to cattle suppliers in the form of lower prices paid for cattle and forward to meat consumers. The costs in the deads and downers column in the table summarize the incremental costs applicable to owners of these animals, including ranchers, dairy farmers, and feed lot owners. These costs are based on an assumption that current rendering levels continue even though the rendering is now for the purpose of disposal. Animal owners might seek alternative disposal methods to avoid the new rendering-for-disposal charges. Renderers will not be willing to handle either SRMs or deads and downers unless the adequate service charges are paid. As is discussed later, the effect of these increased charges on the level of ongoing rendering practices is uncertain.

2.4 Rendering Industry Impacts from SRM Disposal Requirements

By directing that SRM be removed from animal feed, FDA's alternative will have a range of effects on the rendering industry. If SRM are rendered for disposal, revenues for dedicated SRM renderers will more or less replace revenues previously generated by conventional rendering at these facilities. Nevertheless, this section considers the volume of SRM, regardless of their eventual outcome.

Table 2-8 places the reduction in raw materials flowing to rendering within the context of overall rendering material flows. Based on Sparks Inc. (2001), integrated packer/renderers and independent renderers produce approximately 6.65 billion lbs per year of MBM. Poultry-based feeds add an additional 4.27 billion lbs. The industry also produces an estimated 9.57 million lbs per year of tallow (US Census, 2003). The removal of SRM from slaughtered and dead and downer cattle currently picked up by renderers will remove 374.2 million lbs of MBM from productive use in feed. If tallow uses were also to be disallowed (which FDA is not requiring in this draft language for the option), or if the market effectively rejects the material, then 312.8 million lbs of tallow will be lost to productive use. These figures represent 3.4 percent of all MBM and poultry-based feed production and 3.3 percent of all tallow production.

Given the structure of the rendering industry, impacts fall more substantially on independent renderers, who are more dependent upon cattle offal and upon rendering of deads and downers. The SRM regulation would reduce MBM produced for use in animal feed by independent renderers by 7.6 percent. If SRM-derived tallow is lost from productive use, this would affect 5.6 percent of industry tallow production.

As noted previously, the revenue declines from removal of SRM are likely to exceed the levels estimated here because some small slaughterers might not be able to separate animal offal. Assuming separate rendering trucks will be required for picking up SRM and other animal offal, small slaughterers might be unable to attract more than one renderer pickup. To the extent such dislocations in renderer service occur, the quantity of SRM disposed will increase. Impacts of the loss of value for non-SRM cattle offal will fall disproportionately on independent renderers.

Table 2-8. Removed SRM as a Percent of Total MBM and Tallow Production

	Integrated Packer/Renderers	Independent Renderers	Total
Pork and other single-species, non-ruminant MBM	1,148.4	492.2	1,640.5
Ruminant only MBM	2,324.0	410.1	2,734.1
Mixed species MBM, with ruminant protein	1,131.6	1,131.6	2,263.1
Mixed species MBM, without ruminant protein	7.3	7.3	14.6
Total MBM, except poultry (million lbs/yr)	4,611.2	2,041.1	6,652.3
Total poultry-based products (million lbs/yr)	3,418.8	854.7	4,273.5
Reduction in MBM production			
Decline in MBM from cattle SRM (million lbs/yr)	154.9	69.1	224.0
Decline in MBM from downers and deadstock (million lbs/yr)	0.0	150.2	150.2
Total reduction in MBM production (million lbs/yr)	154.9	219.3	374.2
Total percentage reduction in MBM production, excl. poultry	3.4%	10.7%	5.6%
Total percentage reduction in MBM production, incl. poultry	1.9%	7.6%	3.4%
Reduction in tallow production (If there is no tallow recovery from prohibited bovine material)			
Decline in tallow from cattle SRM (million lbs/yr)	147.6	65.8	213.4
Decline in tallow from downers and deadstock (million lbs/yr)	0.0	99.4	99.4
Total tallow production (million lbs/yr)	6,634.1	2,936.5	9,570.6
Total reduction in tallow production (million lbs/yr)	147.6	165.2	312.8
Total percentage reduction in tallow production	2.2%	5.6%	3.3%
Potential declines in production as % of aggregate industry revenues			
Average historic market prices, MBM per lb.	$0.09	$0.09	NA
Assumed price for poultry-based feed	$0.12	$0.12	NA
Average historic market prices, tallow per lb.	$0.18	$0.18	NA
Approx. industry revenues for MBM and poultry-based feed sales	$825,262,650	$286,264,350	$1,111,527,000
Approx. industry revenues for tallow sales	$1,194,129,902	$528,574,858	$1,722,704,760
Reduction in MBM revenues from SRM (from Table 2-2)	$13,937,981	$6,218,342	$20,156,323
Reduction in MBM revenues from deads, downers (from Table 2-2)	$0	$13,520,250	$13,520,250
Reduction in tallow revenues from SRM (from Table 2-2)	$26,559,937	$11,849,547	$38,409,484
Reduction in tallow revenues from deads, downers (from Table 2-2)	$0	$17,889,930	$17,889,930
Combined percentage decline in revenues	2.0%	6.1%	3.2%

Source: For total volumes of material, Sparks Companies, Inc. 2001.
Estimates of distribution between renderer categories are estimated by ERG based on Sparks Companies, Inc., 2001, and other data. Estimates of reduction in MBM production derived from material in Table 2-2.
Tallow production figures are from U.S. Census Bureau, 2003. Tallow production data is for 2002.

The revenue declines described in Table 2-8 represent the removals from current rendering of the SRM and dead and downer cattle inputs and do not reflect the possible conversion of some rendering facilities to dedicated SRM rendering for disposal. To the extent such conversions occur, the MBM revenues will be more or less replaced with SRM disposal service charges. The relative revenues and profits from dedicated SRM rendering as opposed to current rendering operations have not been forecast.

As mentioned in Section 2.3, the post-regulation level of dead and downer rendering will also change. At present, renderers sometimes pay large suppliers of dead or downer cows, but will generally charge small suppliers to pick up such animals. Thus renderers might pay feedlots and dairy farms that generate substantial numbers of animal carcasses, but will charge small ranchers located in remote areas to pick up small numbers of dead animals. Small ranchers with only one or two dead animals at a time generally are now paying for rendering pickups.

With the loss of productive value for rendered MBM from dead and downer animals, the economics of renderer pickups of dead animals worsen considerably because renderers will realize a substantial reduction in their revenues from processing these raw materials. This will lead to increases in renderer charges, and ranchers will be much less likely to call renderers to remove dead or downer animals. As described in Section 2.3, about 149,000 more animals will now be disposed on farms. However, feed lots, dairy farms, and other land-constrained operations (or operations subject to effective state enforcement for animal carcass disposal) appear to have fewer options for on-site disposal (unless they are willing to pay for incinerators or other technologies) and appear most likely to pay the increased renderer charges.

Because the elimination of SRM from rendering processes will generally lower the utilization rate for equipment, these percentage reductions in production levels probably understate the actual reductions in profits for renderers processing non-SRM cattle offal. Potential rendering plant closures are assessed in Section Four.

2.5 Rendering Capital Investments

ERG discussed the impact of an SRM ban with selected rendering industry executives and requested forecasts on the potential capital investment plans for the industry in view of a possible SRM ban. The executives noted that, if the SRM option generates a substantial flow of SRM that are prohibited from animal feed, renderers might dedicate some facilities to SRM rendering for disposal. The executives forecast, however, that industry will not build new rendering plants for the purpose of SRM disposal. Of course, the SRM option will not create a change in the total amount of raw material (SRM and other cattle offal), so industry capacity is theoretically adequate to handle both material flows. This forecast doesn't consider the potential for geographical imbalances between existing and SRM rendering capabilities throughout agricultural areas. Such imbalances as occur might encourage construction of new rendering facilities. Nevertheless, industry appears likely to approach such investments cautiously.

The conversion of facilities from current rendering to SRM rendering might generate some renovation costs but they are likely to be modest. Rendering for SRM will likely involve less demanding product standards for the process outputs (MBM) than does normal MBM rendering. The SRM-based MBM will only need to meet the product specifications necessary for landfilling, rather than the more demanding specifications for inclusion of the material in animal feed. Renderers might also need to make some changes to trucking fleets, either to collect materials over a changed and possibly larger geographic region. Renderers that collect both SRM and non-SRM animal offal might require more trucks, assuming that SRM and non-SRM cannot be carried in the same truck. ERG did not forecast the impact of such changes on the renderers trucking fleet.

2.6 Cost Implications of Incremental Restrictions on Tallow

The new FDA restriction on tallow use for animal feed is consistent with current recent industry trends to reduce impurity levels for tallow. Thus, FDA's requirement that tallow used for animal feed contain no more than 0.15 percent hexane-insoluble impurities is in line with common customer specifications for inedible tallow. For example, the renderers' fatty acid customers and export market customers have required impurity levels consistent with the FDA requirement. The producers of edible tallow for use in food products, mostly packer/renderers, meet tighter impurity specifications (i.e., 0.05 percent impurities).

The December 2003 discovery of a BSE-diseased cow in Washington State, and increased quality control demands from their customers, gave considerable new impetus to renderers' efforts to reduce the impurity levels. Industry executives noted that a majority of renderers are probably now achieving the impurity limits in compliance with the possible FDA SRM option. Among the remaining independent renderers, such as those that are supplying local feedlots and might not have had sufficient incentive to reduce impurities, many are installing additional purification equipment.

Thus, the FDA alternative will further encourage an industry trend for inedible tallow producers toward reducing impurities, but some producers are not yet in a position to meet the tighter requirements. Estimates made by rendering industry executives and equipment vendors varied on the extent to which renderers have installed or will soon install the equipment needed to reduce impurities. Based on the combined commentary of industry personnel, ERG judged that some firms would not make the necessary investments without further regulatory impetus. Thus, ERG judged that the FDA alternative, if imposed within the next year, would generate incremental costs for some inedible tallow manufacturers among independent renderers.

Using the 1997 Census count on independent renderers (which represents the most recent data available on establishments for the economic impact analysis), there are 228 independent rendering establishments. Based on discussions with industry executives and equipment vendors, ERG estimated that thirty percent of independent renderers (68 establishments) lack necessary equipment to achieve the impurity requirements for tallow. Many plants have decanter centrifuge systems to remove larger chunks of material but still need polishing centrifuges to remove additional impurities.

Polishing centrifuges range in installed cost from $75,000 to as high as $500,000 for the most sophisticated and large-capacity units (Barlagi, 2004). Another vendor estimated that many centrifuges are sold in the $90,000 to $165,000 range (Hensley, 2004). For the rendering facilities, ERG used the mid-point of the second cost range of $128,000, and added a 25 percent allowance for installation and engineering costs. ERG calculated that annualized capital costs are $22,800 per year (at 7 percent per year over 10 years). ERG also assumed that operating costs are equal to 10 percent of the equipment costs and thus amount to $12,800 per year.

Small rendering facilities have some technical potential to achieve the tightened impurity levels by installing less expensive filtering equipment. Such systems generate higher operating costs, however, because plant workers must periodically clean or replace the impurity filters. Thus, such systems were mentioned as a possibility but appeared to have uncertain viability given their operating costs and technical limitations. Also, many small renderers have been investing in centrifuge systems because they are among the firms particularly dependent upon tallow export markets where impurity concerns have been of particular concern. Thus, ERG assumed that all affected renderers would upgrade to centrifuge systems.

The total operating and annualized capital costs per year across all facilities adding equipment are estimated at $2.4 million per year. If costs are annualized at 3 percent per year, the total costs for this requirement are $2.1 million per year.

2.7 Cost Implications of Incremental Restrictions on Meat from 4D Animals and from Mechanically Separated Beef

Renderers and other dead animal, or "4D," firms[5] collect dead and downer cattle and carve the carcasses to yield red meat for the pet food manufacturers, zoos, greyhound dog track operators and other animal feeding operations. Typically the 4D firms perform rough deboning by hand and remove the choicest and most accessible cuts of meat. Some of the facilities also use mechanical separation equipment to produce additional meat for pet food manufacturers.

Based on discussions with industry executives, ERG estimates that there are roughly twenty firms engaged in red meat and MS beef production, divided equally between renderers and non-rendering companies. The latter firms collect dead animals and provide carcasses directly to pet food manufacturers. They might also provide animal offal to rendering facilities.

The 4D firms appear to be the only firms using MS systems. Slaughterers have largely discontinued use of mechanical separation systems for beef production due to regulatory pressure, but renderers still use the equipment in some operations. The US Department of Agriculture Food Safety and Inspection Service (FSIS) first required labeling of MS beef, which discouraged MS beef production by most meat packers. FSIS then banned MS beef from human consumption. FSIS representatives stated that there was very little impact on slaughterers from the FSIS ban on MS beef from human consumption because so little was being produced (Perrata, 2004 and Payne, 2004). Pet food manufacturers have also been decreasing their purchases of MS beef from "4-d" plants in recent years. Many renderers have noted over the

[5] The term refers to dead, dying, diseased, and disabled cattle.

years that pet food companies, and particularly the large name-brand producers, are sensitive to public perception about pet food inputs.

Although there appear to be no published or widely accepted figures on the size of the 4D industry, one industry executive estimated the total market for red meat, including MS beef, from 4D animals was $90 million per year, and a second judged that revenues were more than $90 million per year but could not give a precise estimate. For the purposes of estimating economic impacts, ERG assumed a total market size of $100 million per year. (The industry sales are too small or not distinguished from other materials sufficiently to be covered in Census figure data for either renderer sales or pet food manufacturer purchases of feed.) ERG judges that most of this value is generated from the red meat (carved by hand) and MS beef sold to pet food firms and other animal feeding operations. The total share of production from MS beef has declined considerably over the last several years, and now represents roughly 20 to 25 percent of red meat production for 4D firms. The remainder of the value is generated by the red meat removed from the carcasses. ERG assumed that industry generates 25 percent of its value by collecting animals for rendering.

If the SRM option is implemented, both of the principal products for 4D firms' (red meat carved by hand and MS beef) will be prohibited. ERG is unaware of any other potential uses for meat from 4D animals outside of the animal feed chain. Thus, virtually all of these operations appear likely to close. The dead animal pickup services for rendering (an estimated 25 percent of the industry value added) are assumed to be absorbed into existing rendering operations, although this conclusion has to be considered speculative. In any case, the 75 percent of value added generated from meat sales will be lost. Thus the net loss for this sector was estimated at $75 million (75 percent of $100 million).

2.8 SRM Marking Costs

FDA's SRM option will also require renderers of SRM material to mark the resulting product to help ensure it will not be used as feed. Thus renderers will need to add some type of identifying material to processed SRMs in addition to the labeling requirements.

No markings are currently being used in US industry and FDA has not yet specified the marking techniques and their associated technical requirements. ERG has assumed that the markings will need to be environmentally compatible and readily evident. ERG also assumed that marking material will be added at the end of the rendering process.

No estimates were identified of the costs for renderers to mark their MBM outputs. One cost estimate for a very small UK slaughterer (four employees) estimated his annual dye expenses for marking prohibited offal at 500 British pounds or roughly $950 per year (allowing for $1.90 per British pound, based on approximate exchange rates in August 2004) (Farmers Journal, 2004).

Flourescent dyes, such as those used in tracing water plumes and other environmental study purposes, are sold through various chemical supplies, such as Lab Safety Supply. The 2004 Lab Safety Supply catalogue lists several tracing dyes. These include dyes of different colors, environmental characteristics, solubility, and other characteristics. The prices vary from $85 to $154 per gallon (Lab Safety Supply, 2004). Renderers would presumably enter into long-term bulk order purchase contracts at prices per gallon considerably below those shown in the catalogue. The marker dyes are generally used in dilution. For example, one source indicates that Patent Blue V dye (a violet-colored dye that is frequently mentioned as a possible marker) would be diluted to a 0.5 percent solution, i.e., diluted by a factor of 200 (British Poultry Council, 2004).

Lacking precise information or industry experience with marking dyes, ERG used a range of assumptions to characterize the cost of adding marker dyes to MBM produced from rendered SRMs. Assuming purchase prices for dyes of $85 to $156 per gallon, dilution by factors of 100 to 200, application rates of one quart to one-half gallon of diluted dye per ton of MBM, and applying the assumptions so as to generate the widest possible cost range, the cost per ton of rendered MBM would vary from less than $0.11 to $0.78 per ton (see Table 2-9).

Table 2-9. SRM Marking Costs for Renderers

Cost Component	Low Estimate	High Estimate
Cost per gallon	$85	$156
Dilution factor	200	100
Cost per diluted gallon	$0.43	$1.56
Application rate (gallons) per ton of MBM	0.25	0.50
Cost per ton of MBM	$0.1063	$0.7820
Total cost of marking (for 374 million pounds from Table 2-8)	$19,889	$146,312

Sources: Lab Safety Supply, 2004; British Poultry Council, 2004; and ERG estimates

2.9 Converting Facilities Among Dedicated Uses

The language of the SRM option allows facilities to switch from dedicated handling of prohibited bovine materials to handling of unrestricted animal proteins. Facilities will need to satisfy FDA requirements for cleanout and will not be expected to switch rapidly between prohibited and unrestricted protein handling.

ERG lacked information about the frequency with which renderers will switch between handling of SRM and unrestricted protein should the alternative language be implemented. The estimates presented here implicitly assume that the rendering industry dedicates a share of its establishments to SRM rendering for disposal, and that the arrangements are fairly stable. There is no data for estimating how many or how frequently the pattern of plant dedication will change, although it appears unlikely that plants would switch between these options very often.

In any case, ERG judged that renderers will voluntarily be deciding whether and when to initiate or cease dedicated SRM rendering. No costs were estimated for their expenses in making these choices to undertake or switch between these categories of activities.

2.10 Recordkeeping and Labeling Costs

The SRM option requires all renderers handling cattle materials to keep records and label their products. Renderers handling prohibited bovine materials are required to establish and maintain records tracking the prohibited materials to ensure they are not used in animal feed. These renderers are also required to label the products as inappropriate for animal food. Renderers of cattle materials other than prohibited materials are required to keep records and appropriately label products to demonstrate that they do not contain prohibited bovine materials.

To estimate recordkeeping costs for these requirements, ERG made certain assumptions about the number of renderers affected. According to FDA's inspection database, 141 rendering facilities handle ruminant proteins. ERG assumed all these renderers are affected by the recordkeeping and labeling requirements.

As a result of the alternative, some of these renderers will choose to render prohibited cattle materials and others will choose to render cattle materials other than prohibited material. The exact numbers of renderers handling prohibited or other cattle materials is irrelevant for the purpose of this analysis since the recordkeeping and labeling costs are identical for both groups of renderers.

Recordkeeping requirements for renderers handling prohibited materials could be addressed by records of sales to buyers of the rendered product or disposal records of the prohibited materials. Renderers currently keep records of sales and disposals and hence, incremental recordkeeping costs associated with ensuring that animal feed is free of prohibited cattle materials will be minimal. Similarly, recordkeeping requirements for renderers handling cattle material that are not prohibited will be also minimal. Most such facilities already collect records demonstrating the source of the cattle materials they render such as purchasing or receiving records.

In evaluating compliance costs, ERG has noted the enhancement in industry recordkeeping practices mandated by the 1997 feed rule. Hence, renderers already must properly record and label shipments. For this regulation, only modest incremental recordkeeping costs are anticipated for supplemental recordkeeping. Recordkeeping costs are estimated for an initial modification of procedures, as well as a quarterly review and filing of records to ensure that they are sufficient to meet the requirements of the rule. Recordkeeping costs are assumed to be identical for renderers handling prohibited cattle material and for those handling other cattle material. ERG judged that an initial process modification will require 10 hours of labor, while the quarterly record review and filing will require 2 hours per quarter.

To convert the labor estimates to costs, ERG used the mean hourly wage for office and administrative support occupations within the animal slaughtering and processing industry from BLS's Occupational Employment Survey. This hourly estimate was then increased by 40 percent to account for fringe benefits. Using the resulting labor rate of $17, recordkeeping requirements for renderers handling prohibited bovine materials is estimated to be $255 per facility for the first year and $85 per facility for the following years (see Table 2-10).

As with the recordkeeping requirements, incremental labeling requirements of the alternative language are also deemed to be minimal. Renderers currently label their products and/or invoices and hence, any additional labeling requirement will not create significant costs. For this analysis, ERG estimated incremental labeling costs for the one-time initial design, production, and filing of a label or invoice. ERG judged incremental labeling time estimates to include 2 hours of management time (estimated at $52.86 per hour, as derived from the BLS and loaded) and one hour of clerical labor time (at $17 per hour) per facility. Per facility labeling design and review costs are estimated at $123 (see Table 2-10). Incremental printing or paper costs for the labels or invoices are judged to be negligible.

As shown in Table 2-10, total recordkeeping and labeling costs for all rendering facilities are estimated to be $101,000 for the first year and $48,000 each subsequent year.

Table 2-10: Recordkeeping and Labeling Costs of the SRM Ban

Cost Component	Value
Clerical wage rate: Loaded wage rate for all office and administrative support occupations in animal slaughtering and processing industries	$17
Management wage rate: Loaded wage rate for all management occupations in animal slaughtering and processing industries	$53
Recordkeeping requirements	
Initial modification of procedures	
Hours needed for modification	15
Cost of modification (using clerical wage rate)	$256
Quarterly review and filing of records	
Hours needed for quarterly review	5
Cost of quarterly review and filing (using clerical wage rate)	$85
Set-up recordkeeping costs per facility	$595
Recurring annual recordkeeping costs per facility	$340
Labeling requirements	
Design of label or invoice	
Hours needed for design	2
Cost of design (using management wage rate)	$106
Production and filing of label or invoice	
Hours needed for review	1
Cost of production and filing (using clerical wage rate)	$17
Set-up labeling costs per facility	$123
Total set-up costs for all affected rendering facilities	**$101,179**
Recurring annual costs for all affected rendering facilities	**$47,929**
Annualized costs for all rendering facilities	**$62,333**

Source: BLS, 2004 and ERG estimates.
Note: Totals might not sum due to rounding.

SECTION THREE

ANALYSIS OF ADDITIONAL REGULATORY ALTERNATIVES

ERG considered additional alternative forms of a regulation in which FDA would require:

- A prohibition on the use of ruminant-derived plasma and blood meal products in ruminant feeds, and
- The use of separate (i.e., dedicated) equipment or facilities for the manufacture, process, blend, or distribute products containing ruminant or non-ruminant materials in order to prevent cross-contamination.

In these alternative regulatory analyses, there is no exclusion of SRM. The dedication requirement would be distinct from the dedication requirement in the SRM requirements that are specific to the SRM rendering facilities. These alternative requirements generate impacts for a substantial section of the rendering and feed industries, as well as for dairy farmers.

3.1 A Blood Meal Prohibition

FDA has been considering a prohibition on use of ruminant-derived plasma and blood meal products in ruminant feeds. FDA did not prohibit use of blood products in the 1997 feed ban and ruminant feeders have continued to use them at roughly mid-1990s levels (Sparks, 2001). Additionally, new blood-based products have been developed since the 1997 feed ban. Dairy cattle are large consumers of plasma products, protein-based feed additives, and ruminant blood meal.

ERG distinguished impacts on four categories of bovine blood-related products:

- Plasma-based products designed for (1) therapeutic use, or (2) as feed additives;
- Premium ruminant blood-containing feed additives; and
- Commodity blood meal.

Plasma-based therapeutic products markets will be adversely affected by the alternative changes to the feed rule. Manufacturers of these products capture blood from the slaughterhouse floor and immediately separate plasma from the blood. In recent years agricultural product manufacturers have developed bovine plasma-derived therapeutic products that are much more effective in the bovine species from which they are derived than in cross-species use (Russell, 2004). APC Inc. is the largest manufacturer of these products. They report that their therapeutic product sales have been growing rapidly since the products were introduced a few years ago. Their acceptance among dairy farmers is said to have been increasing rapidly and the company anticipated market sales to rise to the level of $25 to $50 million within the next few years

(Russell, 2004). With the change in the feed rule, however, sale of these products to dairy herds will stop entirely. These products cannot be sold for nearly the same price to other agricultural sectors because they do not have the same therapeutic value in other species. APC Inc. is discontinuing production of the products intended for bovine animals.

The elimination of these products will also adversely affect dairy farms. APC Inc. states that their therapeutic products have a substantial positive impact on calf survival rates on dairy farms. The products are also very helpful in combating Johne's Disease, a common dairy herd affliction. Dairy nutritionists contacted by ERG agreed that the loss of therapeutic products would have a negative effect on future dairy herd survival rates and profitability (Hutjens, 2004). This topic is considered further in Section Four.

APC Inc. and other manufacturers also produce **plasma-based feed additives** for the pig starter and bovine calf markets. These are primarily nutritional products and their inherent value is comparable in bovine and swine populations. Thus, their current sales to dairy or beef cattle producers could theoretically be shifted to non-ruminant markets, such as pork (Holcomb, 2004). Because this bovine-derived material is a valuable protein product, it should eventually maintain a price similar to that which existed prior to the ban, once all protein markets have become stabilized. Thus the short-term and anticipatory market impact has been to close these products out of much previous use.

APC Inc. reported that it has closed a production facility and will close another one, although the closures are influenced by several factors, including market shifts, international requirements for separation in processing of porcine and bovine materials, and anticipated regulatory requirements.

Plasma-derived products of this type typically sell for approximately $1.50 per lb. to dairy operations (Holcomb, 2004). Based on discussions with industry personnel, domestic consumption of the plasma-based feed additives is estimated at roughly 40 to 50 million lbs. The total market is estimated at approximately $60 to $75 million per year.

Manufacturers of other **premium ruminant blood-containing products** raised similar concerns about market losses. One manufacturer of a premium protein additive product for dairy cattle, for example, noted that his product would decline in value. This product includes ruminant blood meal and a number of other additives designed to enhance performance for dairy cattle. Like the ruminant plasma-based milk replacers, however, it is a relatively new product, having been on the market for approximately two years. The manufacturer stated that their product had been selling for more than twice the price of conventional blood meal to dairy producers (i.e. roughly $1,200 per ton compared to an average price for ruminant blood meal in 2003 of $550 per ton). The premium protein additive can be used by other species but cannot be sold for nearly the same price (Betton, 2004).

Prices for porcine-derived plasma products are likely to experience some long-term price increase because they can possibly be substituted for some ruminant species as well as for porcine uses. There is substantially less porcine-derived plasma than beef plasma so demand will generally be very tight for the porcine-derived plasma.

Combining the therapeutic and the premium ruminant market impacts, there is a net reduction in the market value of ruminant-derived products. Although ERG lacked a precise means of separating regulatory from roughly similar international demands for additional safeguards on production, ERG estimated an aggregate loss of market value from the FDA regulation of $10 million per year. This figure is speculative, pending the possibility of better information offered by industry executives. In lieu of more complete information, ERG made this estimate to acknowledge the decline in the value of production of these specialized products.

Commodity ruminant blood meal is valued as a source of protein and amino acids. It has been consumed predominantly by dairy cattle, although it can also be used as a supplement in other species diets. An alternative regulation with the expanded prohibition will adversely affect this market.

With the alternative regulatory prohibition on blood meal for ruminants, a large number of feed mills will drop ruminant blood meal from their rations for ruminant animals. Based on the Feed Magazine survey of mills (introduced in Section One), 50 percent of mills use blood meal (Gill and Lobo, 2004). Because 76 percent of blood meal is derived from ruminant sources, this suggests that as many as 2,300 mills of the total of 6,100 will quit using ruminant blood meal. (For mills that do not feed any ruminant animals, ruminant blood meal can be retained in rations.) For many of these mills, ruminant blood meal is the last ruminant-derived protein used in rations. They will substitute other protein sources, such as porcine blood meal, fishmeal, or vegetable-based protein sources where and when they are available and cost effective. The mills or their customers might also add amino acid supplements to the feeds to achieve the characteristics of the previous blood meal constituents. [Many smaller mills purchase protein-containing premix, some of which include blood meal, and probably do not receive blood meal shipments directly themselves. Premix suppliers will drop blood meal from many of these products.]

Feed substitution efforts generate various impacts, although most impacts do not represent net social costs. The prohibition of blood meal will increase feed costs for some animal producers but potentially reduce costs for others. Porcine blood meal will increase in price, thereby adversely affecting its consumers (primarily dairy cattle) and benefiting porcine animal producers. Prices for other protein sources to substitute for ruminant dairy cattle in some feed mixes might also increase slightly, although the net effect on some prices (e.g., soybean meal) will be extremely small and will not be discernible.

With these changes, some animal producers would see feed price increases. Commodity porcine and ruminant blood meal are interchangeable, but supplies of porcine blood meal are inadequate to replace all ruminant blood meal in dairy cattle diets. Three-quarters of blood meal is derived from bovine sources and only about one-quarter from porcine sources. Dairy farmers and other animal producers that continue to use porcine blood meal would pay higher prices. Dairy farmers that cannot obtain porcine blood meal but who choose to maintain current protein and amino acid levels in their feeds would also pay higher prices. Still other dairy farmers might respond to the shortage of blood meal by abandoning this component of their feeds, thereby settling for a lower-protein feed for their animals. ERG considers the aggregate significance of these price increases in the discussion below. The impacts of feed price changes are also addressed further in Section Four in the context of dairy farm budgets.

Table 3-1 indicates that 54.8 million pounds or 27,400 tons of porcine blood meal (counting both integrated and independent rendering production) are produced annually. For these calculations, it is assumed that porcine blood meal is substituted for ruminant blood meal currently fed to dairy cattle. In February, porcine blood meal was selling for $880 per ton. Prior to the FDA announcement of an interim final rule, ruminant blood meal was selling for $455 per ton. Ignoring all other possible normal market influences on prices, these prices indicate that porcine blood meal at that point is either $425 per ton more expensive than ruminant blood meal was before the announcement. This translates to an income transfer of $11.9 million or $3.9 million per year from dairy farmers to pork renderers (i.e., porcine blood meal producers) and ultimately pork producers.

Table 3-2 presents the quantities and average 2003 prices for commodity blood meal derived from porcine and ruminant sources. Based on an average annual price for 2003, and estimated quantities, blood meal sales generated approximately $41+ million in annual revenues for 2003.

Table 3-1: Blood Meal Production Volumes, by Type of Producer (Millions of pounds)

Blood Meal Category	Blood Meal Producer		Total	Percentage Share of Production for Integ./Indep. Renderers
	Integrated Packer/ Renderer	Independent Renderer		
Porcine and other single species	43.8	11.0	54.8 (24.2%)	80/20
Ruminant only	109.7	12.2	121.9 (53.8%)	90/10
Mixed species	24.9	24.9	49.8 (21.9%)	50/50
Total	**178.5**	**48.1**	**226.5**	Not applicable

Source: Sparks Companies, Inc., 2001. Distributions between integrated and independent renderers were estimated by ERG based on the Sparks estimate that roughly 80 percent of blood meal is produced by integrated facilities.

Table 3-2. Recent Price History and Price Changes in Early 2004 for Ruminant and Porcine Blood Meal ($/Ton)

Date	Ruminant	Change Since January 26, 2004	Porcine	Change Since January 26, 2004	Premium Price for Porcine Blood Meal ($/ton)
2001 (Average)	$359	NA	$400	NA	+$41
2002 (Average)	$320	NA	$382	NA	+$62
October 11, 2003	$418	NA	$429	NA	+$11
January 26, 2004	$455	NA	$507	NA	+$52
January 30, 2004	$354	-$101	$534	+$27	+$180
February 6, 2004	$218	-$237	$755	+$248	+$537
February 14, 2004	$313	-$142	$880	+$373	+$567
February 20, 2004	$350	-$105	$875	+$368	+$525

Date	Ruminant	Change Since January 26, 2004	Porcine	Change Since January 26, 2004	Premium Price for Porcine Blood Meal ($/ton)
February 28, 2004	$500	+$45	$838	+$304	+$338
March 20, 2004	$544	+$89	$596	+$89	+$52
May 1, 2004	$518	+$63	$584	+$77	+$66
May 22, 2004	$527	+$72	$692	+$185	+$165
June 12, 2004	$545	+$90	$867	+$360	+$322
June 26, 2004	$553	+$98	$1,000	+$493	+$447
July 17, 2004	$580	+$125	$1,075	+$568	+$495
July 31, 2004	$441	-$4	$875	+$368	+$434

NA= Not applicable
Source: Sources: USDA, 2003b for 2001 and 2002 averages and USDA, 2004 for weekly data.

Unlike ruminant MBM prices, blood meal prices showed no obvious reaction to the original discovery of the infected cow in Washington State, but remained fairly consistent through December 2003. The inclusion of a possible blood meal restriction in the FDA announcement on January 26, 2004, however, caused immediate, significant price movement. As shown in Table 3-2, porcine blood meal prices increased by several hundred dollars per ton and ruminant blood meal prices declined by more than half in the immediate aftermath. A market analyst for Jacobsen market newsletter, a prominent agricultural price monitoring publication, described the market condition as of early February as very uncertain, with buyers very tentative about what purchases they should or would be allowed to make in the future (Dieterichs, 2004). As of mid-March, the market had moved back towards late 2003 conditions and porcine blood meal was selling at only a $52 premium to ruminant blood meal. Nevertheless, in May and June, porcine prices increased once again, peaking at $1,075 in mid July and falling to about $875 at the end of July. Ruminant blood meal prices retained their level through much of July but then dipped again late in that month.

Table 3-3 shows revenue gains and losses for producers of blood meal, using the assumption that the immediate post-announcement price shifts from February 2004 against ruminant blood meal will reflect the long-term relationship among these products. That assumption is probably pessimistic because the assumption gives too much emphasis to the near term elimination of the dairy cattle market, without allowing for some emergence of alternative markets for this valuable protein product. The projection also makes an implicit assumption that the supply of blood meal is relatively inelastic. In any case, the table illustrates the possible pattern of price impacts, in which porcine blood meal manufacturers receive a windfall and ruminant blood meal producers incur a revenue decline. Because of the market shifts and the size of the relative price moves, the short-term price impacts resulted in a net loss of revenue to the industry. The bulk of the short-term losses were incurred by integrated packer/renderer operations that recover the larger share of blood during slaughtering.

Table 3-3. Short-Term Change in Producer Revenues from Blood Meal Production, by Type of Producer, Assuming February 14, 2004 Prices Hold for Year

Blood Meal Category	Blood Meal Producer (millions of pounds)		Change in Price Due to Regulation ($/ton)	Change in Producer Revenue ($million)	
	Integrated Packer/ Renderer	Inde-pendent Renderer		Integrated Packer/ Renderer	Inde-pendent Renderer
Porcine and other single species	43.8	11.0	+373	$8.2	$2.0
Ruminant only	109.7	12.2	-142	-$7.8	-$0.9
Mixed species	24.9	24.9	-142	-$1.8	-$1.8
Total	**178.5**	**48.1**	**NA**	**-$1.4**	**-$0.6**

NA=Not applicable; Totals might not add due to rounding.
Source: See quantities estimated in Table 2-1 and ERG assumptions about average post-regulation price change.

ERG forecasts that commodity ruminant blood meal should eventually retain a market value consistent with its inherent protein value. The long-term price impact might be slightly negative due to some additional costs to transport material to new markets or other relative inefficiencies in use in new markets. As described below, transportation cost impacts for ruminant materials are forecast to create impacts for renderers.

Much of the decline in renderers' market revenues would be passed on to animal producers through a small decline in the drop value of animals at slaughter.

The average dairy farm is estimated to spend approximately $71,000 per year in feed for approximately 81 cows, according to the 1997 Census of Agriculture (US Department of Agriculture, 1999b). Across 129,034 dairy farms, this translates to $9.16 billion per year in total feed expenditures. Blood meal is added to dairy rations in small quantities of no more than 1 lb per day per cow due to its poor palatability, and many dairy cows are not fed blood meal. Using the upper and lower range of the price increases that might be attributed for replacement (porcine) blood meal ($11.9 million or $3.9 million per year), dairy farmers would incur an aggregate price increase of 0.13 percent to 0.04 percent. The impact of the possible increase in blood meal or replacement protein costs is assessed on a farm-specific basis in Section Four.

3.1.1 Investments for Feed Mix Relabeling, Reformulation, and Reregistration in Response to Elimination of Blood Meal Exemption

Feed mills would be substituting away from ruminant blood meal to other protein sources in order to comply with the FDA alternative regulatory formulation. Table 3-4 summarizes these costs. As noted above, 50 percent of mills in 2003 were including blood meal in their rations (Gill and Lobo, 2004). Given that approximately three quarters of blood meal is from ruminant sources, ERG further assumed that three quarters of these mills would need to reformulate their blood meal-containing mixes (Sparks Companies, Inc., 2001).

Table 3-4. Costs for Feed Mills to Relabel, Reformulate, and Reregister Feed Mixes

Row No.	Cost Category or Parameter	Cost or Value	Source or Basis for Assumption
	GENERAL MILL INFORMATION		
1	Number of feed mills potentially affected	6,099	FDA Database of feed ban inspections
2	Number of mills/corporate entities affected	10	ERG review of FDA database entity names
3	Number of corporate entities affected	610	Row 1 divided by row 2
4	Percent of mills forecast to change labels	50%	Based on Gill and Lobo, 2004; see text
5	Percent of blood meal from ruminant sources	76%	Sparks Companies, Inc., 2001
6	Number of mills affected	2,318	Row 1 * row 4 * row 5
7	Number of feed mixes in average mill	291	Gill and Lobo, 2004
8	Percent of mixes affected by regulation	15%	ERG estimate; see text
9	Number of affected feed mixes in average mill	43.7	Row 7 * row 8
	RELABELING COSTS		
10	Number of mixes per corporate entity potentially affected	65	Assumed to exceed avg. number of mixes
			per mill by 50%. (Row 9 * 1.5)
11	Percentage of affected mixes to be relabeled	50%	ERG estimate; see text
12	Cost of printing plate change per feed label revised	$120	ERG estimate
13	Total cost for preparing new printing plates	$2,395,992	Row 3 * row 10 * row 11 * row 12
14	Labor costs per feed label revised, by staff category	$18.76	Sum of labor costs
15	Senior management ($52.12/hr)	$2.61	BLS, 2004; 0.05 hrs/label, per ERG estimate
16	Nutritionist ($39.70/hr)	$1.99	BLS, 2004; 0.05 hrs/label, per ERG estimate
17	Middle management ($26.81/hr)	$13.41	BLS, 2004; 0.5 hrs/label, per ERG estimate
18	Clerical ($15.26/hr)	$0.76	BLS, 2004; 0.05 hrs/label, per ERG estimate
19	Per corporate entity costs for revising labels	$614.13	Row 10 * row 11 * row 14
20	Total corporate entity costs for relabeling feed mixes	$374,559	Row 3* row 19
21	Potential cost of discarding unused inventory of labels/mix	$120	See text; based on 30-day implementation
22	Potential cost/mill of discarding unused label inventory	$2,619	Row 9 * row 11* row 21
23	Total industry cost for discarding unused inventory	None	FDA is assumed to allow inventory to be used
24	Aggregate industry costs to relabel affected mixes	$2,770,552	Row 13+row 20+row23
	REFORMULATION COSTS		
25	Nutritionist's assessment of new requirements (once/mill)	$158.82	BLS, 2004; 4 hrs/mill, per ERG estimate
26	Labor hours per feed mix reformulation, by staff category	$24.56	Calculated sum of labor costs
27	Senior management ($52.12/hr)	$2.61	BLS, 2004; 0.05 hrs/mix, per ERG estimate
28	Nutritionist ($39.70/hr)	$19.85	BLS, 2004; 0.5 hrs/mix, per ERG estimate
29	Middle management ($26.81/hr)	$1.34	BLS, 2004; 0.05 hrs/mix, per ERG estimate
30	Clerical ($15.26/hr)	$0.76	BLS, 2004; 0.05 hrs/mix, per ERG estimate
31	Per mill cost for reformulating mixes	$1,231	(Row 9 * row 26) + row 25
32	Aggregate industry costs to reformulate affected mixes	$2,852,828	Row 6 * row 31

Row No.	Cost Category or Parameter	Cost or Value	Source or Basis for Assumption
	RE-REGISTRATION COSTS		
33	Percentage of affected mixes to be relabeled	50%	ERG estimate; see text
34	Percentage of mixes not manufactured in licensing states	20%	ERG estimate; see text
35	Potential number of mixes per corporate entity	65	Assumed to exceed avg. number of mixes per
			per mill by 50%. (Row 9 * 1.5)
36	Average number of state registrations per mix	20	See text
37	Per corporate entity, number of re-registrations required	131	Row 33 * row 34 * row 35 * row 36
38	Average state re-registration fee per product per state	None	Assumed that fee is waived for re-registration
39	Labor hours per re-registration, by staff category	$16.77	Calculated sum of labor costs
	Senior management ($52.12/hr)	$2.61	BLS, 2004; 0.05 hrs/reg., per ERG estimate
	Middle management ($26.81/hr)	$13.41	BLS, 2004; 0.5 hrs/reg., per ERG estimate
	Clerical ($15.26/hr)	$0.76	BLS, 2004; 0.05 hrs/reg., per ERG estimate
40	Per corporate entity, re-registration costs	$2,197	Row 37 * row 39
41	Aggregate costs to reregister affected mixes	$1,339,687	Row 3 * row 40
	TOTAL OF RELABELING, REFORMULATION		
	AND REREGISTRATION COSTS	$6,963,066	(Row 41 + row 32 + row 24)
Totals might not add due to rounding.			
Source: As described by each item. ERG estimates are described in the text.			

In estimating these administrative costs, ERG assumed that most work would be performed at corporate offices where centralized administrative staffs prepare the various notifications to state agencies. The corporate offices will prepare new labels for distribution to the mills, and, when necessary, re-register with state agencies. Each corporation in the feed industry was assumed to operate ten mills each. Each feed mill will discard unused label inventories and reformulate mixes, based on their local prices and alternative substitute products. Other assumptions and estimates were also used:

- The average mill prepares almost 300 mixes, which are often intended for a variety of animal populations.

- ERG assumed that 15 percent of mixes need to be reformulated, with the largest share of changes involving the removal of blood meal or other blood-containing feed additives.

- Based on the Feed Management Magazine survey of feed mills, 50.0 percent of mills used blood meal in their mixes (Gill and Lobo, 2004). (Many mills incorporate blood meal only indirectly through its inclusion in premixes that they incorporate into their feed. ERG has assumed that these mills might incorporate premixes into their own mixes so that relabeling of blood meal containing mixes is still required.) Further, an estimated 76 percent of blood meal is derived from ruminant animals (Sparks Companies, Inc., 2001). Combining this data, ERG calculated the share of mills likely to need to reformulate feeds. A small number of additional mills will need to revise mixes in which ruminant MBM is currently being used, such as where the mill is dropping this ingredient to come within the dedicated equipment requirements. These mixes are assumed to be accounted for within the 15 percent of mixes in affected facilities that will be reformulated.

- ERG assumed that the feed industry will need to relabel one-half of the changing mixes. ERG assumed that the other half of labels will not need to be relabeled because the original label will still describe their revised mix because of the coverage of the collective term for “animal protein products” and/or other proteins.

- Many states, especially in the Midwest, license feed mills instead of registering products. Thus, ERG judged that re-registration is required only in states that are not licensing and this share was estimated at 20 percent of all affected feeds.

- ERG also assumed that each corporate entity must register its feed with 20 state agencies, although the state agencies will not charge a new registration fee for a reregistered product.

- The discarding of obsolete labels could generate a major share of the compliance costs, although FDA might allow the feed industry to draw down its inventories. If inventories must be discarded for more rapid implementation, the number of labels discarded has been estimated at roughly 6,000 per mix, which (at $20 per thousand) generates a cost per mill per mix of $120. The aggregate cost of this provision would be approximately $6 million. Nevertheless, ERG assumed that FDA would allow the old label supplies to be exhausted before new labels are used and no costs are included in the totals.

- Some portion of these relabeling exercises might coincide with annual reregistration cycles. In those cases, mills would be revising labels anyway and the incremental costs of regulation-driven relabeling would be reduced or virtually eliminated. That is, manufacturers can incorporate multiple labeling changes at approximately the same cost as a single labeling change. Nevertheless, given uncertainty on the timing of any required changes, ERG did not adjust costs downward for this possibility.

ERG estimated a total industry cost of $7.0 million in the first year for this expense. Annualized over ten years at 7 percent and 3 percent respectively, the industry costs are $0.99 million or $0.82 million per year. The average one-time investment cost per mill for relabeling is estimated at $3,004.

3.2 A Dedicated Equipment Requirement (Separate from an SRM Regulation): Rendering Industry Impacts

FDA has been considering a dedicated equipment requirement for those producing or handling animal feeds or feed ingredients. Under such a regulatory requirement, renderers of non-ruminant protein would need to exclude all ruminant protein from their facility. Similarly, feed mills would need to exclude all ruminant protein-containing feed if they prepare feeds for ruminant animals in their facility. Thus, the net effect of this change is a further restriction in ruminant protein markets and a corresponding price decline.

The effect of the new market restrictions would be offset to some extent where feed mills choose to dedicate their operations to feeding of non-ruminant animals and increase their purchases of ruminant protein. Similarly for the rendering industry as a whole, the net negative impacts on some renderers are offset by likely price increases for renderers that sell porcine protein, a common substitute in animal diets for bovine protein. In general, the market losses for ruminant protein is forecast to be larger than the gain for porcine protein as some animal feeders might shift away from ruminant-derived to fish or grain-based protein sources.

Table 2-8 in the previous section presented the estimated distribution of ruminant MBM production between integrated packer/renderers and independent renderers. The packer/renderers produce a larger volume of material and the majority of the species-specific product. Independent renderers produce the majority of mixed species material, and their MBM products almost always contain some ruminant protein. In general, packer/renderers producing porcine MBM would benefit relative to independent renderers, most of whom sell ruminant MBM.

The renderers' decisionmaking will be directly influenced by the price differentials among the protein products they can produce. Table 3-5 presents the recent price history for ruminant and porcine MBM in the domestic US market. In late January 2004, FDA announced that expanded regulations on bovine protein would soon be in place. As of July 2004, however, the long-term price impacts on MBM of the January FDA announcement of a potentially expanded prohibition are not yet discernible or measurable with econometric techniques. (Several years of price data and stabilized MBM markets would be needed before such measurements are well developed.) After the original discovery of a cow with BSE in December 2003, market observers noted that export markets for beef and ruminant (and even porcine) MBM were closed. MBM suppliers initially struggled to redirect their product into productive uses, resulting in steep price declines (USDA, 2004), with prices falling from over $200 to under $100 per ton. As of the end of February, ruminant MBM prices appeared to stabilize and increase as poultry producers appeared to take advantage of the bargain prices and purchased increased volumes for poultry feed. As of July 31, 2004, prices for MBM in the Central region (as defined in USDA reporting) had risen to $211 per ton. (The fact that ruminant MBM prices passed those existing prior to the discovery of the cow presumably reflects the normal rise and fall of MBM prices. It also suggests, but does not prove, that price impacts would not be very significant. There is insufficient data to estimate by econometric methods the impact of the mad cow discovery or the FDA announcement regarding a possible rulemaking on prices.)

Table 3-5. Recent Price History and Price Changes in Early 2004 for Ruminant and Porcine Meat and Bone Meal ($/Ton)

Date (Week Ended)	Ruminant	Change Since January 26, 2004	Porcine	Change Since January 26, 2004	Premium Price for Porcine Blood Meal ($/ton)
2001 (Average)	$166	NA	$189	NA	+$23
2002 (Average)	$164	NA	$171	NA	+$7
October 11,2003	$208	NA	$210	NA	+$2
January 26, 2004	$84	NA	$145	NA	+$61
January 30, 2004	$92	+$8	$152	+$7	+$60
February 6, 2004	$103	+$19	$196	+$51	+$93
February 14, 2004	$160	+$76	$227	+$82	+$67
February 20, 2004	$175	+$91	$245	+$100	+$70
February 28, 2004	$212	+$128	$273	+$128	+$61
March 20, 2004	$263	+$179	$294	+$149	+$31
May 1, 2004	$242	+$158	$287	+$142	+$45
May 22, 2004	$193	+$109	$272	+$127	+$79
June 12, 2004	$187	+$103	$276	+$131	+$89
June 26, 2004	$225	+$141	$289	+$144	+$64
July 17, 2004	$285	+$201	$352	+$207	+$68
July 31, 2004	$211	+$127	$273	+$128	+$62

NA= Not applicable
Sources: USDA, 2003b for 2001 and 2002 averages and USDA, 2004 for weekly data.

Past econometric work on this market indicated that the original FDA feed ban had created a statistically significant structural change in the industry and a reduction in the price of prohibited MBM (See, for example, Sparks Companies, Inc., 2001). Casual observation of more recent market prices, however, suggests that the feed ban's structural modification of the market had been moderating. As shown in Table 3-5, the price differential between prohibited MBM and (unrestricted) porcine MBM had declined to very modest levels, throughout 2001 and most of 2003. Nevertheless, there is considerable potential for error in such observations.

Lacking a substantial series of price data for the period after the FDA announcement, ERG can only theorize about likely long-term price impacts on ruminant MBM prices. The February and March 2004 convergence of ruminant and pork MBM prices after an initial market shock suggests that ruminant MBM prices might not be dramatically affected over the long run. The inherent protein and nutrient value of ruminant MBM in non-prohibited uses should continue to be reflected in the protein markets. These markets for ruminant protein are price elastic so that any temporary ruminant MBM price decline would likely result in increased consumption in those markets where it can still be used (e.g., poultry rations).

Further, ERG estimates that a dedicated equipment requirement (separate from an SRM ban) would affect only a small share of ruminant MBM. As will be noted in the feed mill discussion, many large mills removed ruminant MBM in response to the 1997 feed ban requirements and only 6.2 percent of mills continue to receive ruminant protein.

The likelihood of modest long-term price impacts from a dedicated equipment requirement is also based on the observation that the largest purchasers of ruminant MBM, poultry producers and pet food manufacturers, appear likely to continue using the product. Table 3-6 presents the distribution of consumer markets for MBM. Poultry feeders represent the largest share of the market at 43 percent as of 2000. Based on some recent reports, poultry feeders responded to the short-term price declines of February 2004 with exceptionally high inclusion rates for prohibited MBM in chicken rations.

Table 3-6. US Sales of Ruminant and Non-Ruminant MBM, by Market

	Percent of Sales	
Purchasing Sector	**1995**	**2000**
Beef Cattle	7	4
Dairy Cattle	8	6
Pork	11	13
Poultry	42	43
Pet Food	22	23
Other	10	11
Total	**100**	**100**

Source: Sparks Companies, 2001.

ERG does note that a dedicated equipment requirement (and the transportation dedication equipment requirement described below) might cause some market inefficiencies in distribution of the restricted protein to the animal feeders. While renderers continue to produce prohibited MBM, some product would either need to be transported greater distances to find its market (with transportation costs as described below). ERG notes that some feed industry executives expect significant price differentials between prohibited and non-prohibited MBM to persist.

As markets adjust to a new regulatory structure, renderers would continue to experience a short-term decline in revenues relative to those they would otherwise have received. These are generated by industry and world market reactions, as well as by the potential for regulatory action.

Thus, data are inadequate to formally model or forecast long-term price impacts. ERG judges, however, that ruminant and mixed species MBM should continue to be valuable inputs for feed mills based on their inherent protein and amino acid content. ERG also forecasts that over the long run, after a period of adjustment among feed mills and feeders, prohibited MBM would recover most of the apparent lost premium to porcine MBM.

3.2.1 A Dedicated Equipment Requirement: Renderer Investments

ERG considered the potential costs of renderer investments in dedicated facilities. Some renderers would need to or would choose to change their facilities and operations in order to comply with the expanded feed rule and maintain or possibly expand their markets. As for feed mills, only renderers with certain characteristics would consider new investments in dedicated facilities. This discussion presents a forecast of the potential for spending to develop dedicated rendering facilities.

FDA's inspection database indicates that 41 rendering facilities handle ruminant proteins and prepare materials that are intended for use in ruminant feed. These facilities are most likely to be considering the development of dedicated cooking and grinding lines.

ERG contacted a selection of these rendering facilities to gauge the potential interest in plant renovations and additions. These contacts covered primarily independent renderers. (Some contacts discussed plans for rendering facilities that were not among the 41 that appeared most likely to be contemplating changes in operations.) Table 3-7 presents the summary of contacts. ERG suppressed some information about the size of the companies or their exact activities in order to avoid revealing company identities.

In general, few renderers appeared likely to invest in dedicated facilities. One firm (#2) currently separates poultry and ruminant MBM at one facility. The firm had previously invested a portion of the equipment needed to create a dedicated facility. That firm planned to spend an additional $1 million to complete construction of dedicated facilities and also to take advantage of the increased price differential they foresee between ruminant MBM and poultry byproduct. Another firm (#1) operates two rendering lines in a rendering facility and can now create separate, dedicated facilities relatively easily. Both of these companies anticipated that they could construct these separate, dedicated facilities within the same structure as ruminant MBM processing, a presumption that had yet to be tested. Another firm (#3) is now separating ruminant and poultry materials at one facility, and receives a price premium for the poultry-based product. The firm would have an incentive to dedicate facilities so that the poultry product could continue to receive its price premium, and not be grouped with the restricted ruminant material. This firm judged, however, that they probably could not expand this urban-location plant due to technical reasons and permitting obstacles.

Table 3-7. Summary of Rendering Industry Contacts on Potential Processing Changes to Satisfy a Dedicated Facility Regulation (Not Including Transportation Impacts)

	Facility Operations	Current Affected Rendering Operations	Possible Changes in Operations	Economic Impacts
1	Operates one facility with two rendering lines	Can readily separate processing into two dedicated lines, assuming requirements do not require separate buildings	No major changes in rendering operations; can achieve dedication with modest effort	No major investment costs or operating cost increases are forecast although no quantitative estimates were given
2	Operates multiple rendering facilities	One plant has virtual dedicated processing lines at present; A second plant (not now separating) has part of the equipment needed for running two separate dedicated lines	Would spend approximately $1 million to dedicate new line in one of two plants	Facility had previously made part of expenditure needed to prepare for possible regulatory concerns; price differential forecast is now sufficient to proceed with full dedication investments

	Facility Operations	Current Affected Rendering Operations	Possible Changes in Operations	Economic Impacts
3	Operates numerous rendering facilities	Is separating materials at one facility only	Cannot develop dedicated facility where now segregating materials so processing would not change	Company would lose revenue premium from a poultry by-product that would now be mixed with ruminant MBM
4	Comments address only one rendering facility of large network	Was separating materials in plant	Would no longer be able to separate MBM product or produce a premium blood meal-containing product	Would lose value of premium blood meal containing product for dairy cows and premium on separated non-prohibited MBM. Processing change also invalidates much of computer-based safety system in rendering operation.
5	Operates numerous rendering facilities	Renders beef and swine	No processing changes forecast	No economic impacts in processing
6	Operates numerous rendering facilities	Processing primarily mixed species, with limited non-prohibited material; not manufacturing blood meal	No processing changes forecast	No economic impacts in processing
7	Operates numerous rendering facilities	Processing primarily mixed species, adding some non-prohibited materials into ruminant MBM; not manufacturing blood meal	Company is considering dedicated operations at one plant with two lines, or by trucking raw materials to separate plants	FDA final rule would not directly mandate changes; Would wait on dedication decisions until relative prices can be forecast

Source: Telephone contacts made by ERG to selected renderers.

Renderers # 3 and 4 indicate that they expect to lose a portion of their revenues if they can no longer separate proteins. This would force them to include non-prohibited with prohibited raw materials and sell the combined mix as prohibited.

Overall, ERG was able to review the circumstances of 11 of the 41 rendering facilities that, based on the FDA's inspection data, appeared most likely to face adverse impacts. (Although contractors such as ERG are allowed by Office of Management and Budget to interview no more than nine entities for a given survey without formal authorization, some executives were able to review the status of more than one rendering facility owned by their company. Due to brief project deadlines, no OMB authorization for a larger survey was sought.) Of these 11, 1 plant (9 percent) planned to modify their existing partially separated processing capabilities to create two separate dedicated processing lines. Two more facilities (18 percent) would cease separation activities and would produce only a lower-priced mixed species MBM, thereby losing the price premium on non-prohibited materials. (Note: Renderer #2 would invest in a facility that is not one of the rendering facilities currently separating and, therefore, is not considered to be "forced" by the regulation to consider an investment in dedicated facilities.)

The other seven facilities would not be dedicating or otherwise changing their rendering processes. For several of these facilities, it was not possible to determine why their operations were recorded as they were in FDA's database. Based on the telephone discussions, ERG can judge only that the renderers (1) had abandoned separation of materials since their last FDA inspection, (2) had understated the scope of their processing activities when contacted by ERG, or (3) FDA and state inspectors had categorized firms incorrectly when completing the inspection forms. Based on a review of the questionnaire and discussions with FDA, it appeared most likely that some firms had been categorized incorrectly regarding the intended use of their materials (i.e., their processed materials were not actually intended for ruminant feed.)

In any case, the finding that few renderers would invest in new process equipment is quite consistent with the forecasts of industry-wide impacts made by industry executives contacted for this study. In general, these executives judged that few companies would now undertake separation/dedication efforts if they had not undertaken them previously. Renderer company options are constrained by their sources of raw materials and firms with non-restricted raw materials were likely to have already taken whatever measures they could to manufacture premium MBM products without the potential for contamination. The observers also noted that some renderers would lose the ability to separate and make premium products, incurring a market loss.

Although there is considerable uncertainty in forecasting industry actions, ERG extrapolated these results over the 41 facilities most likely to consider investments in dedicated facilities or to incur losses from reducing their product line. ERG thus calculated that renderers would invest in dedicated operations at 9 percent of 41 facilities or 4 facilities and would incur market losses at 18 percent of these facilities or 7 facilities. These latter market impacts are separate from the industry-wide impacts of changes in market prices for prohibited and non-prohibited MBM.

The cost per rendering facility for renovations are estimated based on the expectation that partial separation and dedication facilities are already in place. Of the two plants identified as making or considering investments, one plans to spend $1 million and the other stated that they did not require major work but had not prepared a cost estimate. In previous research on the rendering industry, an executive estimated the costs of a new cooker (the principal component of a rendering line) at roughly $1 million, the cost of an entire cooking/grinding line at roughly $5-7 million dollars, and a new plant at $10-14 million (Carlson, 1996). ERG assumed that renderers investing in dedicated lines would have some equipment in place but, based on comments from the only firms providing this data, allowed for a total investment cost of $2 million for potential supplemental requirements related to the FDA dedication requirements. Applying this estimate to the 4 plants projected to make investments generates a total industry investment cost of $8 million. Annualized over 10 years using a 7 percent and 3 percent discount rate, these investments represent expenditures of $1.14 million or $0.94 million per year.

Large relative price differentials between prohibited and non-prohibited MBMs would encourage more renderers to invest in dedicated facilities, even if the facilities are not separating materials at present. Thus, the criteria applied to the FDA database to identify the renderers most likely to dedicate facilities might miss some candidates. For example, ERG discussed the possibility of dedication investments with a renderer of mixed species MBM and poultry byproducts serving poultry feeders. This renderer might consider separating mixed species and poultry MBM if the relative prices are far apart. For this particular renderer, however, FDA is not mandating the change because either of his protein products can be fed to poultry. Nevertheless, such firms are typical of those renderers that collect varied raw materials among several rendering facilities and, at higher price differentials, might choose to reorganize production among facilities. ERG forecasts that such instances would be rare but could be more numerous if long run price differentials are fairly substantial.

Rendering facility closures are a possibility among facilities that would be losing the ability to separate materials and would experience the most significant revenue declines. Closures would occur among renderers who judge that the return on investment in dedicated facilities would be inadequate but who would lack an economically efficient scale of operation without all of their major product lines. ERG did not identify any rendering facilities that appeared to be good candidates for near-term closure. Current market prices, including prices for tallow, another unrestricted cattle by-product captured by renderers, remain fairly high relative to historic levels. These high prices might help create a temporary buffer for existing renderers against the impact of adverse market impacts.

3.2.2 A Dedicated Equipment Requirement: Feed Mill Impacts

Feed mills currently handling ruminant protein and whose facilities are not currently dedicated solely to feeding of non-ruminant animals would have to adjust their practices to comply with a possible FDA regulatory alternative requiring dedicated facilities. Specifically, affected facilities have the following options:

(1) Invest in the expansion of their facility to create the dedicated, separate facilities required.

(2) Cease handling of ruminant protein (and feed ruminants and/or other species), but continue serving all of their clients' species populations. Thus, if the feed mill continues to serve ruminant populations, it would substitute non-restricted protein sources for ruminant protein for the non-ruminant populations.

(3) Cease services to the ruminant populations (i.e., feed non-ruminants with ruminant protein or any desired feed).

(4) For feed mill companies with multiple facilities within a region, reallocate customers, to the extent they can, among nearby feed mills while continuing to serve all species populations. Thus, nearby mills might dedicate facilities to one species or another and serve other specie populations from other mills. (The opportunities for specialization by reallocating service geographically are very limited.)

To forecast feed mill responses, ERG first compiled statistics describing the current makeup of feed mills, and their protein handling and customer characteristics. ERG used the FDA feed mill inspection results as of January 23, 2004 to assess the potential impact of a possible FDA rule.

The FDA data indicates that a large majority of mills are not handling ruminant MBM. Additionally, various industry observers commented on this pattern and noted that larger feed mills are particularly likely to have dropped ruminant MBM from their feed inputs in the years since the 1997 feed rule. Because ruminant blood meal was not previously prohibited, FDA inspectors have not asked mills whether ruminant blood meal was included in their rations. Based on industry contacts, ruminant blood meal has remained in wide use for bovine rations, especially for dairy cows where protein requirements are particularly high. Sparks Companies, Inc, which has prepared several reports related to the costs of the FDA feed restrictions, reports that 70 percent of blood meal is fed to dairy cattle (Sparks Companies, Inc., 2001). Blood meal is also used as a feed additive for pigs, especially as a starter feed.

Table 3-8 describes the patterns of ruminant MBM use and ruminant feeding among feed mills, as reported in the FDA inspection database. Renderer and protein blender activities are also summarized. This compilation represents a summary of the last inspections made to the facilities and covers through the period to January 23, 2004. According to FDA, feed mills that were not using ruminant MBM during inspections in 1999 or 2000 were given lower priority for re-inspection and might not yet have been revisited (Bataller, 2004). Overall, FDA statistics show 124 mills (34 licensed feed mills and 90 unlicensed feed mills) were using ruminant MBM and produced ruminant feed at the time of last inspection. Further, 41 renderers and 27 protein blenders handle ruminant protein and prepare non-ruminant protein for use in ruminant feeds.

Table 3-8 Feed Mill and Renderer Ruminant Feed and Protein Handling Practices

Feed Mill or Feed Producer Category	Number of Entities in FDA Inspection Statistics	Number Handling Ruminant Feeds (a)	Percent of Total Facilities	No. Also Handling Prohibited Ruminant Protein	Percent of Total Facilities
Licensed feed mills	1,082	749	69.2%	34	3.14%
Unlicensed feed mills	5,017	4,387	87.4%	90	1.79%
All feed mills	6,099	5,136	84.2%	124	2.03%
Renderers	235	108	46.0%	41	17.45%
Protein blenders	250	198	79.2%	27	10.80%

(a) Facilities with incomplete inspection records on handling practices were included in this column. That is, they were assumed to be handling materials intended for ruminant feed.

Notes: Some establishments perform multiple functions and are listed in more than one category.
Source: Food and Drug Administration, 2004.

ERG contacted a small sample of mills (nine) that the FDA inspection data indicated might be affected by a dedicated facilities requirement. FDA's database indicated that these mills were both handling prohibited ruminant MBM protein and preparing feeds for ruminant animals. ERG staff asked each mill operator, under a dedicated facilities requirement, if they planned to change their operations and if so, what changes were planned. Based on the mill responses, ERG judges that some mills might invest in or renovate their facilities in order to claim "dedicated" operations, whereas others would drop ruminant material from their inventories. Table 3-9 summarizes the mill responses.

Table 3-9 Summaries of Telephone Survey Responses to Potential Expansion of Ruminant Protein Feed by Potentially Affected Feed Mills

Mill	Can we confirm that your mill prepares ruminant feeds and uses ruminant protein in same facility?	Probable mill response to potential rule changes	Net impact of potential rule changes
1	Yes, although only ruminant blood meal now used	Appear likely to drop ruminant blood meal use	Adverse impact; Some increase in feed costs forecast by mill
2	Yes, mill handles ruminant protein and prepares ruminant feed	Mills owns several facilities and plans to renovate inactive mill to "dedicated" status	Mixed impact: Would incur cost for inactive mill renovation but sees market opportunity and potential increase in market share
3	No, mill handles ruminant protein but doesn't make ruminant feed (only poultry feed)	No response required	No impact
4	No, mill does not handle ruminant protein or make ruminant feed; Facility makes only feed pre-mix	No response required	No impact
5	Yes, with caveat. Mill uses ruminant protein and, until recently, made ruminant feed	In immediate response to FDA announcement, mill dropped cattle feed and will now only purchase feed from other sources	Adverse impact; mill will purchase and distribute bagged cattle feed and pass increased costs to customers (a)
6	Yes, mill uses ruminant protein and makes ruminant feed	Mill is investigating cost for "dedicating" part of its facility	Adverse impact: Mill foresees substantial investment costs for change to developing dedicated facility
7	No, mill no longer uses ruminant protein	No response required	No impact
8	Yes, mill uses ruminant protein (blood meal only) and makes ruminant feed	Mill might drop blood meal, although it is also studying the conversion to "dedicated" facilities	Adverse impact: Will buy more expensive feed components or incur investment expense (a)
9	Yes, mill uses ruminant protein and makes ruminant feed	Mill would drop ruminant feed rations, which represent 5 percent of production	Adverse impact: Mill would either discontinue sales or buy bagged feed elsewhere as substitute feed supply to their dairy customers (a)

(a) Adverse impacts for these mills imply positive additional impacts on other competing mills in their area.

Source: Contacts to selected mills that, based on FDA inspection statistics, appeared to be potentially affected. The selected mills were listed as both using ruminant MBM and preparing ruminant feeds.

Two mills (2 of 9 or 22 percent) foresee investment costs to develop dedicated facilities, although their perspectives are quite different. Mill 2 owns several mill facilities, including an inactive one that they are planning to renovate for use as a dedicated ruminant-protein handling site. The mill operator views the investment as a response to an anticipated market opportunity because he does not expect other mills in the area to continue handling ruminant protein. ERG presumes that the expectation of a substantial price differential between ruminant and other proteins would justify the investment expense. Mill 6, however, which is manufacturing dairy and poultry feed, considered the necessary investments to be forced upon them because they were unable to survive by modifying feed rations or dropping one set of customers.

ERG judges that the position of Mill 6 is indicative of the class of mills most directly and adversely affected by the FDA regulatory alternative. Mills with an approximately even split of customers between poultry and dairy farms might be forced to consider investments for separated and dedicated operations or incur a loss of one of their review streams. Because so many poultry feeding operations are vertically integrated and heavily industrialized, profit margins in poultry feeding are typically very low (Harlan, 2004b). Mills cannot retain poultry customers if they fail to use the most cost-effective protein source, namely ruminant protein. Thus, such mills must continue handling ruminant protein. Further, these mills probably cannot tolerate the loss of revenue from either customer group without becoming too small to be competitive.

ERG identified 3 mills (3, 4, and 7) that were either no longer using ruminant protein, or no longer preparing ruminant feed, in apparent contradiction of the FDA database information. (The FDA inspection database might have been outdated for the mills in question—ERG did not ask mills when they had ceased using ruminant MBM.) These mills reflect the general industry pattern in which mills have discontinued ruminant protein use in the years since the FDA feed ban.

Other mills (1, 8, and 9) reported to ERG that they are likely to drop ruminant protein to comply with a dedicated facilities regulation. Two of these had previously dropped ruminant MBM and thus are now dropping ruminant blood meal. Another mill (No. 5) had already responded to the FDA announcement by immediately dropping its ruminant MBM. Some of the adverse impacts on these mills translate to revenue increases for other, competing mills in the same regions.

If the small mill survey is assumed to predict the status of the 124 mills most directly affected by the potential rule changes, then most of the mills have either already dropped ruminant MBM (as FDA will determine on their next inspection visit) or would discontinue use in response to the expansion of FDA feed ban. As noted, mills that are not currently using ruminant MBM are also judged likely to stop using ruminant blood meal under the expanded rule.

Thus, ERG forecasts that a dedicated facilities regulation would encourage a small number of mills to invest in dedicated facilities to continue using ruminant MBM to serve non-ruminant populations. These mills might use existing but currently unused mills for dedicated capacity. Based on the sample of contacts made and the apparent market incentives, ERG estimates that 22 percent of the 124 mills would create dedicated facilities. Otherwise, mills that have continued to use ruminant MBM in rations and that also serve ruminant populations would drop ruminant MBM.

There are potentially some social costs to the extent that the reformulated feed mixes are less efficient than the previous mixes. Thus, animal producers would need to acquire substitute protein sources that either are less desirable for animal diets (such as non-animal protein that lacks the same amino acid constitutes or bypass protein quality of blood meal) or that simply must now be acquired from sources that are farther away or otherwise less convenient. These costs, however, are not amenable to measurement and have not been estimated.

Also, feed manufacturers incur social costs in reevaluating their feed options and adjust numerous mixes. The one-time cost of this exceptional reconfiguring of feed mixes is considered in the cost estimates below. Unless higher priced ingredients must be used, ongoing costs to maintain the optimal feed mixes are not considered compliance costs; feed mill managers constantly modify feed mixes in response to availability and price changes among feed ingredients.

For some feed mills, impacts would include profit declines due to losses of market share. The profit declines for specific mills are presumably offset by profit increases for competing mills that increase market share. ERG lacks sufficient data to determine how significant the market shifts among feed mills would be.

Feed mill managers would also need to inform staff of the regulatory revisions, although this amount of new compliance information is modest. ERG judged this activity to be covered in the normal course of business.

The regulatory alternative does not explicitly require feed mills to choose any one particular response and does not require feed mills to make any investments. Such investments would be undertaken only where market conditions present such incentives. For example, unless there are significant price differentials between ruminant and other protein sources, mills would not invest in dedicated ruminant protein handling facilities. The price differential must be sufficient for mills to capture market share by handling the now cheaper ruminant MBM. Given that the investments in dedicated facilities would not be undertaken unless price conditions warrant them, their inclusion as “regulatory impacts” is uncertain. Despite this ambiguity, ERG has treated the investments that appear to be imposed on selected feed mills to be compliance costs.

3.2.2.1 A Dedicated Equipment Requirement: Investment Costs for Dedicating Feed Mill Operations

ERG contracted with an agricultural architecture and engineering firm to prepare cost estimates for three hypothetical scenarios for feed mill investments. Table 3-10 summarizes the engineering cost estimates. The three scenarios are:

- Construction of an entirely new feed mill,

- Construction of a separate dedicated mill capability within the structure of an existing mill, and
- Renovation of an existing but inactive mill for use as a dedicated ruminant-protein handling mill.

Each scenario is a theoretical possibility for feed mills needing to dedicate facilities. Furthermore, an important, fourth scenario of a low-cost renovation effort was introduced by one of the industry contacts. One mill (#2) reported that it would need to spend only $250,000 to renovate a facility for use as a dedicated mill. (ERG did not obtain details of the capital spending that would result in this much lower priced option.) Nevertheless, this fourth possibility of a low cost renovation/modernization project is evidently quite possible.

Table 3-10. Engineering Investment Cost Estimates for Three Dedicated Feed Mill Scenarios

Engineering Cost Category	Scenario 1 New "Greenfield" mill	Scenario 2 Modernization of a 40 year-old mill. Work would be completed in non-operating facility.	Scenario 3 Renovation adding a non-ruminant processing line to an existing mill. Facilities share common utilities, support and site services
Engineering	$200,000	$100,000	$150,000
Contractor General Conditions	$475,000	$150,000	$200,000
Equipment Rental	$250,000	$150,000	$150,000
Start up Technicians and Support Services	$25,000	$15,000	$15,000
Demolition	$0	$100,000	$100,000
Miscellaneous Units	$5,000	$5,000	$5,000
Truck Receiving Tunnel	$45,000	$0	$45,000
Concrete Feedmill Foundation	$55,000	$0	$25,000
Liquid Containment Dike	$12,000	$12,000	$0
Scale Foundation	$18,000	$18,000	$0
Feedmill Building	$850,000	$100,000	$250,000
Machinery Freight and Unloading	$50,000	$10,000	$20,000
Equipment Supports and Platforms	$175,000	$20,000	$50,000
Receiving and Reclaim Systems	$160,000	$80,000	$130,000
Raw Material Processing Systems	$325,000	$75,000	$125,000
Formulation Machinery Systems	$375,000	$175,000	$150,000
Pelleting Machinery Systems	$1,100,000	$300,000	$550,000
Bagging Machinery Systems	$275,000	$80,000	$100,000

Engineering Cost Category	Scenario 1 New "Greenfield" mill	Scenario 2 Modernization of a 40 year-old mill. Work would be completed in non-operating facility.	Scenario 3 Renovation adding a non-ruminant processing line to an existing mill. Facilities share common utilities, support and site services
Loadout Machinery Systems	$60,000	$30,000	$60,000
Product Recovery Systems	$20,000	$20,000	$20,000
Support Machinery Systems	$160,000	$60,000	$60,000
Mechanical Freight and Unloading	$10,000	$5,000	$5,000
Boiler System	$100,000	$100,000	$75,000
Liquids Ingredient Systems	$100,000	$25,000	$0
Miscellaneous Mechanical Systems	$20,000	$10,000	$10,000
Site Development	$400,000	$25,000	$50,000
Earthwork and Subsurface Subcontractor	$35,000	$0	$22,000
Ancillary Building Subcontractor	$700,000	$100,000	$125,000
Painting Subcontractor	$75,000	$75,000	$33,000
Electrical Subcontractor	$500,000	$200,000	$325,000
Mechanical Subcontractor	$375,000	$125,000	$175,000
Payroll Tax and W/C insurance	$150,000	$50,000	$65,000
Contingency	$200,000	$60,000	$85,000
Profit and Overhead	$700,000	$225,000	$325,000
Total	**$8,000,000**	**$2,500,000**	**$3,500,000**

Source: Costs estimated for hypothetical scenarios by ERG subcontractor, T.E. Ibberson, Co., Minneapolis, MN. All mill scenarios assume the mill has 50 tons per hour, 200,000 tons per year with a theoretical capacity at 65 percent efficiency.

Numerous industry contacts indicate that the feed mill companies are most likely to invest where they have an economic advantage, such as well-located excess mill capacity. Some feed industry executives noted that there are numerous inactive mills and considerable overcapacity in the industry. Others noted, however, that only excess mill capacity that is located advantageously relative to intended markets (i.e., would have competitive transportation costs) would be renovated, a constraint that would narrow the list of candidate renovation projects. Other mill executives (Mill #6) noted that there were no inactive mills in their area that could be renovated for new uses. ERG also could not confirm that mill executive plans to create separate dedicated facilities under a single roof would be acceptable to FDA.

ERG judged that the renovation options are more likely to be undertaken than new mill construction, and that some newly dedicated capacity (based on the mill #2 response) would be accomplished at relatively low cost. ERG judged that low cost ($250,000) renovations would be accomplished for one-half of the newly dedicated mills, and that the more costly renovation or expansion projects would be accomplished for one-quarter of the renovations each. ERG also judges that no new mills would be built. These judgments generate average costs of $1.6 million per newly dedicated mill. Applied across 22 percent of 124 mills, or 27 mills, this generates a total investment cost of $43.2 million. The annualized cost discounted at 7 percent or 3 percent over ten years is $228,000 or $188,000 per year, respectively. Applying this cost to 27 mills generates an annualized cost of $6.2 million (7 percent) or $5.1 million per year (3 percent).

3.2.3 Economic and Market Impacts on Dedication Requirements for Truck Fleets

If FDA were to implement a dedicated facilities requirement, it might be interpreted to extend to the dedication of feed and protein material supply trucks. Thus, transporters of ruminant materials would be prohibited from carrying materials intended for ruminant animals. This requirement could amplify the market impacts on ruminant protein.

Transportation services are widely distributed through the affected agricultural sector, and FDA inspectors classified many of the inspected firms as transporters. ERG contacted a selection of feed mills, agricultural trucking companies, and renderers to prepare a brief profile of current transportation arrangements and possible transportation changes. Table 3-11 summarizes these contacts. Several basic observations can be made:

- The significance of the changes in transportation costs varies with the activities of the affected entity. In general, renderers are forecasting larger increases in transportation costs than feed mills.

- Contract haulers are important to many agricultural commodity flows, particularly for delivery of rendered products (to feed mills) and feeds (to farmers or feedlots).

- Some renderers and their transporters foresee purchases of additional truck capacity in order to be able to dedicate some trucks to handling of either prohibited or non-prohibited materials.

- A number of independent renderers of prohibited MBM and some feed mills foresee substantial increases in operating costs because dedicated delivery trucks would need to return empty to the facility rather than backhauling other agricultural commodities. The loss of backhaul rates, if applicable, is forecast to increase freight costs by 70 to 100 percent. The assumptions behind these estimates are discussed below.

- Some contract haulers might decline service to producers of restricted materials (see, for example, contact #8). In other conversations, renderers have forecast denial or sharply increase transportation rates. One renderer stated that an agreement to lease rail cars was canceled by the leasing company. Contract haulers and leasing companies specializing in hauling of prohibited materials might, however, emerge.

- Some independent renderers own large truck fleets for the collection of raw materials. While many independent rendering facilities are making mixed species MBM and collection would not be affected, a facility seeking to dedicate a facility expects to buy a number of new trucks. Large independent renderers have fleets of several hundred trucks.

The analysis of incremental transportation needs is complicated by uncertainty about the exact dedication requirements for transportation equipment. First, companies do not know if they would be able to steam-clean or perform some other through cleaning operation in order to switch from dedicated to undedicated uses. It was generally assumed, however, that trucks would need to remain in a single use for most circumstances.

Table 3-11. Summary of Telephone Survey Responses to Potential Expansion of "Dedicated Facilities" Requirements for Truck Fleets

Trans-porter	What materials do you haul?	Current Trucking Arrangements	Probable Response to Dedication Requirement	Expected Net Impact
1	Mill produces only poultry feed	Mill owns 4 augur-type trucks; uses contract hauler	Their trucks handle only poultry feed deliveries; Contractor would need to dedicate some trucks to prohibited materials	Expects increase in cost and decrease in timeliness of deliveries to customers
2	Mill produces dairy and turkey feed, and is switching to all turkey feed.	Owns 2 trucks; Both would now be used only in turkey feed operations.	Would change use of one of trucks.	Only modest impacts on truck use because of move to specialization in poultry
3	Operates two separated feed mills, one of which handles prohibited materials. Moved two years ago to separate facilities.	Own augur-type trucks they use for deliveries; most received materials arrive in others' trucks; use cleaning and flushing and monitor other trucks deliveries	Some logistics changes regarding truck deployment. No truck purchases were anticipated.	Impact estimated not to be very large (part of potential impact incurred by separation effort two years ago).
4	Haul dairy and swine feed; Would not handle prohibited materials.	Own 80 trucks	None	No impact; Company policies already prevent handling prohibited materials in any trucks
5	Rendering operation that makes swine and ruminant MBM and fats.	Use own trucks for 1/3 and contractors for 2/3 of material pickups (the bulk of the fleet) and product deliveries, encompassing a fleet of several hundred trucks. Can usually get backhaul rates on long	Forecasts purchase of 4 to 8 new trailer trucks; Uncertain what "dedicated" would mean for some of their trucking logistics. Raw material collection trucks are	At $40,000 per truck, would spend $160,000 to $320,000. Estimates a transportation cost increase of $3 million/yr, assuming backhaul rates are not available.

Trans-porter	What materials do you haul?	Current Trucking Arrangements	Probable Response to Dedication Requirement	Expected Net Impact
		trips.	not fully dedicated.	
6	Independent company performs all its service for a rendering firm.	Owns 4 trucks and 9 hopper-bottom trailers.	Forecasts purchase of 3 to 4 trailers and considerable additional work for planning routes.	Foresees costs of $100,000 and additional freight cost due to numerous "empty" trailer trips
7	Agric. trucking company performs 25% of work for swine and ruminant renderer, also carries other feed, bulk agric. materials.	Owns 35 trucks.	Forecasts no truck purchases but that trucks would be empty on their return trips.	Forecasts increase in transportation costs of 70-80%.
8	Agric. trucking company hauling beef and dairy feed and poultry litter; only litter has ruminant protein	Owns 20 trucks	Forecasts that they would drop poultry litter transporting; no other impacts	Forecasts a decline in revenues of less than 10% due to drop in service performed.
9	Rendering operation that makes poultry and ruminant protein	Owns several hundred collection trucks but customers pick up most production with own or contractor vehicles	Collection trucks are not dedicated and some changes needed; plans for deliveries uncertain but substantial increase in empty truck returns are forecast	While plans are tentative, expects delivery cost per ton to increase by $10/ton. Would need to increase collection fleet by 1/3.

Source: Contacts to selected mills and renderers that, based on FDA inspection statistics, appeared to be potentially affected. The selected facilities were listed as both using or handling ruminant MBM and preparing ruminant feeds.

Further, respondents were uncertain whether dedicated haulers of prohibited materials could also handle other commodities if handling those commodities did not violate the intention of the FDA mammalian feed ban. If trucks have the flexibility to seek backhaul cargoes (albeit from a much more restricted set of commodities), this would mitigate incremental transportation costs. The renderers contacted assumed that "dedicated" trucks would not be allowed to carry any other materials, even when carrying the other materials would not violate the intent of the ruminant feed ban. For example, can a carrier of restricted materials make a return trip carrying soybean meal to a swine feeder?

Rendering industry incremental transportation costs. The rendering industry appears unlikely to incur incremental transportation costs for rail transport because a system of "dedicated" rail cars is already used for all MBM shipments, and rail transportation patterns have already been modified. The large railroads informed renderers over the last few years that restricted protein could no longer be carried in their rail cars. Instead, renderers have had to purchase or lease their own rail cars. The railroads would move the equipment but play no role in maintaining it (Finke, 2004, Harlan, 2004b). ERG judges that the change in rail transportation patterns caused some increase in transportation costs, although ERG has not investigated the cost increases. Because the costs were incurred in advance of the FDA regulatory change, they have not been included in this analysis.

Rendering industry executives characterized their transportation patterns for ERG. According to several contacts, long-haul rendering deliveries can usually be combined with return trips of other commodities, allowing renderers to obtain backhaul trucking rates. Delivered prices per ton of prohibited MBM range from $10 to as high as $60 per ton. Drawing from several industry estimates, ERG estimated the average delivered cost per ton is $20. Industry personnel also stated that 60 percent of MBM is shipped by rail. While some incremental costs might be generated for rail shipments, many rail cars are already owned and operated in a dedicated fashion.

Industry personnel were generally pessimistic about the possibility of continuing to obtain backhaul rates for restricted MBM shipments. Most contacts expected contract haulers to charge sharply higher trucking rates and that there would be very few options for backhauling other agricultural commodities. Contract haulers also seemed to indicate that trucking costs would rise significantly for restricted materials. As noted in ERG's contacts on transportation impacts, some entities would choose not to carry restricted material. Further, even if renderer trucks were to be allowed to backhaul other commodities, the range of other agricultural products that would not violate the intent of the announced rule changes might be limited.

ERG has estimated transportation cost increases for renderers in the range of 40 to 80 percent, generating $8-16 million in incremental annual shipping costs. If backhaul cargoes are completely unavailable, the cost increases for transportation might approach the 80 percent figure. If some backhauling remains possible, trucking arrangements are forecast to be adjusted to eventually reduce the transportation cost increase. Under these more flexible circumstances, the smaller cost increase is forecast.

Table 3-12 summarizes the rendering industry transportation costs. The rendering industry transportation costs would not be shared among all firms but only among those processing ruminant protein. According to the FDA inspection database, there are 141 rendering facilities in this category.

Table 3-12. Baseline and Incremental Transportation Costs for Renderers

Quantity/Cost Parameter	Value	Post-Rule Forecast	Source
Prohibited MBM production (million lbs./yr)	4,997.2	4,997.2	SCI, 2001
Prohibited MBM production (million tons/yr)	2.5	2.5	Calculated value
Percent of cargo shipped by truck	40%	40%	Harlan, 2004b
Average miles per round trip	300	300	Harlan, 2004b
Tons per truckload	24	24	Typical truck capacity
Average cost per truck mile – baseline	$1.60	NA	Est. avg. for industry
Average cost per truck mile -- lower range impact	NA	$2.24	At 40% increase
Average cost per truck mile -- higher range impact	NA	$2.88	At 80% increase
Average trans. cost per truckload—baseline	$480	NA	Calculated value
Average trans. cost per truckload-- lower range impact	NA	$672	Calculated value
Average trans. cost per truckload--higher range impact	NA	$864	Calculated value
Average trans. cost/ton of prohibited MBM—baseline	$20.00	NA	Calculated value
Forecasted trans. cost/ton of prohibited MBM—lower range	NA	$28.00	Calculated value
Forecasted trans. cost/ton of prohibited MBM--higher range	NA	$36.00	Calculated value
Aggregate trans. Cost for trucking ($ million/yr) —baseline	$20.00	NA	Calculated value
Forecasted agg, trans. cost for trucking ($ million/yr)—lower range	NA	$28.0	Calculated value
Forecasted agg. trans. cost for trucking ($ million/yr)—higher range	NA	$36.0	Calculated value
Forecasted incremental aggregate trans. cost ($ million/yr)—lower	NA	$8.0	Calculated value
Forecasted incremental aggregate trans. cost ($ million/yr)—higher	NA	$16.0	Calculated value

Source: Estimated by ERG except as noted.

Feed industry incremental transportation costs. Feed manufacturers would also incur incremental transportation costs. Table 3-13 summarizes the calculations used to derive the transportation estimates for feed mills.

Table 3-13 Baseline and Incremental Transportation Costs for Feed Mills

Quantity/Cost Parameter	Value	Post-Rule Forecast	Source
Prohibited MBM production (million lbs./yr)	4,997.2	4,997.2	SCI, 2001
Prohibited MBM production (million tons/yr)	2.5	2.5	Calculated value
Share of MBM for animal feed not shipped directly to end uses	15.0%	15.0%	ERG estimate; see text
Feed qnty. w/proh. material at a 10% inclusion rate (mill. tons/yr)	3.7	3.7	Calculated value
Percent of affected cargo shipped by truck	90%	90%	ERG estimate
Tons of feed with proh. protein shipped by truck (million tons/yr)	3.4	3.4	Calculated value
Additional feed produced from dedicated mills	1.1	1.1	ERG estimate; see text
Total feed subject to transportation restrictions	4.5	4.5	Calculated value
Average trans. cost/ton of feed—baseline	$12.66	NA	See note (a).
Forecasted avg. trans. cost/ton of prohibited MBM--lower range	NA	$15.83	At 25% increase
Forecasted avg. trans. cost/ton of prohibited MBM--higher range	NA	$18.99	At 50% increase
Aggregate trans. cost for trucking ($ million/yr)--baseline	$56.8	NA	Calculated value
Forecasted agg. trans. cost for trucking ($ million/yr)--lower range	NA	$71.0	Calculated value
Forecasted agg. trans. cost for trucking ($ million/yr)--higher range	NA	$85.2	Calculated value
Forecasted incremental agg. Trans. cost ($ million/yr)--lower	NA	$14.2	Calculated value
Forecasted incremental agg. Trans. cost ($ million/yr)--higher	NA	$28.4	Calculated value
(a) Average of last three years reported in Gill and Lobo, 2004.			
Source: Estimated by ERG, except as noted.			

The quantities of animal feed to be restricted in their transport were calculated based on the amount of MBM mixed into rations, after excluding MBM sent to other sectors. First, much rendered MBM does not go through commercial feed mills but goes directly to the feeding operations of large integrated animal producers. For these shipments, no further transportation costs need to be added to the feed mill transportation calculations. Another share of rendered MBM is shipped to pet food manufacturers or exported, when international markets are accepting material, so these materials are also left out of the feed mill calculations. The Sparks company report from 1997 estimated the distribution of MBM among various intermediate and end use markets (Sparks Companies, Inc. 1997). At that time, and prior to the implementation of the 1997 feed ban, Sparks estimated that 24 percent of MBM from independent renderers and 8 percent from packer/renderers was shipped to feed mills. Another 13 percent from each group was shipped to protein blenders and was then shipped to poultry operations and other operations. Assuming that independent and packer/renderers now produce 40 percent and 60 percent of MBM, respectively, and that these shipment patterns had remained unchanged, then 14.4 percent of MBM reaches feed mills and another 13 percent is processed through protein blenders. Feed mills and protein blenders would then incur incremental transportation costs by shipping feed or blended protein containing this share of MBM (27.4 percent).

The share of prohibited MBM going to feed mills or protein blenders (and thereby potentially incurring additional transportation costs) has, however, declined since 1997. The FDA database indicates that only 6.3 percent of licensed and unlicensed feed mills are handling ruminant material as of their most recent inspection. The proportion of all prohibited MBM handled by these facilities is not known. Further, some of these facilities are probably located at end-users, such as integrated feeding operations, where the delivered MBM would not incur further transportation. In view of this trend, ERG adjusted the share of MBM affected by further transportation costs to 15 percent of all MBM shipments.

The Feed Management magazine survey reports on the average delivered cost per mile for prepared feed (Gill and Lobo, 2004). Because the survey-reported cost series is erratic over recent years, ERG averaged the transportation costs over the last three years to derive an estimate of $12.66 per ton.

To calculate the incremental costs, ERG readjusted considered the cost increases used for renderers. ERG notes that some feed manufacturers are as concerned about the retention of backhaul trucking rates as the renderers, while other feed manufacturers are not currently backhauling materials. Because feed deliveries are made over shorter average distances than renderers, it is likely that fewer trips are made with backhaul cargoes. Nevertheless, feed delivery distances remain substantial, with the survey reporting averages over the last three years of 99 to 150 miles, with 2.1 to 2.8 stops per trip (Gill and Lobo, 2004).

Whether or not feed mills are currently obtaining backhaul rates for their feed deliveries, a number of mills forecast transportation cost increases due to the dedicated equipment requirements. ERG estimated the range of incremental transportation costs for feed operators at 25 to 50 percent. This cost estimate remains speculative.

The incremental transportation costs would be substantially affected by any changes in mill dedication patterns. This appears likely to increase the specialization in the supply of animal feed. The extent of the changes in mill use patterns has not been estimated in quantitative terms.

ERG estimated the quantity of prohibited protein likely to be affected by assuming an inclusion rate for prohibited MBM of 10 percent in feed rations. Thus, the tonnage of prohibited material was increased by a factor of 10 to approximate the feed quantities.

Prepared feeds from the mills that continue to use prohibited protein would all be considered contaminated and subject to the transportation restrictions, whether or not they contain prohibited protein. Thus, these feed mixes that do not contain ruminant protein would have to be transported in the dedicated transportation equipment, regardless of their protein content. ERG assumed that 25 percent of the production from these mills would not contain prohibited MBM. Thus, the quantity of prepared feed requiring additional transportation was increased accordingly. This estimate is uncertain because the range of animal populations served by the newly defined dedicated mills cannot yet be forecast with reasonable precision.

While industry contacts reported that trucks move the large majority of prepared feeds, ERG lacked objective data on the transportation modes used to move the share of prepared feed that includes prohibited materials. ERG judged that 90 percent of prepared feeds with prohibited MBM are moved by truck.

With the assumptions described, ERG estimates the incremental transportation costs for feed mills at $14.2 million to $28.4 million per year (in Table 3-13 above). These costs are defined to include the amortized cost of capital equipments, such as new trucks, as well as all incremental operating and maintenance costs for transportation equipment.

The incremental transportation costs would not be evenly distributed among mills but would be incurred by those mills continuing to handle prohibited protein. Only 20.4 percent of licensed feed mills and 3.1 percent of unlicensed feed mills are currently handling prohibited MBM, for a total of 376 mills. Of 30 protein blenders (counting only facilities that are not also classified as feed mills or on-farm mixers), 10 handle prohibited MBM. Among these feed mills, many would stop using prohibited MBM if the regulatory alternative were to be final. Assuming approximately one-half of the mills cease prohibited MBM use, the transportation impacts would be divided among approximately 200 feed mills and protein blenders.

3.2.4 A Dedicated Equipment Requirement: On-Farm Mixers and Other Farm Impacts

FDA's inspection database shows 1,219 entities currently operating and identified as on-farm mixers, i.e., farm operations performing some mixing of feed ingredients. Of this total, however, 86 are also identified as licensed feed mills and 120 are also shown as non-licensed feed mills. Impacts on these entities were addressed in the feed mill analysis. Of the remaining 1,013 on-farm mixers, about 70 percent (717) handled ruminant feed, presumably to feed ruminant animals on the farm. Among this sub-group, only three indicated they also handled prohibited material. Overall, just 24 of the 1,013 on-farm mixers indicated they handled prohibited material. These statistics imply that only a handful of on-farm mixers would be impacted by the new FDA prohibitions.

These statistics mirror the data indicating that the large majority of feed mills do not handle ruminant protein. Thus, the large majority of farmers dependent upon feed mills for their animal populations appear to have no access to ruminant protein.

For those animal producers that are currently buying ruminant MBM, feed price increases are a possibility. As the price series since the FDA announcement indicate, the markets for ruminant MBM and competing porcine products appear to have returned to roughly FDA pre-announcement conditions. This could have occurred for a variety of reasons, including the possibility that animal producers and/or feed mill operators have simply returned to previous practices pending the final FDA decision.

Possible farm-specific and aggregate feed price impacts were calculated assuming that the recent price fluctuations for ruminant protein products would be representative of the shifts for in feed costs. The price increases were applied to the quantity of material to be redirected, thereby capturing an aggregate estimate of the possible price increases for animal producers affected.

Similarly, based on Table 3-8, 2.03 percent of feed mills handle ruminant protein and manufacture feed for ruminant animals. These mills are most likely to change production practices under this regulatory alternative. For this calculation, it was assumed that these mills handle 2.03 percent of all ruminant MBM and that one-half of the customers of these mills' ruminant protein (such as local pork or chicken producers) are in effect forced to change to alternative feeds. Summing the quantities of ruminant-containing MBM shown in Table 2-8, this translates to 2.03 percent of 5 million lbs per year, or 25,400 tons. (Other customers are assumed to acquire feed from other suppliers who are not forced by their circumstances to drop ruminant protein from their mills.) ERG further assumed that the replacement protein is purchased at a cost that is 20 percent more than the pre-announcement cost of ruminant MBM (or $40 per ton more based on a pre-announcement price of approximately $200/ton for ruminant MBM). Thus, the new protein sources would be purchased for an aggregate incremental cost of $1.0 million per year. The feed costs represent transfer payments to the producers of other protein sources.

The percentage increase in aggregate animal feeding costs for the possible substitution away from ruminant protein will be very small. Spreading the effect of these highly localized changes in feed constituents over all animals dilutes the impacts to very small size. Further, the outcome of possible feed substitutions away from ruminant protein will vary widely with the availability and price of feeds locally. These effects were not quantified further.

As noted, the price increases are not net social costs but transfer payments within the agricultural sector. The restriction of some existing agricultural feeding practices might generate some inefficiency, such as where substitute feed must be brought from greater distances than previously. The size of these efficiencies could not be quantified, although their significance appears unlikely to be very large.

Where on-farm mixers with ruminant animals also continue to handle ruminant protein, there appears a potential for economic impacts due to the dedicated equipment requirements for farm equipment, such as grinders, and feed spreading equipment. Most multiple species farm operations are of modest size and are unlikely to have a capability for using separate systems for different species, as the regulatory alternative might require. Based on the FDA inspection data for on-farm mixers and feed mills, however, few farms appear to be in this circumstance. Apparently, very few of the on-farm mixers are handling ruminant protein, a finding that is consistent with the data on the small percentage of feed mills that are handling ruminant protein.

Small farmers might also be affected by requirements for dedicated transportation equipment. Such impacts will be minimal because, once again, few mills handle ruminant protein and thus few farmers have access to ruminant protein. Transportation impacts are also reduced to the extent that small on-farm mixers transport only bagged feed. For example, farmers using pick-ups or other farm vehicles to transport bagged feed are not covered by the dedicated equipment requirements of the potential rule changes.

As a result of the potential regulatory alternative, the number of feed mills handling ruminant protein might decline further. Based on potential price differentials for porcine or vegetable proteins relative to ruminant protein, the affected farmers' feed costs will probably increase, at least in the near term. Small farm operations might see their costs for feeding non-ruminant animals increase relative to those of large integrated feeders that can acquire ruminant protein for their animals. Data are not adequate at this time to describe the significance of this impact. As noted elsewhere, long-term price impacts on prohibited proteins are uncertain.

3.2.5 Conclusions on Potential Impacts of an Alternative Regulation Requiring Equipment Dedication

Table 3-14 summarizes the applicable capital investment and annualized costs for the dedicated equipment requirements.

Renderers. Under the dedicated equipment alternative, integrated packer/renderers will generally not modify their principal operations, but some independent renderers will need to modify operations and dedicate their facilities to handle either ruminant or non-ruminant protein. Rendering firms will also generally have to modify their transportation logistics to satisfy the requirements for dedicated equipment.

- ERG forecasts that 4 renderers will invest about $8 million in dedicated facilities, based on surveys of industry contacts and the apparent market incentives. The annualized investment cost (at a 7 percent discount rate) is estimated at $1.1 million for renderers.

- ERG forecasts that a handful of renderers' facilities might close. These facilities might not be able to make the necessary market adjustments or investments in dedicated facilities, or cannot absorb the increased transportation costs.

- The dedication of transportation equipment is expected to increase renderers' costs by a substantial percentage. ERG estimated the cost increase for renderers at 40 to 80 percent, based on expectations that they will lose the ability to backhaul other materials in the trucks delivering prohibited materials. This requirement will increase transportation costs for renderers by $8 to $16 million per year (or $8 to $16 dollars per ton delivered prohibited MBM product).

Table 3-14 Dedicated Equipment Requirements: Capital Investment and Annual Costs

Sector	Investment Costs ($millions)	Annual Costs, w/ transportation cost range ($ millions/yr)	
		Low	High
Dedicated Equipment Requirements			
Renderers			
Dedication of facilities	8.0	1.1	1.1
Transportation (a)	NE	8.0	16.0
Revenue decline	NE	NE	NE
Total – Renderers	8.0	9.1	17.1
Feed Mills			
Dedication of facilities	43.2	6.2	6.2
Transportation (a)	NE	14.2	28.4
Revenue decline	NE	NE	NE
Total – Feed Mills	43.2	20.4	34.6
On Farm Mixers		NEG.	NEG.
Total – Dedicated Equipment Requirements	51.2	29.5	51.7

NE=Not applicable
NEG= Negligible
Totals might not add due to rounding.
Note: Investment costs annualized at 7 percent over ten years.
(a) While some facilities will purchase new trucks to meet the dedicated equipment requirements, many will use contractors. ERG assumed for costing that contractors will perform all additional trucking of these agricultural commodities.

Feed mills currently handling ruminant protein will need to choose between continuing to handle ruminant protein or discontinuing service to ruminant animal producers. The following projections are made of the feed mill impacts and responses:

- ERG forecasts that 27 feed mills will invest about $43 million in dedicated facilities, at an estimated cost of $6.2 million per year, and that 3 to 6 feed mills will close.

- A larger number of feed mills will drop ruminant blood meal from their rations for ruminant animals. Based on a mill survey, 50 percent of 6,100 mills include blood meal in feed, of which roughly three quarters is derived from ruminants. Thus, approximately 2,300 feed mills will reformulate dairy and other animal feeds to eliminate ruminant blood meal.

- The remaining feed mills that produce ruminant feed and that have continued to use ruminant MBM, and that will not or cannot dedicate facilities to ruminant protein use, will need to drop ruminant in favor of porcine or vegetable protein. The effect of these changes on the cost of animal feed and on the aggregate ruminant MBM market is forecast to be small.

- The dedication of transportation equipment is expected to increase costs for feed mills by 25 to 50 percent, which amounts to $14.2 million to $28.4 million per year.

SECTION FOUR

FINANCIAL IMPACTS ON AFFECTED INDUSTRIES AND AGRICULTURAL SECTORS

This section presents regulatory impacts of FDA's SRM option, which would prohibit the use of certain bovine materials (including SRMs, mechanically separated beef, dead or non-ambulatory cattle, and tallow with more than 0.15 percent hexane insoluble impurities). Additional analysis of the impacts of additional alternatives, including a prohibition on the use of ruminant-derived plasma and blood meal products in ruminant feeds and the requirement of dedicated facilities and equipment for the manufacture of ruminant products, are also briefly discussed.

The prohibition of SRMs will primarily affect animal slaughterers (NAICS 311611) and renderers (NAICS 311613). Several other industries will also be affected if the SRM option language is promulgated, including farming operations and "4D" firms. These industries are not examined in the full quantitative detail as the slaughtering and rendering industries.

Section 4.1 addresses Small Business Regulatory Enforcement Fairness Act (SBREFA) requirements for the NAICS industries mentioned above. Section 4.2 presents the financial impact model framework used to estimate impacts on these industries while financial impacts for the NAICS industries mentioned above are presented in 4.3. Section 4.4 discusses impacts on "4-D" firms as a result of an SRM ban. ERG uses a market model to present market impacts as a result of an SRM prohibition in Section 4.5. ERG presents impacts of the additional alternative requirements in Section 4.6.

4.1 Number of Establishments

Tables 4-1 shows the total number of establishments in the NAICS industries affected by the SRM option, as described in this study. The establishments are distributed by employment size group, as reported by the Census Bureau's *2001 County Business Patterns*. The large majority of establishments in both the slaughtering and rendering industries employ fewer than 100 workers.

The table also shows the number of affected establishments in both the slaughtering and rendering industries. For slaughterers (NAICS 311611), ERG assumed that all beef slaughterers would be affected by SRM requirements. ERG used data on the number of federally inspected slaughter plants by number of head slaughtered as shown in Table 1-7 to find the number of affected establishments. ERG matched Census's employment based size groups with USDA's number of head based size groups in Section 2.2.

Renderers will be impacted by three separate requirements in the SRM option. These include increased restrictions on tallow, recordkeeping and labeling requirements, and SRM marking requirements. Of the 228 renderers in NAICS 311613, ERG assumed that the increased restrictions on tallow and the SRM marking requirements would affect 30 percent or 68 renderers. ERG also estimated that 141 handle cattle materials and will be affected by the recordkeeping and labeling requirements. The affected renderer establishments were then allocated to the employment size classes using each size class's share of the total number of establishments.

Table 4-1. Number and Size Distribution of Establishments for the Prohibition of SRMs

Employment Size Group	NAICS 311611 (Slaughterers)		NAICS 311613 (Renderers)			
	Total Number of Estab.	Number of Affected Estab.	Total Number of Estab.	Number of Estab. Affected by Tallow Restrictions	Number of Estab. Affected by Recordkeeping Requirements	Number of Estab. Affected by SRM Marking Requirements
1 to 4	1,035	508	32	10	20	10
5 to 9	428	89	20	6	12	6
10 to 19	243	26	50	15	31	15
20 to 49	164	11	65	19	40	19
50 to 99	77	12	47	14	29	14
100 to 249	57	8	12	4	7	4
250 to 499	38	11	2	1	1	1
500 to 999	13	9	0	0	0	0
1,000 to 2,499	56	13	0	0	0	0
More than 2,500	0	2	0	0	0	0
Total	**2,111**	**689**	**228**	**68**	**141**	**68**

Sources: USDA, 2004; U.S. Census Bureau 2004.

For the economic and SBREFA analysis, ERG notes that the large majority of entities (that is, firms rather than establishments) in both slaughtering and rendering are small, i.e., employing fewer than 500 workers (SBA, 2004a). In slaughtering, 1,970 of 2,014 entities are small. In rendering, 96 of 122 entities are small (SBA, 2004b). Nevertheless, ERG's economic impact analysis is designed to assess impacts on small establishments. The facility closure decisions will be made primarily at the establishment level, whether or not the establishment is a stand-alone business or part of a larger entity. These results, in turn, help define impacts on small and large entities.

4.2 ERG's SBIM© Model

ERG used its Small Business Impacts Model (SBIM©) to estimate financial impacts of an SRM ban and the additional restriction on blood meal usage. The SBIM© model has been developed previously for the analysis of EPA and FDA regulated industries (ERG, 2002). This model allows ERG to evaluate financial impacts on establishments by employment size group, as well as to predict business closures using alternative income specifications, such as cash flow, net income, earnings before interest and taxes (EBIT), and revenues.

The ERG SBIM© framework is primarily based on two basic concepts:

(1) Negative net income is analogous to short-run average variable costs exceeding average revenues, and

(2) Size affects an establishment's ability to absorb regulatory costs.

First, economic theory states that a profit-maximizing firm will shut down where short-run average variable costs (AVC) exceed average revenues (AR). In modern corporate finance, accounting net income is roughly analogous to the comparison of short-run variable costs and revenues. Net income essentially measures the current operating revenues net of operating costs of an establishment.[6] Thus, if an establishment's net income turns negative after regulatory costs are subtracted from its pre-regulatory net income, then it is equivalent to the theoretical microeconomic firm that shuts down due to short-run AVC exceeding AR.

Second, differences in establishment size typically result in differences in relative earnings (e.g., net income as a percent of operating costs, or per employee). Additionally, regulatory cost burdens tend to vary across different-sized establishments. Hence, establishment size is an important determinant of regulatory impacts.

Using these assumptions as the starting point, the application of the small business model framework to a specific industry requires the (1) characterization of a series of different-sized model establishments and (2) estimation of net income and its distribution for each of the model establishments.[7] Accounting for the distribution of net income for all establishments represented by each model establishment is essential because each model establishment reflects the average of a group of establishments, not a group of identical establishments. Hence, a simple comparison of average regulatory costs with a model establishment's net income will generate an all-or-nothing result (i.e., all facilities represented by a particular model incur impacts identical to those of the model facility) leading to impact estimation errors.

The model uses the following information to estimate the distribution of net income for establishments represented by each model establishment:

- Mean of the distribution,
- Variance of the distribution, and
- Type of distribution.

In the context of the model framework, the mean of each distribution is equal to the model establishment's net income. Similarly, the variance of each distribution is equal to the variance of the model establishment's net income (derived from Census Bureau data obtained by special

[6] Although less than ideal, the depreciation charge in the net income acts as a proxy for continuing capital requirements to maintain the current level of operations; no better measure of these current requirements is available.

[7] ERG's SBIM© model also evaluates impacts utilizing three additional income measures, mainly revenues, earnings before interest and taxes (EBIT), and cash flow (see Appendix A). However, in this discussion, only net income impacts are evaluated.

request). Appendix A presents the data sources for the estimation of model establishment mean net income and its variance in detail. For the type of distribution, ERG assumed that within each model establishment class, net income is normally distributed around the model establishment mean.[8] Hence, given the mean and variance of net income for each class of model establishments, and assuming that net income for each class is normally distributed, ERG was able to estimate the distribution of net income for each model class. Appendix A describes how the distribution of net income is estimated in further detail.

4.2.1 Impact Methodology

4.2.1.1 Impacts on Net Income

Impacts on net income are estimated by measuring the pre- and post-regulatory net income of the average establishment in each employment size group. If net income becomes negative after regulatory costs are subtracted from an establishment's pre-regulatory net income, it can be reasonably inferred that closure was a result of the regulatory cost burden.[9]

ERG used Census data to estimate average establishment net income by employment size group for the relevant NAICS industries. The *1997 Economic Census: Manufacturing – Industry Series* data provide detailed revenue (shipments) and operating cost information by employment size group and additional cost information at the industry level. (The 2002 Census is not yet available.) ERG allocated operating costs to each size group using certain assumptions (see Appendix A for more detail). In order to calculate net income per establishment from revenues per establishment, ERG first estimated earnings before interest and taxes (EBIT) per establishment for each employment size group as the difference between the revenues and operating costs.

ERG then calculated net income per establishment for each employment size group from EBIT, using additional assumptions to estimate tax and interest payments. ERG calculated net income as:

$$\text{Net Income} = \text{EBIT} \times (1 - \text{Tax Rate}) - \text{Interest Payments}$$

To estimate per establishment tax payments, ERG multiplied EBIT for each employment size group by the sum of the relevant federal corporate income tax rate and the average state corporate income tax. ERG estimated interest payments using a combination of Annual Survey

[8] ERG also examined alternative distributional assumptions to provide analysis of the sensitivity of model impacts to the normality assumption (see Appendix A).

[9] The effect of the regulation on facilities with negative net income in the baseline ("baseline closures") cannot be evaluated. The basis for determining the impact of a potential regulation on an establishment is that the establishment must have positive earnings prior to the regulation and negative earnings after regulation. If an establishment has negative earnings prior to the regulation, then it may very well close even if the regulation is never promulgated. Thus, closure of such an establishment should not be considered an impact of the regulation.

of Manufacturers (ASM) data on past investment by industry, Census data on relative investment in buildings and equipment, historical interest rates, and assumptions about investment behavior. Interest payments were then attributed to each employment size group based on the percentage of industry investment accounted for by that employment size group in the 1997 Census. See Appendix A for more detail on the net income estimation methodology.

4.2.1.2 Incremental Closure Impacts

ERG's strategy for assessing establishment net income closure impacts compares pre-regulatory net income with post-regulatory net income. Presumably an establishment might close if regulatory costs cause net income to change from being positive to negative.

Net income for a given group of establishments within a size group will lie in a distribution around the average; some establishments will have smaller and some will have larger incomes. To incorporate this to the model framework, ERG estimated the distribution of net income among establishments in each size group. By modeling an establishment's income distribution using an estimated mean and variance, the model projects how compliance costs impact not just the model establishment in a size group, but the establishments represented by it as well.

To estimate the distribution of income, ERG obtained special tabulations of the variances and covariances of relevant income components for each employment size group from the Census Bureau (U.S. Census Bureau, 2004 and 2001). Combining these data along with the assumption that the income components are normally distributed around their mean, ERG constructed cumulative probability distributions for revenues, EBIT, and consequently, net income.

The variance of EBIT depends on the variance and covariance of each of its components. EBIT is a linear function of its revenue and cost components. Thus, the variance of EBIT can be estimated using the standard statistical relationship wherein the variance of a linear function is itself a linear function of the variance and covariance of its constituents. To estimate the distribution of EBIT for each model establishment in a size group, ERG used the variance and covariance of the value of shipments, payroll, and material costs for each employment size group provided by Census. Because net income is a multiple of EBIT (minus any interest payments), its variance can be calculated directly from the variance of EBIT.[10]

The net income distribution permits ERG to estimate, for each size group, the number of establishments whose net income would fall below a certain threshold. Since establishments might be expected to close if their net income were less than their compliance costs, this model can estimate the number of establishments whose net income is likely to be below the per facility compliance costs and, therefore, are subject to closure. Note that ERG actually calculates the *incremental* probability of closure. ERG's methodology compares positive pre-regulatory net income with post-regulatory net income; if pre-regulatory net income is positive and post-

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[10] The variance of after tax income increases with the square of the tax rate and is invariant to the level of interest payments. For example, if the tax rate doubles, the variance of after tax income quadruples.

regulatory net income is negative, then the establishment is projected to close. If the establishment's pre-regulatory net income is negative, regulatory impacts cannot be defined. Such facilities can be referred to as baseline closures.

4.3 Financial Impacts of an SRM Ban on Slaughterers and Renderers

This portion of the analysis assumes that no regulatory costs will be passed through to consumers. Hence, the impacts presented describe a worst-case scenario for the affected establishments. Although it is hard to predict, the industries will eventually pass on much of the incurred costs. For instance, slaughterers may pass costs backward to animal producers and forward to consumers. Nevertheless, it is to instructive examine impacts before cost pass-through are considered.

The draft language for the option prohibits the use of certain bovine materials including SRMs, mechanically separated beef, dead or non-ambulatory cattle, and tallow with more than 0.15 percent hexane insoluble impurities. An SRM ban would have an impact on animal slaughterers (NAICS 311611). These facilities would be required to remove SRM at the time of slaughter and arrange for the disposal of material. Slaughterers would face incremental costs for investments in modifications to the kill floor, changes in the transport of animal byproducts through the slaughtering facility and to the disposal or disposal/rendering operation, and changes in the labor operations during slaughtering.

Table 4-2 shows net income and closure impacts on NAICS 311611 for minimum and maximum cost estimates (from Table ES-1). Costs are allocated to each employment size group based on share of total slaughter from Table 1-7. As can be seen from the table, net income impacts on slaughterers range from 1.4 percent of net income for establishments with 1 to 4 employees to 77.6 percent of net income for the establishments with 10 to 19 employees, using minimum cost estimates. Using maximum cost estimates, impacts range from 3.2 percent of net income for the smallest size group to 143.1 percent for the establishments with between 10 and 19 employees. A total of 9 establishments are projected to close if minimum cost estimates are used. The incremental probability of closure for the minimum estimate varies from 0.2 to 11.7 percent. Maximum estimates result in incremental probabilities of 0.6 to 21.8 percent and result in a total of 17 establishment closures.

For some size classes, closures might appear to be low relative to the estimated compliance costs. This is because the tables show incremental closures and do not include baseline closures, i.e. establishments where pre-regulatory income is negative. Further, these closures assume there is no cost pass-through. As shown in the market model below, considerable cost pass-through should be expected.

Table 4-2. Net Income and Closure Impacts on Slaughterers Resulting from an SRM Ban

				Minimum Estimate				Maximum Estimate			
Employment Size Group	Number of Affected Estab. [1]	Net Income per Estab. in $1,000 [2]	Net Income Standard Deviation [3]	Compliance Costs per Affected Estab. in $1,000 [4]	Costs as a Percent of Net Income	Incremental Probability Net Income Less than Costs [5]	Number of Estab. with Costs Greater than Net Income [6]	Compliance Costs per Affected Estab. in $1,000 [4]	Costs as a Percent of Net Income	Incremental Probability Net Income Less than Costs [5]	Number of Estab. with Costs Greater than Net Income [6]
NAICS 311611: Animal (Except Poultry) Slaughtering											
1 to 4	508	$29.5	60	$0.4	1.4%	0.2%	1.3	$1.0	3.2%	0.6%	2.9
5 to 9	89	$49.3	95	$6.8	13.9%	2.6%	2.3	$12.4	25.2%	4.7%	4.2
10 to 19	26	$60.9	157	$47.2	77.6%	11.7%	3.0	$87.1	143.1%	21.8%	5.7
20 to 49	11	$358.1	657	$134.4	37.5%	7.4%	0.8	$253.6	70.8%	14.4%	1.6
50 to 99	12	$1,387.6	2406	$282.0	20.3%	4.1%	0.5	$530.0	38.2%	7.9%	0.9
100 to 249	8	$2,871.2	5549	$428.2	14.9%	2.7%	0.2	$846.6	29.5%	5.5%	0.4
250 to 499	11	$4,264.9	8545	$631.0	14.8%	2.6%	0.3	$1,296.5	30.4%	5.5%	0.6
500 to 999	9	$5,306.5	11078	$881.3	16.6%	2.9%	0.3	$1,867.1	35.2%	6.2%	0.6
1,000 to 2,499	13	$31,225.3	57146	$1,649.9	5.3%	1.0%	0.1	$3,756.0	12.0%	2.3%	0.3
More than 2,500	2	$10,579.7	34065	$2,130.8	20.1%	2.4%	0.0	$4,902.2	46.3%	5.6%	0.1
Total	**689**	**NA**	**NA**	**NA**	**NA**	**NA**	**8.8**	**NA**	**NA**	**NA**	**17.3**

[1] The total number of affected establishments is equal to the number for federally inspected cattle slaughter plants from Table 1-7.

[2] 1997 Economic Census data used to estimate net income (see text). The Bureau of Labor Statistics' Consumer Price Index is used to convert the income measures to current dollars.

[3] The standard deviation of the net income statistic is calculated for the special tabulation provided by Census (see text).

[4] Total annual compliance cost is allocated to each size group based on the share of value of shipments.

[5] Probability net income less than compliance costs minus probability net income less than zero.

[6] Probability net income less than costs times the number of establishments.

Sources: BLS, 2004; U.S. Census Bureau 1999; U.S. Census Bureau, 2001; U.S. Census Bureau, 2004.

Restrictions on tallow used in animal food would adversely impact independent renderers. They would need to purchase and install polishing centrifuge systems that would allow the tallow produced to contain less than 0.15 percent hexane insoluble impurities. Renderers would also face incremental annual costs for recordkeeping and labeling and costs for marking rendered products to ensure they are not used in animal feed.

While renderers (and particularly independent renderers) are also likely to incur some adverse impacts due to SRM disposal requirements, much of the financial impact will be determined by whether or not disposal rendering occurs and the disposal service charges are paid. In lieu of a shift toward disposal rendering services, renderers will see a reduction in the volume of renderable raw material, as described in Table 2-8. In that situation renderers will see an overall drop in their plant utilization rates, putting pressure on profit margins. At the relatively favorable current market prices for MBM and tallow of August 2004, renderers generally have some financial cushion to sustain a reduction in throughput without severe financial consequences. The loss of throughput will aggravate financial difficulties, however, should market prices become less favorable.

Thus, some rendering facility closures remain possible over time as substantial shifts occur in relative competitive positions. Firms will decide to process strictly SRM or non-SRM materials. Individual independent renderers and packer renderers will incur reductions in throughput as SRM materials are separated for shipment to other facilities, or as the facility endeavors to modify operations and trucking logistics to service either existing markets or new rendering-for-disposal markets. Most existing independent renderers, having survived a considerable period of market shakeout and consolidation over the last decade, appear well placed to continue operations. Nevertheless, the significant market adjustments needed under this regulation present the possibility of some market disruption. ERG has not undertaken plant-by-plant reviews and otherwise lacks sufficient data to determine whether some plant closures might be forecast in light of potential new competitive alignments and market organization. Although no formal survey was performed on closure prospects, no rendering executives contacted for this report volunteered that an SRM ban would cause them to closure their facility although some expressed considerable concern about what the new market alignments would mean for their operations.

Assuming that the projected shift toward rendering-for-disposal of SRMs goes smoothly, renderers as a group will maintain their overall utilization rates but will incur increased costs for the applicable new regulatory requirements. Table 4-3 presents renderer impacts as a result of increased costs to meet the tallow restrictions, fulfill incremental recordkeeping requirements, and satisfy marking requirements for SRM-derived derived materials. Annual costs for these requirements from section 2 were allocated to affected establishments in employment size groups on the basis of their share of value of shipments.

Financial impacts range from 1.6 percent of net income for establishments with 1 to 4 employees to 4.0 percent of net income for establishments with 50 to 99 employees for the minimum cost estimates. Impacts increase to 1.7 and 4.2 percent of net income for the same size groups with the maximum cost estimates. One establishment is projected to close as a result of these requirements with the incremental probability of closure (i.e. compliance cost greater than net income) ranging from 0.3 percent to 0.8 percent for both minimum and maximum cost estimates.

Table 4-3. Net Income and Closure Impacts on Renderers

Employment Size Group	Number of Affected Estab. [1]	Net Income per Estab. in $1,000 [2]	Net Income Standard Deviation [3]	Minimum Estimate				Maximum Estimate			
				Compliance Costs per Affected Estab. in $1,000 [4]	Costs as a Percent of Net Income	Incremental Probability Net Income Less than Costs [5]	Number of Estab. with Costs Greater than Net Income [6]	Compliance Costs per Affected Estab. in $1,000 [4]	Costs as a Percent of Net Income	Incremental Probability Net Income Less than Costs [5]	Number of Estab. with Costs Greater than Net Income [6]
NAICS 311613: Rendering and Meat Byproduct Processing											
1 to 4	20	$159.0	331	$2.5	1.6%	0.3%	0.1	$2.6	1.7%	0.3%	0.1
5 to 9	12	$542.8	845	$19.7	3.6%	0.8%	0.1	$20.7	3.8%	0.8%	0.1
10 to 19	31	$647.7	1115	$17.8	2.8%	0.5%	0.2	$18.8	2.9%	0.6%	0.2
20 to 49	40	$2,001.1	3406	$50.1	2.5%	0.5%	0.2	$52.7	2.6%	0.5%	0.2
50 to 99	38	$1,937.7	4767	$77.7	4.0%	0.6%	0.2	$81.7	4.2%	0.6%	0.2
100 to 249	0	NA	-	$0.0	NA	NA	NA	$0.0	NA	NA	NA
250 to 499	0	NA	-	$0.0	NA	NA	NA	$0.0	NA	NA	NA
500 to 999	0	NA	-	$0.0	NA	NA	NA	$0.0	NA	NA	NA
1,000 to 2,499	0	NA	-	$0.0	NA	NA	NA	$0.0	NA	NA	NA
More than 2,500	0	NA	-	$0.0	NA	NA	NA	$0.0	NA	NA	NA
Total	**141**	**NA**	**NA**	**NA**	**NA**	**NA**	**0.7**	**NA**	**NA**	**NA**	**0.7**

[1] The number of affected establishments is assumed to be 30 percent of the number of rendering establishments.

[2] 1997 Economic Census data used to estimate net income. The Bureau of Labor Statistics' Consumer Price Index is used to convert the income measures to current dollars.

[3] The standard deviation of the net income statistic is calculated for the special tabulation provided by Census (see text).

[4] Total annual compliance cost is allocated to each size group based on the share of value of shipments.

[5] Probability net income less than compliance costs minus probability net income less than zero.

[6] Probability net income less than costs times the number of establishments.

[7] Data for 7 facilities with employment between 100 and 249 and 1 facility with employment between 250 and 499 are combined in lower category due to disclosure issues.

Sources: BLS, 2004; U.S. Census Bureau 1999; U.S. Census Bureau, 2001; U.S. Census Bureau, 2004.

As previously noted, the renderer impacts had to be calculated using 1997 Census of Manufactures figures. The 2002 Census for renderers will be available later in 2004.

4.4 Impacts on Other Sectors

The SRM option language will also affect farming operations and "4D" firms. Impacts on these firms are discussed below.

Farming operations will also be affected by the SRM option language because they will incur incremental costs for disposing dead and downer cattle. With the prohibition of MBM from dead and downer cattle in animal feed, the number of deads and downers being rendered for disposal will decline. Certain animal operations will dispose of their deads and downers on-site and will incur incremental costs for these disposals. The significance of these costs will vary with the scale of the animal operation but are a very small component of operating costs in any case. ERG has not quantified the impacts of these disposal costs but does not expect these incremental charges to result in farm closures.

4D firms collect dead and downer cattle and either supply red meat or entire animals to the pet food industry. Some firms perform rough manual deboning of cattle and might also supply mechanically separated MS beef to the industry. The estimated 20 4D firms are evenly split between those that also do rendering of dead animals and those that do not.

Significant economic impacts are expected among firms that supply red meat and MS beef to the pet food industry, zoos and to other animal populations. The estimated ten 4D firms who are not also rendering would appear likely to cease operations.

Those 4D firms affiliated with renderers might continue operations solely in support of rendering (i.e., as animal collection operations), although presumably some personnel would no longer be needed and the 4D meat products would be dropped. As has been noted elsewhere, however, the loss of MBM from SRM and from 4D animals will reduce the number of dead animal pickups as renderers will need to increase their prices for these services. Thus the animal collection portion of these businesses will be adversely affected by more than one set of changes.

4.5 Market Level Impacts of the SRM Option

ERG used a market model to examine the impacts of the SRM option on the overall price and output of beef as well as on consumers, slaughterers, and cattle producers. ERG developed the basic framework for this market model to assess the impacts of EPA's meat products industry effluent guidelines, and modified it for use on this rule.

The model simultaneously estimates the perfectly competitive equilibrium price and output in four meat product markets (beef, pork, broilers, and turkey) at the wholesale level. The four markets are modeled simultaneously because these meat products are substitutes. Consumers will tend to respond to an increase in the price of beef by increasing their purchases of the other three products. If these substitution effects are ignored, the impacts of the option on the market for beef are likely to be underestimated. For each of the four meat products, ERG developed standard domestic supply, domestic demand, import supply, and export demand equations for each meat and poultry product. Domestic demand for each meat and poultry product is specified as a function of the price of the other three meat and poultry products in addition to its own price. ERG used USDA data to determine baseline market prices and quantities. Key model parameters (e.g., price elasticities) were selected from existing published sources after an extensive search. For each meat and poultry product market to be in equilibrium, U.S. domestic demand plus foreign demand (exports) must equal U.S. domestic supply plus foreign sales (imports) at its current market price. Further details on the market model may be found in Appendix B.

In order for beef slaughter facilities to be willing to supply exactly the same quantity of beef after the SRM option as before the SRM option, they will have recoup the additional costs incurred as a result of the rule; these costs will be spread over all units sold. Therefore, ERG models the decrease in supply of beef resulting from the SRM option as the annualized compliance costs per pound of carcass weight. Given the shift in the supply curve for beef, ERG solves for the post-regulatory set of meat prices that results in simultaneous equilibrium in all four markets.

The results of the market model analysis are summarized in Table 4-4. For each of the four markets, ERG presents the initial market equilibrium price and quantity, and the percent change in each of those variables resulting from the effects of the SRM option on beef. In addition, within the beef industry, ERG further examined impacts on consumers, processors, and cattle suppliers.

Drawing from the costs shown for slaughterers in Table 2-6, compliance costs of the SRM option range from $0.0024 per pound (wholesale weight) under the minimum cost estimate, to $0.0053 per pound under the maximum cost estimate. This will result in a price increase ranging from 0.09 percent to 0.19 percent in the price of beef, and a 0.05 percent to 0.11 percent decrease in domestic beef consumption. Consumers do substitute pork and poultry for the now relatively more expensive beef, but these impacts are relatively modest; sales of pork and poultry products are projected to increase by less than 0.1 percent.

ERG used a simplified fixed coefficient model of the derived demand for cattle in order to examine differential impacts on consumers, slaughterers, and cattle producers. Based on the ratio of beef production to cattle slaughter in 2003 and standard USDA ratios for determining wholesale and retail production, ERG determined that each slaughtered steer results in about 587 pounds of marketable beef (wholesale weight). Thus, for each 587 pound decrease in beef sales projected by the market model, ERG assumes cattle slaughter decreases by one. The 11.0 million pound reduction in beef sales under the low cost estimate is therefore expected to reduce cattle slaughter by 18,900 head, while the 23.8 million pound reduction in beef sales under the high cost estimate is expected to reduce annual slaughter by 40,600 head. The reduction in demand for cattle reduces the price of cattle by about 0.05 percent under the low cost estimate and about 0.11 percent under the high cost estimate. (These estimates do not include a forecast of the cost increase to farmers from the change in the economics of dead animal removal.)

Table 4-4. Impact of SRM Option on Markets for Meat and Poultry Products

Variable	Baseline	Compliance Cost Estimate Low	Compliance Cost Estimate High
Beef Market			
Compliance costs ($ millions)	NA	$50.9	$109.5
Compliance costs/lb	NA	$0.00245	$0.00526
As percent of price		0.17%	0.37%
Consumers			
Market price	$1.4324	$1.43364	$1.43507
Percent change		0.09%	0.19%
Market sales (million pounds)	21,198	21,187.0	21,174.2
Percent change		-0.05%	-0.11%
Processors			
Farm-to-wholesale price margin	$0.4160	$0.41587	$0.41571
Percent change		-0.03%	-0.07%
Cattle Producers			
Market price	$1,035.27	$1,034.73	$1,034.11
Percent change		-0.05%	-0.11%
Market sales (thousand head)	35,454	35,435.1	35,413.4
Percent change		-0.05%	-0.11%
Pork Market			
Market price	$1.0064	$1.0065	$1.0066
Percent change		0.01%	0.02%
Market sales (million pounds)	14,630	14,631	14,633
Percent change		0.01%	0.02%
Broilers Market			
Market price	$0.6198	$0.6199	$0.6199
Percent change		0.01%	0.02%
Market sales (million pounds)	27,822	27,823	27,825
Percent change		0.01%	0.01%
Turkey Market			
Market price	$0.6208	$0.6209	$0.6209
Percent change		0.01%	0.02%
Market sales (million pounds)	5,168	5,168	5,169
Percent change		0.00%	0.01%

Source: ERG meat products market model.

The farm-to-wholesale price margin is also reduced by the SRM option. The price that processors receive after paying the incremental costs imposed by the SRM option is projected to fall by about 0.1 percent under the low cost estimate and 0.2 percent under the high cost estimate (e.g., for the low cost estimate, the projected post-rule market price of $1.4336 less compliance costs per pound of $0.0024 results in the processors' post rule receipts of $1.4312 per pound, which is 0.09 percent below the processors' pre-rule receipts of $1.4324). However, the processors' farm-to-wholesale margin falls by a smaller amount because they pay less for cattle, about 0.05 percent to 0.11 percent less under the low and high cost estimates respectively. Thus, the net decrease in the processors' margin ranges from 0.03 percent to 0.07 percent.

The market model results can be used to estimate the burden of the SRM option on stakeholders. ERG estimates that about 50 percent of compliance costs will be passed on to consumers in the form of higher beef prices. Cattle producers will incur about 38 percent of compliance costs in the form of reduced cattle prices. Finally, processors will bear about 12 percent of the option's burden in the form of squeezed price margins.[11]

4.6 Financial Impacts of Regulatory Alternatives

This section presents impacts of the alternative regulatory requirements considered by FDA. Impacts of blood meal exclusions are presented in Section 4.6.1. Since blood meal exclusions will affect animal producers and farm operations, ERG examined impacts on one such operation, namely a representative dairy operation. Minor impacts are possible on feed mills owing to labeling requirements, however, these costs are very small and are not examined in detail. Section 4.6.2 discusses impacts of the alternative requirement whereby facilities must be dedicated to either handling of ruminant protein or manufacturing feed for ruminant animals. ERG uses the financial impact methodology described in Section 4.2 to estimate net income and incremental closure impacts pf this alternative on renderers and feed mills.

4.6.1 Regulatory Alternative: Blood Meal Prohibition - Impacts on Dairy Farm Operations

To determine the impact of the alternative rule changes for the end user of ruminant blood meal, ERG investigated the effect of a cost increase/revenue reduction at a dairy enterprise considered to be relatively sensitive to changes in financial conditions.

4.6.1.1 Development of a Baseline Dairy Enterprise Budget

An enterprise is defined as an operation that can be easily isolated using accounting procedures or through compiling separate costs and receipts. An enterprise budget is a projection of annual costs and returns of that operation.

Enterprise budgets might comprise the majority or only a small portion of a farm's income. Larger farms tend to specialize in one enterprise; smaller farms may have several small enterprises, although mixed animal enterprises at one farm tend to be relatively uncommon. For example, dairy operators are more likely to combine the dairy enterprise with a heifer replacement enterprise than with a hog enterprise. An enterprise is more sensitive to any changes in costs or revenues than the farm as a whole. At the farm level, additional enterprises,

[11] Because the wholesale-to-farm price margin is not calculated as an integral component of the market model, the uncertainty associated with impact estimates on processors is greater than that for consumers and cattle processors.

government subsidies, and off-farm income dilute the effect of changes in enterprise-level costs and revenues.

Land grant universities compile sample enterprise budgets for the many different enterprises on farms, including dairy operations. These budgets are intended to provide farmers with information that can help them determine their costs and revenues under various assumptions of input and product prices. The basic budgets model "typical" farming conditions in the region and incorporate average regional prices for products, such as milk, replacement animals, feed, and veterinary expenses, capital investment, labor, and overhead for typical size operations in the region. Farmers can modify the budgets to incorporate farm-specific conditions (such as numbers of animals) or can model "what if" scenarios by varying pricing assumptions.

Regulatory analysis at an enterprise level is supported by the agricultural industry. The U.S. Environmental Protection Agency recently completed an analysis of a regulation affecting concentrated animal feeding operations using both farm level and enterprise level financial models. EPA added the enterprise level analysis after receiving critical industry comments on a regulatory analysis that did not include sufficient information on the enterprise level effects. The commenters focused on the issue that farmers would not continue an unprofitable enterprise. Enterprise closures are an impact and could ultimately result in highly negative impacts on farms.

The dairy industry's most financially vulnerable enterprises tend to be those operating outside the key U.S. dairy regions. These less-traditional dairy regions are often far from the major feed-producing regions of the Midwest, and tend to be represented by small herd enterprise budgets.

Two types of dairy enterprise budgets are commonly found in the literature: those for Jersey and those for Holstein breed cows. Holstein dairy operations are typically the high volume, large farm operations located in many of the key dairy regions of the U.S. such as the upper Midwest and California. Jersey enterprises tend to be smaller or specialty operations. ERG collected several enterprise budgets, but selected a 2002 Jersey budget prepared by the University of Idaho to represent the pre-regulatory baseline at a small, possibly more vulnerable operation as means for determining a typical- to worst-case assessment of potential impact from effects of the rule (Gray, 2002). This budget was prepared for a herd of 120 cows.

In compiling the enterprise budget, the authors assume that 100 cows are milking and 20 are dry at any one time, with a 33 percent replacement rate (30 percent culling and 3 percent mortality). The herd is divided into 3 pens: (1) high-producing cows, (2) low-producing cows, and (3) dry cows. Cows are rotated among the pens depending on their place in the milking cycle (milk volumes are high following calving, with production dropping over time as the cow approaches a dry period before calving again). The cows are fed a diet of roughage (including alfalfa hay, corn silage, beet pulp, and oat hay) and concentrates (including a commercially prepared [14 percent protein] and purchased dry mixture and whole cottonseed). They also get a mineral supplement. The mix of these feed items differ by pen, with the high producers receiving the largest percentage of concentrates. The dry pen receives roughage only.

Table 4-5 shows the enterprise budget as prepared by the University of Idaho. The university provides the data through the value or cost/cow column. ERG has provided the enterprise level totals in the last column to show revenues and costs over the entire 120-cow herd.

Enterprise cash flow is adequate in this budget, with the enterprise clearing $565 per cow per year over operating expenses. Returns to labor and management are also positive, even when accounting for risk, at least at the assumed price of milk. Note that the largest single cost component is associated with feed (37 percent of all costs).

4.6.1.2 Measuring Financial Changes at the Enterprise Due to the Alternative Regulation

The impacts of the alternative rule changes will be determined partly by the substitutability of other protein sources for ruminant blood meal. Porcine blood meal is a good substitute, but supplies of this feed additive are insufficient and supply is unlikely to be stimulated by increases in blood meal price (Harlan, 2004b). The porcine blood meal price, even if very high, would have only very minor influence on hog prices and thus hog production. Other potential substitutes are considered generally inferior. Industry representatives believe that if ruminant blood meal is banned from ruminant feed, most dairy operations would not be able to match the protein mix needed in their feed and would experience reductions in milk production (Harlan, 2004b, and Russell, 2004). A rendering industry-sponsored analysis conducted by Sparks Companies, Inc. estimated that the losses in milk production will be about 4 pounds of milk per day per cow (Sparks Companies, Inc., 2001).

There are three possible scenarios that might be anticipated based on these observations. First, farmers might choose to replace ruminant blood meal with porcine blood meal, if available. Because porcine blood meal prices rose sharply in the immediate response to the potential rule changes, ERG assumed that the price of porcine blood meal might be $875/ton, or approximately $525 per ton more than average ruminant blood meal prices ($350/ton) from 2003 (see Section Three discussion on blood meal). The cost to the enterprise for porcine blood meal fed at a rate of 0.5 lbs./cow/day would yield an incremental cost per cow of $0.131 more than average ruminant blood meal prices.[12] This increased cost per cow is added to the cost per cow on the concentrates line item in the enterprise budget.

[12] The Idaho budget indicates that the high producing pen receives a higher percentage of concentrates (and thus protein additives) than the low producing pen, and the dry pen receives no concentrates. ERG assumes that the high producing cows receive 1 lb./day of blood meal (the highest palatable amount [source]), and the dry pen cows receive 0 lbs./day. ERG further assumes that Pen 2 would get 0.4 lbs. per day. The weighted average (calculated over numbers of days each cow is present in each pen—80 days in Pen 1, 240 days in Pen 2 and 45 days in Pen 3) is 0.5 lb. per day per cow. This figure matches the average pounds per day per cow over a production year provided by (Sparks Company, Inc. 2001).

Table 4-5. Alternative Regulation: Baseline Enterprise Budget for 120-Cow Jersey Herd

Line Item	Unit	Price or Cost/Unit	Number of Units/Cow	Value/ Cost 100 lbs Milk	Value or Cost/Cow	Enterprise Cost (120 Cows
Gross Receipts						
Milk	Cwt	$ 14.75	159.2	$ 14.77	$ 2,348.20	$281,784.00
Bull Calves	Head	$ 39.00	0.567	$ 0.14	$ 22.11	$ 2,653.56
Heifer Calves	Head	$ 130.00	0.567	$ 0.46	$ 73.71	$ 8,845.20
Cull Cows	Head	$ 430.00	0.308	$ 0.83	$ 132.44	$ 15,892.80
Manure Credit	Head	$ 25.46	1	$ 0.16	$ 25.46	$ 3,055.20
Total Receipts				**$ 16.36**	**$ 2,601.92**	**$312,230.76**
Operating Costs						
Feeds:						
Roughage	Cwt	$ 4.44	72	$ 2.01	$ 319.68	$ 38,361.60
Concentrates	Cwt	$ 7.45	74.64	$ 3.50	$ 556.07	$ 66,728.16
Hired Labor	Hr.	$ 10.00	19.49	$ 1.23	$ 194.90	$ 23,388.00
Herd Health:						
Breeding	Head	$ 26.00	1	$ 0.16	$ 26.00	$ 3,120.00
Veterinary	Head	$ 23.45	1	$ 0.15	$ 23.45	$ 2,814.00
Drugs	Head	$ 23.45	1	$ 0.15	$ 23.45	$ 2,814.00
Marketing	Head	$ 70.85	1	$ 0.45	$ 70.85	$ 8,502.00
Supplies, etc:						
Barn Supplies	Head	$ 28.50	1	$ 0.18	$ 28.50	$ 3,420.00
Utilities	Head	$ 47.50	1	$ 0.30	$ 47.50	$ 5,700.00
Records	Head	$ 20.00	1	$ 0.13	$ 20.00	$ 2,400.00
Bedding	Head	$ 30.71	1	$ 0.19	$ 30.71	$ 3,685.20
Other Supplies	Head	$ 120.00	1	$ 0.75	$ 120.00	$ 14,400.00
Repairs—all	Head	$ 86.53	1	$ 0.54	$ 86.53	$ 10,383.60
Professional Service	Head	$ 10.00	1	$ 0.06	$ 10.00	$ 1,200.00
Fuel	Head	$ 39.04	1	$ 0.25	$ 39.04	$ 4,684.80
Replacement Cost	Head	$ 1,150.00	0.33	$ 2.39	$ 379.50	$ 45,540.00
Interest on Cattle	Dollar	$ 0.07	790	$ 0.34	$ 53.72	$ 6,446.40
Interest on Operating Capital	Dollar	$ 0.06	1525.7	$ 0.05	$ 8.01	$ 961.19
Total Operating Costs				**$ 12.82**	**$ 2,037.91**	**$244,548.95**
Income Above Operating Cost					$ 564.02	$ 67,681.81
Ownership Costs						
Interest on Average Investment	Dollar	$ 0.07	2014	$ 0.86	$ 136.95	$ 16,434.24
Depreciation on All	Head	$ 194.45	1	$ 1.22	$ 194.45	$ 23,334.00
Insurance	Head	$ 10.41	1	$ 0.07	$ 10.41	$ 1,249.20
Total Ownership Costs				$ 2.15	$ 341.81	$ 41,017.44
Total Costs				**$ 14.97**	**$ 2,379.72**	**$285,566.39**
Returns to Operator Labor, Mgmt & Risk					$ 222.20	$ 26,664.37
Cost of Investment	Head	$ 2,804.00	1	$ 17.64	$ 2,804.00	$336,480.00
Return on Investment (Returns/Investment)						7.92%

Source: Gray, 2002.
Note: This table might not match the published budget exactly due to minor rounding differences.

Second, farmers might be unable to obtain porcine blood meal and would then substitute less desirable products, or, in the worst case, eliminate the extra protein source altogether, resulting in the possible loss of 4 pounds of milk per day per cow. By eliminating the additional protein from their concentrate mix, however, farmers save on feed costs. The Sparks Companies, Inc. analysis assumed that ruminant blood meal is directly added at the rate of 0.5 lbs/cow per day on average, which is about $0.0875 per day per cow (using the $350/ton price cited above). Based on these observations, ERG modified the enterprise spreadsheet shown in Table 4-4 to accommodate a reduction in concentrate cost per cow per year at $31.94 per year ($0.0875/cow x 365). ERG also adjusts the milk production in the number of units per cow, previously 159.2 cwt per year, to 145 cwt per year (159.2 - [(4 lbs x 365)/100]).

ERG did not directly analyze the third scenario. In this scenario, ERG envisioned a situation in which dairy enterprises fed heifer calves colostrum replacements based on ruminant sera to reduce calf mortality. ERG determined using the Idaho budget that at $20 per calf (Illini DairyNet, 2004), a heifer price of $130 (see Table 4-4), and an additional survival of 2 to 3 calves (based on improvements in mortality rates of about 3-5 percent [Illini DairyNet, 2004; Louis Russell, 2004]), colostrums replacements are not economical in this enterprise, unless premiums for heifer calves receiving disease free colostrums replacements exceed 11-12 percent (Illini DairyNet indicates that some premium could result).

ERG notes that these colostrums replacement products are not widely used, which apparently stems from their expense. These products are most likely more economical in the very largest herds where disease control is a major concern. Additionally, use of disease-free colostrums replacements may more likely command premium prices for heifer calves in the major dairy regions where very large herds are common.

Thus this scenario would probably not affect the vast majority of dairy enterprises in the United States. Furthermore, very large enterprises are likely to be able to withstand these impacts, particularly since it is likely that at the current prices, colostrum replacement may result in only very small increases in returns on a percentage basis.

The results under the two other scenarios are described below.

Scenario 1

In Scenario 1, ERG assumes that porcine blood meal can substitute for ruminant blood meal, but at a $525 premium over current ruminant blood meal prices (see Section Three). As Table 4-6 shows, this results in a concentrate cost per cow of $603.97. Returns to investment drop slightly from the baseline of nearly 8 percent to just over 6 percent.

Table 4-6. Alternative Regulation: Scenario 1—Farmer Substitutes Porcine Blood Meal for Ruminant Blood Meal

Line Item	Unit	Price or Cost/Unit	Number of Units/Cow	Value/ Cost 100 lbs Milk	Value or Cost/Cow	Enterprise Cost (120 Cows	Difference from Baseline
Gross Receipts							
Milk	Cwt	$ 14.75	159.2	$ 14.77	$ 2,348.20	$281,784.00	$ -
Bull Calves	Head	$ 39.00	0.567	$ 0.14	$ 22.11	$ 2,653.56	$ -
Heifer Calves	Head	$ 130.00	0.567	$ 0.46	$ 73.71	$ 8,845.20	$ -
Cull Cows	Head	$ 430.00	0.308	$ 0.83	$ 132.44	$ 15,892.80	$ -
Manure Credit	Head	$ 25.46	1	$ 0.16	$ 25.46	$ 3,055.20	$ -
Total Receipts				**$ 16.36**	**$ 2,601.92**	**$312,230.76**	**$ -**
Operating Costs							
Feeds:							
Roughage	Cwt	$ 4.44	72	$ 2.01	$ 319.68	$ 38,361.60	$ -
Concentrates	Cwt	$ 8.09	74.64	$ 3.80	$ 603.97	$ 72,476.91	$(5,748.75)
Hired Labor	Hr.	$ 10.00	19.49	$ 1.23	$ 194.90	$ 23,388.00	$ -
Herd Health:							
Breeding	Head	$ 26.00	1	$ 0.16	$ 26.00	$ 3,120.00	$ -
Veterinary	Head	$ 23.45	1	$ 0.15	$ 23.45	$ 2,814.00	$ -
Drugs	Head	$ 23.45	1	$ 0.15	$ 23.45	$ 2,814.00	$ -
Marketing	Head	$ 70.85	1	$ 0.45	$ 70.85	$ 8,502.00	$ -
Supplies, etc:							
Barn Supplies	Head	$ 28.50	1	$ 0.18	$ 28.50	$ 3,420.00	$ -
Utilities	Head	$ 47.50	1	$ 0.30	$ 47.50	$ 5,700.00	$ -
Records	Head	$ 20.00	1	$ 0.13	$ 20.00	$ 2,400.00	$ -
Bedding	Head	$ 30.71	1	$ 0.19	$ 30.71	$ 3,685.20	$ -
Other Supplies	Head	$ 120.00	1	$ 0.75	$ 120.00	$ 14,400.00	$ -
Repairs—all	Head	$ 86.53	1	$ 0.54	$ 86.53	$ 10,383.60	$ -
Professional Service	Head	$ 10.00	1	$ 0.06	$ 10.00	$ 1,200.00	$ -
Fuel	Head	$ 39.04	1	$ 0.25	$ 39.04	$ 4,684.80	$ -
Replacement Cost	Head	$ 1,150.00	0.33	$ 2.39	$ 379.50	$ 45,540.00	$ -
Interest on Cattle	Dollar	$ 0.07	790	$ 0.34	$ 53.72	$ 6,446.40	$ -
Interest on Operating Capital	Dollar	$ 0.06	1525.7	$ 0.05	$ 8.01	$ 961.19	$ -
Total Operating Costs				$ 13.12	$ 2,085.81	$250,297.70	$(5,748.75)
Income Above Operating Cost					$ 516.11	$ 61,933.06	$ 5,748.75
Ownership Costs							
Interest on Average Investment	Dollar	$ 0.07	2014	$ 0.86	$ 136.95	$ 16,434.24	$ -
Depreciation on All	Head	$ 194.45	1	$ 1.22	$ 194.45	$ 23,334.00	$ -
Insurance	Head	$10.41	1	$ 0.07	$ 10.41	$ 1,249.20	$ -
Total Ownership Costs				**$ 2.15**	**$ 341.81**	**$ 41,017.44**	**$ -**
Total Costs				**$ 15.27**	**$ 2,427.63**	**$291,315.14**	**$(5,748.75)**
Returns to Operator Labor, Mgmt & Risk					$ 174.30	$ 20,915.62	$ 5,748.75
Cost of Investment	Head	$2,804.00	1	$ 17.64	$ 2,804.00	$336,480.00	$ -
Return on Investment (Returns/Investment)						6.22%	

Source: Gray, 2002.

Scenario 2

The results of Scenario 2, in which farmers eliminate the additional protein from the diets of their cows altogether, resulting in milk declines per cow, are shown in Table 4-6. In this scenario, the units of milk per cow drop from 159.2 to 144.6, and the cost of feed concentrates per cow drops to $524.13.

As the table shows, this enterprise loses about $25,000 in revenues, affecting only a $3,800 savings in feed, with a net effect of losing about $22,000 per year. Returns on investment drop from about 8 percent to about 1.4 percent. Although the enterprise is still viable, the owner may question continued investment, given the low rate of return. However, many farmers in small operations are in business for a number of reasons that may not be solely economic.

4.6.1.3 SBREFA Analysis for Farm Operations

There are a number of ways that impacts on small businesses can be assessed. A closure analysis can be implemented to determine which small businesses might close, and other analyses can investigate the magnitude of costs relative to small firm revenues. This latter analysis, known as a revenue test, is commonly used when responding to Regulatory Flexibility Act analytical requirements. The revenue test may be more sensitive or less sensitive than a closure analysis, but it provides another measure of impact.

The SBA classifies small businesses at the highest level of corporate organization, which is the firm, not the facility (for business where a firm owns more than one facility). For farms, the vast majority of farms are both the firm and the facility, particularly among those that meet SBA size criteria. The enterprise, however, may not correspond to the firm, since farms often involve more than one enterprise. Among dairy farms, although the dairy might be the major enterprise, farms might also have heifer replacement enterprises, or a crop enterprise. Therefore, enterprise budgets are not appropriate for use in a small business analysis.

ERG thus uses USDA's data from what was previously known as its Farm Cost and Returns Survey (FRCS), from 1997 (2002 data are still being processed). These data provide average balance sheet and income statement line items for farms by size, and also provides numbers of farms and numbers of cows at those farms. Based on these data, ERG is able to characterize two sizes of small business dairy farms.

USDA reports data for three sizes of dairy farms, a small operation with less than 100 cows, a medium size operation with 100 to 500 cows, and a large operation with over 500 cows. The upper bound in the SBA definition of a small dairy farming business is a firm with $750,000 or less in annual revenues. USDA's small and medium farm sizes appear to represent small businesses under the SBA definition--the average revenue for the small operation is $99,864 and the average revenue for the medium-size operation is $403,057. Thus, ERG assumes that all 104,863 small operations and 21,678 medium size operations with dairy cows (as estimated by USDA) are small businesses. The remaining 2,492 farms are considered large businesses (average revenue is greater than $3 million per year). Thus, small businesses are estimated to

Table 4-7. Alternative Regulation: Scenario 2--No Protein Supplements Added to Feed

Line Item	Unit	Price or Cost/Unit	Number of Units/Cow	Value/ Cost 100 lbs Milk	Value or Cost/Cow	Enterprise Cost (120 Cows)	Difference From Baseline
Gross Receipts							
Milk	Cwt	$ 14.75	144.6	$ 14.71	$2,132.85	$255,942.00	$(25,842.00)
Bull Calves	Head	$ 39.00	0.567	$ 0.15	$ 22.11	$ 2,653.56	$ -
Heifer Calves	Head	$ 130.00	0.567	$ 0.51	$ 73.71	$ 8,845.20	$ -
Cull Cows	Head	$ 430.00	0.308	$ 0.91	$ 132.44	$ 15,892.80	$ -
Manure Credit	Head	$ 25.46	1	$ 0.18	$ 25.46	$ 3,055.20	$ -
Total Receipts				**$ 16.46**	**$2,386.57**	**$286,388.76**	**$(25,842.00)**
Operating Costs							
Feeds:							
Roughage	Cwt	$ 4.44	72	$ 2.20	$ 319.68	$ 38,361.60	$ -
Concentrates	Cwt	$ 7.02	74.64	$ 3.61	$ 524.13	$ 62,895.66	$ (3,832.50)
Hired Labor	Hr.	$ 10.00	19.49	$ 1.34	$ 194.90	$ 23,388.00	$ -
Herd Health:							
Breeding	Head	$ 26.00	1	$ 0.18	$ 26.00	$ 3,120.00	$ -
Veterinary	Head	$ 23.45	1	$ 0.16	$ 23.45	$ 2,814.00	$ -
Drugs	Head	$ 23.45	1	$ 0.16	$ 23.45	$ 2,814.00	$ -
Marketing	Head	$ 70.85	1	$ 0.49	$ 70.85	$ 8,502.00	$ -
Supplies, etc:							
Barn Supplies	Head	$ 28.50	1	$ 0.20	$ 28.50	$ 3,420.00	$ -
Utilities	Head	$ 47.50	1	$ 0.33	$ 47.50	$ 5,700.00	$ -
Records	Head	$ 20.00	1	$ 0.14	$ 20.00	$ 2,400.00	$ -
Bedding	Head	$ 30.71	1	$ 0.21	$ 30.71	$ 3,685.20	$ -
Other Supplies	Head	$ 120.00	1	$ 0.83	$ 120.00	$ 14,400.00	$ -
Repairs—all	Head	$ 86.53	1	$ 0.60	$ 86.53	$ 10,383.60	$ -
Professional Service	Head	$ 10.00	1	$ 0.07	$ 10.00	$ 1,200.00	$ -
Fuel	Head	$ 39.04	1	$ 0.27	$ 39.04	$ 4,684.80	$ -
Replacement Cost	Head	$1,150.00	0.33	$ 2.62	$ 379.50	$ 45,540.00	$ -
Interest on Cattle	Dollar	$ 0.07	790	$ 0.37	$ 53.72	$ 6,446.40	$ -
Interest on Operating Capital	Dollar	$ 0.06	1525.7	$ 0.06	$ 8.01	$ 961.19	$ -
Total Operating Costs				**$ 13.83**	**$2,005.97**	**$240,716.45**	**$ (3,832.50)**
Income Above Operating Cost					$ 380.60	$ 45,672.31	$(22,009.50)
Ownership Costs							
Interest on Average Investment	Dollar	$ 0.07	2014	$ 0.94	$ 136.95	$ 16,434.24	$ -
Depreciation on All	Head	$ 194.45	1	$ 1.34	$ 194.45	$ 23,334.00	$ -
Insurance	Head	$ 10.41	1	$ 0.07	$ 10.41	$ 1,249.20	$ -
Total Ownership Costs				$ 2.36	$ 341.81	$ 41,017.44	$ -
Total Costs				$ 16.19	$2,347.78	$ 281,733.89	$ (3,832.50)
Returns to Operator Labor, Mgmt & Risk					$ 38.79	$ 4,654.87	$(22,009.50)
Cost of Investment	Head	$ 2,804.00	1	$ 19.34	$2,804.00	$ 336,480.00	
Return on Investment (Returns/Investment)						1.38%	

comprise 98 percent of the total 129,034 dairy farms estimated by USDA to be operating in 1997.

USDA also provides data to calculate the average number of cows at each farm size. Small operations own on average about 39 cows per farm; medium-size operations own on average about 160 cows per farm.

ERG estimated in Sections 4.6.1.1 and 4.6.1.2 that the cost of feeding concentrates per cow might increase by as much as $48 per cow per year (considered a worst-case estimate). (See feed concentrate entries in Tables 4-5 and 4-6 and Section Three). This increase was calculated based on a 120-cow operation, which is between the size of the average small operation and average medium-size operation, so is considered a reasonable approximation of the cost increase that might apply to small dairy farm businesses.

Applying the per-cow cost increase to the small and medium farms in the USDA data (39 and 160 cows, representatively), ERG calculated the cost impacts relative to revenues. At the small farm, annual costs associated with feeding the more expensive porcine blood meal might be as much as $1,872 per year, or 1.9 percent of average annual revenues ($99,684). Annual costs at a medium-size farm might rise by $7,680, or (again) 1.9 percent of average annual revenues ($403,057). Given that the relationship between costs per cows and revenues per cow might be relatively linear at farms of these sizes (which is supported by the fact that both the small farm and medium-size farm appear to have approximately the same costs to revenues percentage), it is likely that all farms of this size (126,521 farms) would face costs exceeding 1 percent of revenues at an assumed $48 per cow cost increase. This estimate of the cost increase is, however, considered very high. As long as the cost increase stayed below about $25 per cow, costs as a percentage of revenues would be less than 1 percent of revenues.

In comparison, at large dairy operations, the average number of cows is 1,200, representing costs of $57,600. Given the $3,134,685 average annual revenues at farms of this size, the ratio of incremental regulatory costs to revenues is 1.8 percent. It is possible, however, that the cost increase per cow could be slightly lower at the largest farms, due to some economies of scale.

The aggregate cost of a blood meal restriction is derived by projecting the incremental cost of feed per cow ($48) by the number of cattle now possibly receiving blood meal. Using the estimate from Table 3-2 of 226.5 million lbs of blood meal production per year a total of 1.24 million dairy cows can be receiving 0.5 lbs of blood meal per day. Total impacts across all firms would come to $59.5 million per year.

4.6.2 Regulatory Alternative: Dedicated Facilities

Renderers (NAICS 311613) and feed mills (NAICS 311119) are expected to incur incremental costs with the alternative requirement for facilities dedicated to the production of ruminant feed[13]. Some renderers and feed mills will need to modify operations and dedicate their facilities to handle either ruminant or non-ruminant protein. Renderers will also need to modify their transportation logistics to satisfy the requirements for dedicated equipment.

Using FDA's Inspection Statistics (FDA, 2004), ERG estimated the affected establishments to total 200 feed mills and 141 renderers. (Feed mills also will incur minor impacts under the blood meal restriction of the draft language for the option, but these impacts are very small and were not quantified.) The affected establishments were then allocated to the employment size classes using each size class's share of the total number of establishments. Table 4-8 presents the number of establishments affected by the alternative regulatory requirements of requiring dedicated facilities.

Table 4-8. Number and Size Distribution of Establishments Affected by the Alternative Requirements for Dedicated Facilities

Employment Size Group	NAICS 311119 (Feed Mills)		NAICS 311613 (Renderers)	
	Total Number of Estab.	Number of Affected Estab.	Total Number of Estab.	Number of Affected Estab.
1 to 4	376	48	32	20
5 to 9	275	35	20	12
10 to 19	363	46	50	31
20 to 49	397	51	65	40
50 to 99	115	15	47	29
100 to 249	30	4	12	7
250 to 499	9	1	2	1
500 to 999	0	0	0	0
1,000 to 2,499	0	0	0	0
More than 2,500	0	0	0	0
Total	**1,565**	**200**	**228**	**141**

Sources: FDA, 2004; U.S. Census Bureau 2004.

For renderers and feed mills, ERG allocated maximum and minimum cost estimates from Table 3-14 among the number of affected establishments from Table 4-8. Thus, regulatory costs and impacts will be focused on a subset of firms in each industry. Costs were allocated among facilities according to their share of total industry shipments. Table 4-9 presents net income and closure impacts for feed mills (NAICS 311119) and renderers (NAICS 311613) as a result of the requirement for dedicated facilities.

As can be seen from the table, for NAICS 311119, the minimum estimates range from 1.4 percent of net income for establishments with 250 to 499 employees, to 16.4 percent for establishments with 1 to 4 employees. The maximum cost estimates range from 2.4 percent to

[13] For feed mills, establishments are found in both the 311119 NAICS code and in another NAICS code principally covering pet food manufacturing. ERG judged that the latter group is less clearly representative of feed mill operations and that group was not studied further.

27.8 percent for the same employment size groups. The incremental probability of closure ranges from 0.2 to 2.1 percent using minimum cost estimates and from 0.4 to 3.5 using maximum cost estimates. Three establishments are projected to close using the minimum estimates and 6 establishments are projected to close if the maximum cost estimates are used.

For renderers, minimum estimates range from 2.8 percent of net income for establishments with 1 to 4 employees to 7.1 percent for establishments with 50 to 99 employees. The maximum impacts range from 5.2 percent to 13.4 percent for the same size groups. Using the minimum estimates, the number of facilities expected to close varies between 0.5 percent and 1.4 percent among size classes. Using the maximum estimates, ERG estimates that the number of facilities projected to close varies from 0.9 percent for establishments with 1 to 4 employees, to a high of 2.6 percent for establishments with between 5 and 9 employees. In other words, the number of establishments expected to close increases by 1 establishment for the maximum estimate of impacts due to the alternative.

This analysis assumes that none of the costs can be passed on to feed consumers. Many of the affected feed manufacturers contacted by ERG, however, expected to be able to pass on their transportation costs, possibly reflecting strong positions in their local markets. This possibility of feed price increases should ameliorate impacts for some feed manufacturers. Nevertheless, ERG expects that some feed manufacturers will not have such strong locational or other advantages, relative to potential new competition in their operating area, and thus will not be able to pass some or most of their costs on to their customers. Such mills are candidates for closure.

Among renderers, the second smallest size strata (5 to 9 employees) appear most vulnerable. In such small firms, the range of activities might be quite limited.[14] Their viability will likely depend on the particularities of their operating and market circumstances.

[14] Members of the owner's family and/or other workers with ownership stakes might be employed in these small firms and would not be reported as employees.

Table 4-9. Alternative Regulation: Net Income and Closure Impacts Resulting from the Requirement for Dedicated Facilities

				Minimum Estimate				Maximum Estimate			
Employment Size Group	Number of Affected Estab. [1]	Net Income per Estab. in $1,000 [2]	Net Income Standard Deviation [3]	Compliance Costs per Affected Estab. in $1,000 [4]	Costs as a Percent of Net Income	Incremental Probability Net Income Less than Costs [5]	Number of Estab. with Costs Greater than Net Income [6]	Compliance Costs per Affected Estab. in $1,000 [4]	Costs as a Percent of Net Income	Incremental Probability Net Income Less than Costs [5]	Number of Estab. with Costs Greater than Net Income [6]
NAICS 311119: Other Animal Food Manufacturing (Feed Mills)											
1 to 4	48	$50.8	154	$8.3	16.4%	2.1%	1.0	$14.1	27.8%	3.5%	1.7
5 to 9	35	$313.7	756	$28.9	9.2%	1.4%	0.5	$49.0	15.6%	2.4%	0.8
10 to 19	46	$801.6	1882	$75.1	9.4%	1.5%	0.7	$127.4	15.9%	2.5%	1.2
20 to 49	51	$1,722.4	4256	$177.7	10.3%	1.5%	0.8	$301.4	17.5%	2.6%	1.3
50 to 99	15	$2,354.7	6520	$258.7	11.0%	1.5%	0.2	$438.7	18.6%	2.5%	0.4
100 to 249	4	$4,721.9	12592	$553.8	11.7%	1.6%	0.1	$939.2	19.9%	2.8%	0.1
250 to 499	1	$34,308.1	78183	$489.5	1.4%	0.2%	0.0	$830.3	2.4%	0.4%	0.0
500 to 999	0	NA	NA	$0.0	NA	NA	NA	$0.0	NA	NA	NA
1,000 to 2,499	0	NA	NA	$0.0	NA	NA	NA	$0.0	NA	NA	NA
More than 2,500	0	NA	NA	$0.0	NA	NA	NA	$0.0	NA	NA	NA
Total	**200**	**NA**	**NA**	**NA**	**NA**	**NA**	**3.2**	**NA**	**NA**	**NA**	**5.5**
NAICS 311613: Rendering and Meat Byproduct Processing											
1 to 4	20	$159.0	331	$4.4	2.8%	0.5%	0.1	$8.3	5.2%	0.9%	0.2
5 to 9	12	$542.8	845	$35.1	6.5%	1.4%	0.2	$65.9	12.1%	2.6%	0.3
10 to 19	31	$647.7	1115	$31.7	4.9%	1.0%	0.3	$59.6	9.2%	1.8%	0.6
20 to 49	40	$2,001.1	3406	$89.1	4.5%	0.9%	0.4	$167.5	8.4%	1.7%	0.7
50 to 99 [7]	38	$1,937.7	4767	$138.2	7.1%	1.1%	0.3	$259.6	13.4%	2.0%	0.6
100 to 249	0	NA	NA	$0.0	NA	NA	NA	$0.0	NA	NA	NA
250 to 499	10	NA	NA	$0.0	NA	NA	NA	$0.0	NA	NA	NA
500 to 999	0	NA	NA	$0.0	NA	NA	NA	$0.0	NA	NA	NA
1,000 to 2,499	0	NA	NA	$0.0	NA	NA	NA	$0.0	NA	NA	NA
More than 2,500	0	NA	NA	$0.0	NA	NA	NA	$0.0	NA	NA	NA
Total	**141**	**NA**	**NA**	**NA**	**NA**	**NA**	**1.2**	**NA**	**NA**	**NA**	**2.3**

[1] The total number of affected establishments is from FDA's Inspection Statistics and is allocated to the size groups based on share of the total number of establishments.
[2] 1997 Economic Census data used to estimate net income. The Bureau of Labor Statistics' Consumer Price Index is used to convert income measures to current dollars.
[3] The standard deviation of the net income statistic is calculated for the special tabulation provided by Census (see text).
[4] Total annual compliance cost is allocated to each size group based on the share of value of shipments.
[5] Probability net income less than compliance costs minus probability net income less than zero.
[6] Probability net income less than costs times the number of establishments.
[7] Data for 7 facilities with employment between 100 and 249 and 1 facility with employment between 250 and 499 are combined in lower category due to disclosure issues.
Sources: BLS, 2004; U.S. Census Bureau 1999; U.S. Census Bureau, 2001; U.S. Census Bureau, 2004.

SECTION FIVE

REFERENCES

Annual Survey of Manufacturers. 2004. The NBER-CES Manufacturing Industry Database (1958-1996). Accessed March 3 from http://www.nber.org/nberces/nbprod96.htm

Battaller, Neal. 2004. FDA database compilation for inspections through January 23, 2004. Center for Veterinary Medicine. Provided to ERG electronically, February 4, 2004.

Barlagi, Greg. 2004. Telephone communication between Reetika Motwane and Greg Barlagi, Alfa Laval. June 24.

Betton, George. 2004. Telephone communication between John Eyraud of ERG and George Betton, General Manager, Venture Milling, Co. February 13.

British Poultry Council. 2004. Code of Practice on the Production, Handling and Processing of Animal By-Products. Compiled by The Animal By-Products Industry Working Group, August 2003. Accessed August 11 from http://www.poultry.uk.com/food/ABPCoP_03.pdf

Bureau of Labor Statistics. 2004. Consumer Price Index: All Urban Consumers, 1913 to 2004. Retrieved March 3 from ftp://ftp.bls.gov/pub/special.requests/cpi/cpiai.txt

Bureau of Labor Statistics. 2004. Occupational Employment Survey: 2003. Retrieved from http://www.bls.gov/oes/home.htm

Carlson, Dean. 1996. Telephone communication between John Eyraud of ERG and Dean Carlson, President. National By-Products. June 28.

Dieterichs, Bill. 2004. Telephone communication between John Eyraud of ERG and Bill Dieterichs, author of Feed Bulletin, The Jacobsen Publishing Company. February 4.

Eastern Research Group. 2002. Model for Estimating the Impacts of Regulatory Costs on the Survival of Small Businesses and its Application to Four FDA-Regulated Industries, Draft Final Report. June 7, 2002.

Farmers Journal. 2004. Abattoir Building Regulations to be Considered. 20 October 2002. Accessed August 11 from http://www.farmersjournal.ie/2002/1026/farmmanagement/farmbuildings/

Federal Reserve. 2004. Historical Data on Interest Rates. Retrieved March 3 from http://www.federalreserve.gov/releases/h15/data.htm

Finke, Delane. 2004. Telephone communication between John Eyraud of ERG and Delane Finke, Manager, Tallow and Tankage, Burlington Northern Railroad, March 2.

Food and Drug Administration. 2004. Database of inspections regarding FDA feed ban. Center for Veterinary Medicine. Data provided to ERG on February 5, 2004.

Gill, Clayton and Philip Lobo. 2003. Annual Survey of Feed Plant Managers: Productivity Up, But Stress Showing. Feed Management, January/February 2003.

Gray, C. Wilson, Robert L. Smathers, and Neil R. Rimbay. 2002. Jersey Dairy Enterprise Annual Cow Budget; 2002 Idaho Livestock Costs and Returns Estimates, EBB-D3-02, University of Idaho College of Agriculture Cooperative Extension Service.

Harlan, Dave. 2004a. Analysis of potential regulatory impacts, information provided to FDA by Dave Harlan, Byproducts Marketing Manger, Cargill Taylor Beef Business Unit, Inc. April.

Harlan, Dave. 2004b. Telephone communication between John Eyraud of ERG and Dave Harlan, Byproducts Marketing Manger, Cargill Taylor Beef Business Unit, Inc. February 24.

Hensley, Gary. 2004. Telephone communication between Reetika Motwane of ERG and Gary Hensley, Hutchinson Hayes Separators. June 23.

Holcomb, Steve. 2004. Telephone conversation between John Eyraud of ERG and Steve Holcomb, Business Manager, DuCoa, Inc., Smithville, MO. February 6.

Hutjens, Mike. 2004. Telephone communication between John Eyraud of ERG and Mike Hutjens, Ext Dairy Specialist and Professor of Animal Sciences, University of Illinois. February 24.

Illini DairyNet, 2004. Colostrum alternatives. Website containing price quotation for APC product, Secure Calf Colostrum Replacer. Traill.outreach.uiuc.edu/dairynet/ paperDisplay.cfm?contented=1255. Accessed February 27.

Internal Revenue Service (IRS). 2000. *Instructions for Forms 1120 and 1120-A*. Department of the Treasury. Washington, D.C.

Jacobsen Publishing Company. 2004. Jacobsen Feed Bulletin. Various dates.

Lab Safety Supply. 2004. Safety Supplies, 2004 Edition. Lab Safety Supply, Inc.

Moormans. 2004. Evaluating Undegradable Intake Protein Sources. Feed Facts-- Dairy. Wwww.moormans.com/dairyFF/dairyjun98/uip.htm. June 1998.

Nebraska Farm Business Association. 2002. Livestock Enterprise Reports. http://nfba.unl.edu/Assets/Livestock%20Enterprise%20Averages.pdf

Payne, Keith. 2004. Telephone communication between Reetika Motwane of ERG and Keith Payne, Congressional and Public Affairs, Food Safety Inspection Service, US Department of Agriculture. June 3.

Perrata, Nancy. 2004. Telephone communication between Reetika Motwane of ERG and Mary Perrata, Regulations and Directives Development Staff, Office of Policy, Program Development and Evaluations, Food Safety Inspection Service, US Department of Agriculture. June 4.
Quigley, Jim. 2004. Telephone communication between John Eyraud of ERG and Jim Quigley, Vice President for Research, APC, Inc. February 13, 2004.

Russell, Dr. Louis. 2004. Information provided to ERG by E-mail, February 13, 2004 from Dr. Louis Russell, Vice President of Product Development and Marketing, APC.

Sparks Companies, Inc. 1997. The Economic Impact of Proposed Regulations Concerning Ruminant-Based Protein Products. Prepared for the National Renderers Association. Memphis, TN.

Sparks Companies, Inc. 2001. The Rendering Industry: Economic Impact of Future Feeding Regulations. Prepared for the National Renderers Association. McLean, VA. June.

Sparks Companies, Inc. 2002. Livestock Mortalities: Methods of Disposal and Their Potential Costs. Prepared for The National Renderers Association. McLean, VA. March.

State Tax Handbook. 1999. *2000 State Tax Handbook*. CCH Incorporated. Chicago, IL.

U.S. Census Bureau, 1999a. Other Animal Food Manufacturing. EC97M-3111B. 1997 Economic Census: Manufacturing Industry Series. Washington, D.C.: U.S. Department of Commerce. December.

U.S. Census Bureau, 1999b. Rendering and Other Meat Byproduct Processing. EC97M-3116C. 1997 Economic Census: Manufacturing Industry Series. Washington, D.C.: U.S. Department of Commerce. December.

U.S. Census Bureau, 1999c. Animal (Except Poultry) Slaughtering. EC97M-3116A. 1997 Economic Census: Manufacturing Industry Series. Washington, D.C.: U.S. Department of Commerce. November.

U.S. Census Bureau. 2000. Vehicle Inventory and Use Survey. Custom tables. 1997.

U.S. Census Bureau. 2001. Special Tabulation of Census Data for NAICS 311611 and 311613. Washington, D.C.: U.S. Department of Commerce. May.

U.S. Census Bureau. 2003. Census of Manufactures. M311K series for Fats and Oils: Production, Consumption and Stocks. As cited in www.renderers.org/statistics/index.htm.

U.S. Census Bureau. 2004. Special Tabulation of Census Data for NAICS 311119. Washington, D.C.: U.S. Department of Commerce. March.

U.S. Census Bureau, 2004. 2001 County Business Patterns. Retrieved April 19, 2004 from http://censtats.census.gov/cgi-bin/cbpnaic/cbpsel.pl

U.S. Department of Agriculture. 1999a. Census of Agriculture. United States Summary and State Data, National Level Data. Accessed online at http://www.nass.usda.gov/census/census97/volume1/us-51/toc97.htm

U.S. Department of Agriculture. 1999b. Census of Agriculture. Data from the Farm Costs and Returns Survey (FCRS) Database. Revised request received from EPA. March 25.

U.S. Department of Agriculture. 2003a. Livestock Slaughter, 2002 Summary. Accessed online at http://usda.mannlib.cornell.edu/reports/nassr/livestock/pls-bban/lsan0303.txt

U.S. Department of Agriculture. 2003b. 2002 National Carlot Meat Trade Review. Meat, Livestock, and Slaughter Data. Agricultural Marketing Service.

U.S. Department of Agriculture. 2004. 2002 Census of Agriculture. US Summary and State Data, Preliminary Report. Abbreviated Historical Highlights. Accessed online at http://www.nass.usda.gov/census/census97/volume1/us-51/toc97.htm

U.S. Department of Agriculture. Federal State and Inspection Service. 2004. Preliminary Analysis of Interim Final Rules And An Interpretive Rule to Prevent the BSE Agent from Entering the U.S. Food Supply.

U.S. Department of Agriculture. 2004. Weekly National Carlot Meat Report. Livestock and Seed Program, Livestock and Grain Market News Service, Agricultural Marketing Service. Various weekly summaries for January and February 2004.

U.S. Department of Agriculture. 2004. Livestock Slaughter - Annual Summary. 2003. Date released March 5, 2003.

U.S. Department of Agriculture. 2004. Prohibition of the Use of Specified Risk Materials for Human Food and Requirements for the Disposition of Non-Ambulatory Disabled Cattle, Interim Final Rule. Federal Register Vol. 69, No.7, January 12, 2004.

U.S. International Trade Administration, 2004. Industry Sector Data: Trend Tables. Retrieved April 19, 2004 from http://www.ita.doc.gov/td/industry/otea/industry_sector/tables_naics.htm

U.S. Small Business Administration. 2004a. Small Business Size Standards Matched to North American Industry Classification System, Effective January 28, 2004. Accessed online at http://www.sba.gov/size/sizetable2002.html and from http://www.sba.gov/size/sizetable2002.pdf

U.S. Small Business Administration. 2004b. Firm Size Data: Statistics of U.S. Businesses and Nonemployer Statistics, 2001 data on employment size of firms. Accessed on-line at http://www.sba.gov/advo/stats/us_01_n6.pdf

Vanden Berg, 2004. Telephone communication between John Eyraud of ERG and Mel Vanden Berg, Proliant, Ames, IA. February 5.

APPENDIX A

ERG's SMALL BUSINESS IMPACTS MODEL (SBIM©)

In Section Four, ERG presented financial impacts of the FDA alternatives on rendering and feed mill establishments using the Small Business Impacts Model (SBIM©). This appendix describes the basic framework of the SBIM©, previously developed by ERG for estimating small business impacts of EPA and FDA-regulated industries (ERG, 2002).

There are a number of overarching themes in ERG's approach to developing this model framework. First, the model focuses on measures of net facility income. More specifically, it estimates the revenue and cost structure of a series of representative small establishments of varying size classes. These are referred to as model facilities hereafter. By focusing on production costs and revenues instead of just revenues, the Agency can better assess the ability of small businesses to bear regulatory burdens. Second, the model estimates a distribution of income for each model class within each industry. Estimating the *distribution* of income within a model class is necessary for projecting the percentage of facilities in each model class that are vulnerable to a given level of regulatory costs. Third, by modeling a number of model facility classes within each industry, the model provides flexibility for examining impacts among different size classes of small facilities.

Section A.1 presents an overview of the basic model framework. Section A.2 discusses the primary data sources utilized in creating model facilities and their respective income measures. Section A.3 provides a detailed description of the basic model framework, including the development of model facility income measures, the estimation of the frequency distribution of different income measures, and the estimation of impacts on small businesses. Impacts of the SRM option are presented in Section Four.

A.1 Overview of the Model Framework and Presentation

As mentioned in Section Four, the model framework is primarily based on two basic concepts:

(1) Negative net income is analogous to short-run average variable costs exceeding average revenues

(3) Size affects an establishment's ability to absorb regulatory costs.

First, economic theory states that a profit-maximizing firm will shut down where short-run average variable costs (AVC) exceed average revenues (AR). In modern corporate finance, accounting net income is roughly analogous to the comparison of short-run variable costs and revenues. Net income essentially measures the current operating revenues net of operating costs of an establishment. Thus, if an establishment's net income turns negative after regulatory costs are subtracted from its pre-regulatory net income, then it is equivalent to the theoretical microeconomic firm that shuts down due to short-run AVC exceeding AR. Although the model calculates four income measures (revenues, EBIT, net income, and cash flow) and this appendix describes the derivation of all four, impacts of the option are based on net income.

Second, differences in establishment size typically result in differences in relative earnings (e.g., net income as a percent of operating costs, or per employee). Additionally, regulatory cost burdens tend to vary across different-sized establishments. Hence, establishment size is an important determinant of regulatory impacts.

Using these assumptions as the starting point, the application of the small business model framework to a specific industry requires the (1) characterization of a series of different-sized model establishments and (2) estimation of net income and its distribution for each of the model establishments. Accounting for the distribution of net income for all establishments represented by each model establishment is essential because each model establishment reflects the average of a group of establishments, not a group of identical establishments. Hence, a simple comparison of average regulatory costs with a model establishment's net income will generate an all-or-nothing result (i.e., all facilities represented by a particular model incur impacts identical to those of the model facility) leading to impact estimation errors.

The model uses the following information to estimate the distribution of net income for establishments represented by each model establishment:

- Mean of the distribution,
- Variance of the distribution, and
- Type of distribution.

Because the actual calculation of the mean and variance of establishment income involves a wide variety of sources, and a number of calculation steps, this section provides a roadmap through the detailed explanation to follow in Sections A.2 and A.3. Figure A-1 is a flow diagram presenting the key data sources, how those data sources enter the model, the interrelationship between the two primary components of the model, and how those components interact with regulatory cost estimates to project regulatory impacts.

The column of boxes at the left-hand margin of Figure A-1 represents the data sources. First, a variety of industry-specific data sources are used to characterize an industry to determine what Census data (i.e., which NAICS codes) are most appropriate to model a given industry. After using these data sources to map the industry onto Census data, the remaining specified data sources are used to model it. All data are used to develop estimates of model facility income (i.e., revenues, earnings before interest and taxes (EBIT), net income, and cash flow) and their distribution, albeit some data are used indirectly in the form of intermediate calculations. For

example, investment data obtained from the *Annual Survey of Manufactures* are combined with interest rate data from the Federal Reserve to estimate industry interest payments, which are ultimately used in the model facility income calculations.

The key data source is from the U.S. Census of Manufactures. Two types of Census data are used: industry-level data and employment-class data. Various components utilized in generating the income measures are only reported at the industry-level. These data are then distributed among the various employment classes to generate the various income measures. Model establishment classes are defined by employment size; Census provides key components such as revenues, payroll, and material costs at the employment class level. Calculated as means for each employment class, these data are the most important components of model establishment income. Furthermore, ERG obtained from Census the variances and covariances of these components used to estimate the variance of model establishment class income.

Mean revenues, payroll and material costs are the primary components of model facility income, and the variances and covariances of revenues, payroll and material costs are the primary components of the variance of model facility income. Model facility income is, however, modified by the inclusion of other components (e.g., interest payments, taxes, and other operating costs). These components, in all likelihood, affect estimated variance as well as income. Because direct information on the variance of these individual components is not available, the model estimates their impact on the variance of income. Hence, there is a link between the two primary components of the model: income, and the variance of that income.

Given estimated model facility income, and the estimated variance of that income, the cumulative distribution function for the entire class of establishments represented by that model can be estimated. Combining this income distribution with estimates of compliance costs, the model can compute the percentage and number of establishments that incur costs exceeding an income measure and the number of workers employed in those establishments.

A.2 Data Sources

The primary data sources utilized in the base model include:

- *1997* Economic *Census: Manufacturing – Industry Series*,
- 1997 Economic Census customized tabulation,
- Annual *Survey of Manufactures (ASM)*, 1958-1997,
- 2000 Federal and state corporate tax rates,
- Statistics *of U.S. Businesses: Dynamic Data*, and
- Industry specific data sources, if applicable.

The following sections briefly discuss each data source and its utilization in the model framework.

A.2.1 1997 Economic Census: Manufacturing – Industry Series

The U.S. Census Bureau's *1997 Economic Census* for manufacturing industries constitutes the primary data source for the model (the 2002 Census is not yet available.) ERG created an estimated income statement for each model facility from the Census' establishment level data. Census data are the only high quality source of consistent, systematically collected revenue and cost data for most industries. It is these qualities that ensure that model facilities and their estimated income are representative of the industry. The relevant data fields available from the Census include the following:

- At the employment class level: Number of establishments, number of employees, value of shipments, payroll, value-added, cost of materials, and capital expenditures, and

- At the North American Industry Classification System (NAICS) industry level: Employment benefits, depreciation, rent payments, building repairs, equipment repairs, communications, legal services, accounting services, data processing advertising services, and refuse removal services.

The Census data are also provided by establishment employment class. The Small Business Administration (SBA) standards for classifying firms as small are typically expressed in terms of entity employment level. Therefore, it is straightforward to utilize the model to evaluate impacts using the NAICS-based SBA definitions.

In the model, the model facility income measures are based on establishment-level data, while SBA size standards are determined by company-level employment. Where the company is a single-establishment firm, as most small businesses are, the company and the establishment are identical. SBA's Office of Advocacy provides a special compilation of Census data comparing the number of establishments with the number of firms, by employment level. For most industries, the ratio of companies to establishments by employment class is close to 1.0 for establishments with fewer than 20 employees, and greater than 0.9 for establishments with fewer than 500 employees. Thus, the model assumption that the establishment is equivalent to the company should not significantly affect the analysis.

A.2.2 Customized Tabulation From the 1997 Economic Census

In addition to the published Census statistics above, ERG also requested a customized tabulation of the *1997 Economic Census* from the Census Bureau. The additional data fields obtained for each employment size class in a given NAICS included:

- Variance estimates for value of shipments, payroll, and cost of materials,

- Covariance estimates for value of shipments and payroll; value of shipments and cost of materials; and payroll and cost of materials, and

- Correlation coefficients of value of shipments and payroll; value of shipments and cost of materials; and payroll and cost of materials.

ERG used these statistics to estimate the frequency distribution of income measures for each employment class in the model (see Section A.3.2).

A.2.3 Annual Survey of Manufactures (ASM), 1958-1997

Every five years, the Census Bureau surveys around 60,000 manufacturing establishments for the *Annual Survey of Manufactures (ASM)*. The survey sample for the ASM is drawn from the Census of Manufactures database of all manufacturing establishments in the country. The model utilizes time series data (1958 through 1997) from the ASM to compute interest payments for model facilities in each NAICS code.[1] The ASM data fields utilized in the model include

- Investment in capital equipment, and

- Investment in buildings

both of which are denoted in nominal dollars. The interest payment computations in the model must be updated as new annual data becomes available.

A.2.4 2000 Federal and State Corporate Tax Rates

The Internal Revenue Service (IRS) and the state governments provide the applicable Federal and state corporate tax rates in *Instructions for Forms 1120 and 1120-A* and *State Tax Handbook* publications, respectively. The tax rates utilized in the computation of tax payments in the model are provided in Table A-1.

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[1] At present, the ASM time series data are available on a Standard Industrial Classification (SIC) basis rather than the NAICS basis utilized in the model. Thus, ERG transformed the SIC-based investment data into NAICS basis using the SIC to NAICS bridge tables provided by the Census Bureau.

Table A-1. 2000 Federal and State Corporate Tax Rates

Taxable Income	Standard Tax	Taxable Income	Average Effective Tax Rate
$ -	$ -	$ -	15%
$50,000	$7,500	$50,000	25%
$75,000	$13,750	$75,000	34%
$100,000	$22,250	$100,000	39%
$335,000	$113,900	$335,000	34%
$10,000,000	$3,400,000	$10,000,000	35%
$15,000,000	$5,150,000	$15,000,000	38%
$18,333,000	$ -	$18,333,000	35%
Average state tax rate			6.6%

Source: IRS, 2000 and State Tax Handbook, 1999

A.2.5 Statistics of U.S. Businesses: Dynamic Data

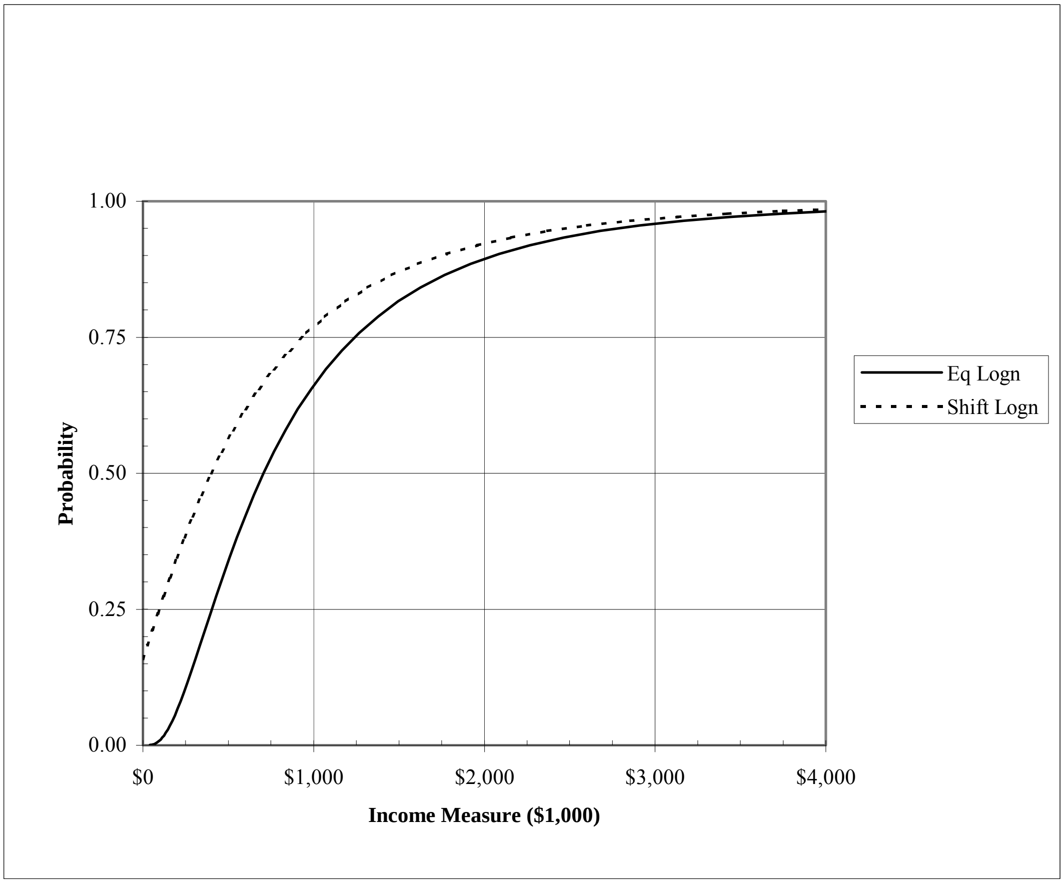
Baseline closures are incorporated into the model with the assumption of a normal distribution of income, i.e., if an establishment's pre-regulatory net income is negative, regulatory impacts cannot be defined. If on the other hand, pre-regulatory net income is positive and post-regulatory net income is negative, then the establishment is projected to close.

However, because the domain for the lognormal function is (0, ∞), the lognormal distributional assumption cannot by definition incorporate the notion of baseline facility closures (i.e., facilities earning negative income regardless of any regulation). To overcome this limitation, ERG can use the reported firm-death rate figures as a proxy for the probability of baseline facility closure. Thus, the cumulative lognormal distribution will shift up by the reported death-rate, such that at $0 income the cumulative probability will be equivalent to the reported firm-death rate for the employment size class. This is depicted in Figure A-2. Reading the point where the shifted lognormal curve intersects the *y*-axis, the probability of baseline closure for the employment size class is around 16 percent in the figure.

The U.S. Census Bureau collects and publishes statistics on the birth and death rate of firms by 4-digit NAICS industry, employment size, and state. The reported death rates correspond to establishments that were in business during the initial year but were out of business in the subsequent year for the 4-digit NAICS. The model uses the firm-death rate data to scale the cumulative frequency distributions of the three income measures under the lognormal distributional assumption.

In Section Four, ERG assumes a normal distribution and consequently, baseline closures are incorporated into the model (see Section A.3.2).

Figure A-2
Lognormal Distribution Function of Income



A.3 Model Framework

The microeconomic basis for the model framework is that a profit-maximizing firm will shut down when short-run AVC exceed AR. Economic theory states that sunk costs (i.e., costs attributable to past capital purchases) are irrelevant to a firm's current decision making; only variable costs matter in the short run. The model assesses when and to what extent a facility is impacted by regulatory costs by measuring the facility's pre- and post-regulation income. If income becomes negative after regulatory costs are subtracted from pre-regulation income, it can be reasonably inferred that the regulatory cost burden caused the facility closure. Impacts of the regulation then would include closure of a facility along with its lost output and employment. The model framework can evaluate impacts on small businesses by utilizing four income measures: revenues, EBIT, net income, and cash flow.

The model preparation covers four stages:

- *Stage 1* – Develop model facility income measures, including revenues, EBIT, net income, and cash flow, for establishments of different sizes;

- *Stage 2* – Estimate the frequency distribution of different income measures for the class of facilities represented by each model facility;

- *Stage 3* – Provide a framework of per-facility regulatory compliance costs for use as inputs in each model facility class by type of regulation; and

- *Stage 4* – Estimate the percentage of facilities with income less than estimated regulatory costs within each model facility class.

A detailed discussion of each of these stages is provided in the following sections.

A.3.1 Development of Model Facility Income Measures

In the first step, ERG developed a series of model facilities for the industry to be analyzed. The model facilities represent establishments of different employment sizes within the industry. The *1997 Economic Census: Manufacturing – Industry Series* data provide detailed revenue and cost information by employment class that ERG primarily used to build model facilities. ERG also utilized the *Annual Survey of Manufactures* (ASM), and Federal and state corporate tax rates, to estimate interest payments and relevant tax rates. For each model facility, the model computes revenues, EBIT, net income, and cash flow.

A.3.1.1 Revenues

The Census Bureau publishes the value of total shipments by employment size and the number of establishments in that class. The value of total shipments includes the value of primary and secondary shipments and the value of resale, contract, and other miscellaneous receipts. Thus, the value of total shipments at the employment class level divided by the number of establishments within the class essentially equals total revenues per establishment, i.e.,

$$\text{Revenues} = \frac{\text{Value of Shipments}}{\text{Number of Establishments}} \tag{1-1}$$

for each employment class. Model facility revenues are the easiest and most accurate income measure to compute as the data are directly provided by the Census distributed to the employment class level. There is, however, no necessary casual link among regulatory costs, revenue impacts, and facility closure. Nonetheless, the model can evaluate impacts on revenues (in addition to EBIT, net income, and cash flow) to check for consistency in model results.

A.3.1.2 Earnings Before Interest and Taxes (EBIT)

Using several assumptions, the model calculates EBIT as total revenues minus operating costs for each model facility. The Census provides most categories of operating costs that are included in the EBIT computation, including

- Value of shipments, payroll, and material costs directly distributed to the employment class level, and
- Benefits, depreciation, rent, and purchased services (listed below) at the NAICS industry level.

In addition to payroll and material costs, Census also provides capital expenditures and value added directly distributed at the employment class level.

To distribute industry level costs to the employment class level, ERG assumed that:

- Employment benefits are proportionate to payroll.
- Depreciation expense is proportionate to capital expenditures.
- Rent payments are proportionate to capital expenditures.
- Building repairs expenses are proportionate to capital expenditures.
- Equipment repairs expenses are proportionate to capital expenditures.
- Communications expenses are proportionate to value of shipments.
- Legal services expenses are proportionate to value of shipments.
- Accounting services expenses are proportionate to value of shipments.

- Data processing services expenses are proportionate to value of shipments.
- Advertising services expenses are proportionate to value added.
- Refuse removal expenses are proportionate to material costs.

In using capital expenditures to distribute depreciation, rent, and repair costs to the employment class level, ERG implicitly assumed that capital expenditures are proportionate to capital stocks. Presumably, expenditures on building repairs, for example, are a function of buildings owned; because that information is not available, however, the model uses an additional assumption that capital stocks by employment class are proportionate to capital expenditures by employment class.

The model calculates model facility EBIT as:

(1-2) $$\text{EBIT} = \frac{(\text{Value of Shipments - Operating Costs})}{\text{Number of establishments}}$$

where

(1-3) $$\text{Operating Costs} = \begin{pmatrix} \text{Payroll} + \text{Material Costs} + \text{Benefits} + \text{Depreciation} + \text{Rent} \\ + \text{Purchased Services} \end{pmatrix}$$

for each employment class. Because revenues, payroll, and cost of materials are the most significant components of EBIT, the error introduced by distributing industry level data among employment classes will be small.

A.3.1.3 Net Income

The model calculates net income for each model facility as EBIT less tax and interest payments. To estimate taxes and interest payments, ERG utilized the ASM, the *1997 Economic Census*, and federal and state corporate tax rates. Because an additional layer of assumptions, however reasonable, must be utilized to estimate net income, the uncertainty associated with the net income estimate is greater than that for EBIT.

The tax payment estimation assumes that establishment EBIT is equal to business entity EBIT, i.e., that the establishment represents the entire business. For the purposes of estimating facility tax payments, ERG multiplied the model facility's EBIT by the sum of relevant Federal corporate income tax rate and the average state corporate income tax rate and added it to the standard tax for the model facility's EBIT. Table A-1 presents the applicable standard taxes and tax rates used in the computations (see Section A.2.4).

The model estimates interest payments using a combination of ASM data on past investment by industry, Census data on relative investment in buildings and equipment, and assumptions about investment behavior. For each industry under consideration, ERG first scaled the ASM time series data on investment, which is based on Standard Industrial Classification (SIC) codes, to represent the applicable NAICS industries. ERG then used the average percentage of relevant industry investment in equipment and structures as presented in the Census data to divide the ASM investment time series into those two components.

To estimate interest payments from the time series of past investment in equipment and structures, the model uses assumptions about industry-borrowing behavior. More specifically, ERG assumed that:

- All investment in each year was funded through bank loans,

- The interest rate on those loans is equal to the nominal prime rate for that year plus 1 percent (since ASM investment time series data is in nominal terms, a nominal interest rate is appropriate), and

- The average loan period was ten years for equipment and 25 years for structures.

With these assumptions, ERG developed a time series estimate of loan payments made by the industry, and the portion of each year's loan payments accounted for by interest. Total interest payments in the baseline year equals the sum of this year's interest payments on the stream of past years' investment.[4] Interest payments were then attributed to each employment class based on the percentage of industry investment accounted for by that employment class in the Census data.

Net income is calculated as:

(1-4) $$\text{Net Income} = (\text{EBIT} - \text{Standard Tax}) \times (1 - \text{Tax Rate}) - \text{Interest Payments}$$

for each model facility.

A.3.1.4 Cash Flow

The model calculates cash flow for each model facility as net income plus depreciation. Depreciation is estimated as a component of EBIT and added back into the cash flow calculation.

(1-5) $$\text{Cash Flow} = \text{Net Income} + \text{Depreciation}$$

where depreciation was estimated for the calculation of model facility EBIT as described in Section A.3.1.2.

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[4] For example, interest payments on equipment investment for the year 1997 would equal the sum of interest paid in year 25 of loans from 1973 plus the interest paid in year 24 of loans from 1974, and so on.

The link between impacts measured by comparing net income or cash flow with compliance costs is much stronger than the link between either EBIT or revenues and compliance costs: when post-compliance net income or cash flow is negative, the facility can be reasonably projected to close. Because the estimate of net income and cash flow is dependent upon a series of assumptions, however, the uncertainty concerning the accuracy of these measures is much greater than that for revenues or EBIT. Thus, this analytic approach presents a tradeoff between the accuracy of the income measure and the certainty of the impacts based on that measure.

A.3.2 Distribution of Income Represented by Model Facilities

The model facilities reflect the average of a group of facilities, not a group of identical facilities. Income for a given group of facilities will lie in a distribution around the average. Ignoring this distribution of facility income will result in impact estimation errors. If the model facility is projected to remain open after incurring regulatory costs, then some facilities that it represents with smaller than average income may, in fact, close due to the regulation despite the model results. Conversely, if the model facility is projected to close as a result of regulatory costs, then some larger than average facilities that it represents may in reality remain open despite the regulatory costs. To address this, ERG estimated the distribution of income represented by model facilities. By modeling a facility income distribution with known mean and variance, the model can forecast how regulatory costs impact not just the model facility, but the facilities represented by it as well.

To estimate the distribution of income, ERG obtained special tabulations of the variances and covariances of relevant income components for each employment class (i.e., model facility) from the Census Bureau. Combining these data along with the starting assumption that these observations are normally distributed around their mean, ERG constructed cumulative probability distributions for the four income measures, revenues, EBIT, net income, and cash flow. The following sections describe the cumulative probability distribution constructs for the individual income measures in further detail.

ERG's SBIM© model can also incorporate an alternative assumption on the frequency distribution of income to assess the sensitivity of model results to the assumption of normality (see Section A.2.5). If, for instance, some facilities within an employment class have atypically high incomes, then the income distribution for the class might be positively skewed rather than symmetric around a mean value. In such a case, using a normal symmetric distribution to approximate the skewed distribution would yield biased estimates. The Census Bureau further indicated that in general, the distribution of facilities in an employment size class tends to be positively skewed (Quash, 2001). Thus, for each of the industry models, ERG can also generate an alternative set of income distributions based on the lognormal function for use in gauging the sensitivity of model results to the normality assumption. However, ERG did not perform such an analysis for this discussion because ERG assumes that even if the distribution of a variable such as revenues, payroll, or material costs is positively skewed, the distribution of a function of those variables (e.g., revenues minus payroll and material costs) will not necessarily be skewed. Thus, while there is intuitive reason to believe the distribution of establishment income measures is skewed, the degree of skewness is difficult to determine.

A.3.2.1 Distribution of Revenues

To estimate the cumulative probability function of revenues, for each NAICS industry and model facility analyzed, ERG obtained the variance of the value of shipments, σ_R^2, around its mean, $\bar{x}_R$. Based on the distributional assumption employed, the model evaluates impacts as the number and percentage of facilities in an employment class for which compliance costs exceed revenues or a specified percentage of revenues.

For the base model, the revenues for a given employment size class are assumed to be normally distributed, i.e.,

(1-6) $$x_R \sim N\left(\bar{x}_R, \sigma_R^2\right)$$

For a lognormal assumption, where $x_R \sim Lognormal\left(\bar{x}_{\ln x_R}, \hat{\sigma}^2_{\ln x_R}\right)$, ERG transforms the mean and variance of revenues to obtain the relevant parameters for the lognormal distribution using the following formulas:

(1-7) $$\bar{x}_{\ln x_R} = \ln \bar{x}_R - \frac{1}{2}\sigma^2_{\ln x_R}$$

(1-8) $$\sigma^2_{\ln x_R} = \ln\left(1 + \frac{\sigma_R^2}{\bar{x}_R^2}\right)$$

A.3.2.2 Distribution of EBIT

Although the variance of revenues (value of shipments) is provided by the Census special tabulation, the variance of EBIT needs to be estimated. EBIT is a linear function of its revenue and cost components. Thus, the variance of EBIT can be estimated using the standard statistical relationship where the variance of a linear function, *x*, of *n* variables is itself a linear function of the variance and covariance of its constituents, such that

(1-9) if $$x = \sum_{i=1}^{n} x_i$$

then

(1-10) $$Var(x) = \sum_{i=1}^{n} Var(x_i) + 2\sum_i \sum_j Cov(x_i, x_j)$$

where the double sum is over all pairs (*i*, *j*) with *i* < *j* (Mendenhall et al., 1990).

To estimate the distribution of EBIT for each model facility, ERG first obtained the variance, σ_i^2, and covariance, σ_{ij}, of the value of shipments (R), payroll (P), and material costs (M) for each employment class from the Census Bureau. Given that EBIT is

(1-11) $$\bar{x}_{EBIT} = \bar{x}_R - \bar{x}_P - \bar{x}_M$$

for each model facility class where $\bar{x}_i$ denotes the mean value of variable *i*, such that *i* = EBIT, R, P, and M, ERG computed the variance of EBIT, σ_{EBIT}^2, as

(1-12) $$\sigma_{EBIT}^2 = \sigma_R^2 + \sigma_P^2 + \sigma_M^2 - 2\sigma_{RM}^2 - 2\sigma_{RP}^2 + 2\sigma_{PM}^2$$

Although payroll and material cost do not comprise all operating expenses included in EBIT, they do comprise the vast majority of EBIT. Hence, excluding the variance for the remaining components should not cause a significant error in the variance estimate.

For a lognormal distributional assumption (i.e., $x_{EBIT} \sim Lognormal(\bar{x}_{\ln x_{EBIT}}, \sigma_{\ln x_{EBIT}}^2)$), ERG transforms the estimated mean and variance of EBIT using (1-7) and (1-8) above, such that

(1-13) $$\bar{x}_{\ln x_{EBIT}} = \ln \bar{x}_{EBIT} - \frac{1}{2}\sigma_{\ln x_{EBIT}}^2$$

(1-14) $$\sigma_{\ln x_{EBIT}}^2 = \ln\left(1 + \frac{\sigma_{EBIT}^2}{\bar{x}_{EBIT}^2}\right)$$

A.3.2.3 Distribution of Net Income

The model estimates the variance of net income, σ_{NI}^2, for each model facility from its estimated variance for EBIT, σ_{EBIT}^2. If the mean of a distribution is multiplied by some scalar, *a*, then the variance of that distribution increases by the square of *a*. That is, if the mean net income, $\bar{x}_{NI}$, for a model facility is some percentage of facility EBIT, such that

(1-15) $$\bar{x}_{NI} = a\bar{x}_{EBIT} \qquad \text{where } 0 < a < 1$$

then the variance of facility net income is equal to the square of that percentage multiplied by the variance of EBIT, i.e.,

(1-16) $$\sigma_{NI}^2 = a^2 \sigma_{EBIT}^2$$

Hence, in the model, ERG first uses the ratio of facility net income to EBIT to determine the scalar, *a*, for estimating the variance of net income, σ_{NI}^2.

A.3.2.4 Distribution of Cash Flow

The variance of cash flow is estimated from the variance of net income. Since cash flow is the sum of net income and depreciation (D) (see equation 1-5), the mean of cash flow is given by

(1-17) $$\bar{x}_{CF} = \bar{x}_{NI} + \bar{x}_D$$

Because the variance of depreciation is not available from the Census or any other published source and is not directly estimable, ERG assumed that it is negligible, i.e., $\sigma_D^2 \approx 0$. This amounts to shifting the cumulative probability distribution of net income with mean $\bar{x}_{NI}$ and variance σ_{NI}^2 along the x-axis. Thus, the variance for cash flow becomes

(1-18a) $$\sigma_{CF}^2 = Var(x_{NI} + x_D) = Var(x_{NI}) + Var(x_D)$$

(1-18b) $$\sigma_{CF}^2 = \sigma_{NI}^2 + \sigma_D^2 = a^2 \sigma_{EBIT}^2 + \sigma_D^2$$

Given that the variance of depreciations is assumed negligible, i.e., $\sigma_D^2 \approx 0$, the variance of cash flow is equivalent to the variance of net income, i.e.,

(1-18c) $$\sigma_{CF}^2 = \sigma_{NI}^2 + \sigma_D^2 = a^2 \sigma_{EBIT}^2$$

It should be noted that model results might be different if the above assumptions were changed regarding the scaling and shifting of distributions utilized in the computation of probabilities in the model. However, it is not possible to determine *a priori* the impacts of favoring one type of adjustment (scaling versus shifting a given distribution) over another without computing model impacts for the various alternatives.

For a lognormal distributional assumption (i.e., $x_{CF} \sim Lognormal\left(\bar{x}_{\ln x_{CF}}, \sigma_{\ln x_{CF}}^2\right)$), ERG transforms the estimated mean and variance of cash flow computed above using the following formulas:

(1-19) $$\bar{x}_{\ln x_{CF}} = \ln \bar{x}_{CF} - \frac{1}{2}\sigma^2_{\ln x_{CF}}$$

(1-20) $$\sigma^2_{\ln x_{CF}} = \ln\left(1 + \frac{\sigma^2_{CF}}{\bar{x}^2_{CF}}\right)$$

A.3.2.4 Adjustments to Variance

ERG "smoothed" (reduction of statistical variance by adjusting observations) the variances of the income measures by applying the median coefficient of variation (i.e., standard deviation divided by mean) within a NAICS code to all employment classes in that code. This results in an identical probability that income is less than zero for all employment classes within a NAICS code. That probability, however, differs across NAICS codes. ERG judged that smoothing was appropriate because of (1) relatively small populations in some employment classes, and (2) relatively large differences in the coefficient of variation among employment classes within a NAICS code.

A.3.3 Estimation of Small Business Impacts

In the final stage of computations, the model uses the model facility income measures and model facility compliance cost estimates to project the number of small business facilities expected to close due to regulatory action. The model can also provides impacts short of facility closure, based on specific income thresholds. The following sections describe the model computations in further detail.

A.3.3.1 Accounting for Facilities Earning Negative Income

In the Census data, some facilities might have negative income. Mainly, the reasons for negative facility baseline income are attributable to the actual establishment financial data collected by the Census on which the estimated distribution is based:

- The parent company that owns the establishment does not assign costs and revenues that reflect the true financial health of the establishment. Two important examples are cost centers and captive sites, which exist primarily to serve other facilities under the same ownership[5]; or

- The facility is in financial trouble; that is, true costs exceed income.

[5] Captive sites may show revenues, but the revenues are set approximately equal to the costs of the operation. Cost centers have no revenues assigned to them.

To the extent that these establishments are contained in an employment class, the projection of negative baseline income is accurate. In either case, it is not possible to evaluate impacts to these establishments as a result of a rule under consideration. To accurately project impacts due to regulatory costs alone, these facilities need to be removed from the analysis. Thus, the model focuses on those facilities whose pre-regulation income (revenues, EBIT, net income, or cash flow) is greater than zero, in the estimation of facility impacts.

In the model, baseline facility impacts are computed for all four income measures prior to the evaluation of incremental impacts. For quality assurance/quality control purposes, the baseline facility impacts, FC_i, predicted by each of the income measures (where $i = R$, $EBIT$, NI, and CF) should be ranked, such that the following inequalities hold in all model computations:

(1-21) $FC_R < FC_{EBIT}$ and $FC_R < FC_{NI}$ and $FC_R < FC_{CF}$ and $FC_{EBIT} < or > FC_{NI}$ and $FC_{EBIT} < or > FC_{CF}$

A.3.3.2 Determination of Facility Closures

The mean and variance completely summarize the distribution of income for each model facility. To estimate facility closures, however, the model assesses impacts on facility income. As previously discussed, net income and cash flow are both associated with a well-defined impact threshold: if post-regulation net income or cash flow is positive (i.e., pre-regulation net income or cash flow minus estimated regulatory costs), the facility is projected to remain open; if post-regulation net income or cash flow is negative, the facility is assumed to close. Therefore, the threshold value for net income or cash flow is equal to the estimated regulatory costs for each model facility. All facilities where regulatory costs exceed net income or cash flow are projected to close due to the regulation considered.

Additionally, the model also estimates incremental impacts based on the two alternative income measures, revenues and EBIT, where facilities are impacted if post-regulation revenues and EBIT are negative. The two alternative computations are provided for comparison purposes only, and hence do not reflect actual facility closures.

A.3.3.3 Determination of Impacts Short of Closure

In evaluating small business impacts, it is also useful to routinely tabulate regulatory costs as a percent of the income measures. First, this tabulation for revenue, EBIT, net income, and cash flow suggests the magnitude of impacts on facilities not projected to close. Second, by comparing projected impacts under the net income or cash flow method with the number of facilities incurring regulatory costs as a percentage of revenues, EBIT, net income, or cash flow, it may be possible to determine a relationship between impacts on revenues, EBIT, net income, and cash flow and projected closures. This information may be useful in the future for use in analyzing industries for which EBIT or net income or cash flow cannot be reliably estimated. Thus, the model is also capable of estimating the number of facilities incurring regulatory costs exceeding a user-specified percentage of revenues, EBIT, net income, and cash flow for each employment class in a given industry.

A.4 References

Annual Survey of Manufacturers. 2004. The NBER-CES Manufacturing Industry Database (1958-1996). Accessed March 3 from http://www.nber.org/nberces/nbprod96.htm

Eastern Research Group. 2002. Model for Estimating the Impacts of Regulatory Costs on the Survival of Small Businesses and its Application to Four FDA-Regulated Industries, Draft Final Report. June 7, 2002.

Internal Revenue Service (IRS). 2000. *Instructions for Forms 1120 and 1120-A*. Department of the Treasury. Washington, D.C.

Mendenhall, W., D.D. Wackerly, and R.L. Scheaffer. 1990. *Mathematical Statistics with Applications*. 4th Edition. PWS-KENT Publishing Company. Boston, MA.

Quash, Nishea. 2001. Personal communication between Nishea Quash (U.S. Census Bureau) and Calvin Franz (ERG). September 10.

State Tax Handbook. 1999. *2000 State Tax Handbook*. CCH Incorporated. Chicago, IL.

U.S. Census Bureau. 2004. Special Tabulation of Census Data for NAICS 311119. Washington, D.C.: U.S. Department of Commerce. March.

U.S. Census Bureau. 2001. Special Tabulation of Census Data for NAICS 311613. Washington, D.C.: U.S. Department of Commerce. May.

U.S. Census Bureau, 1999a. Other Animal Food Manufacturing. EC97M-3111B. 1997 Economic Census: Manufacturing Industry Series. Washington, D.C.: U.S. Department of Commerce. December.

U.S. Census Bureau, 1999b. Rendering and Other Meat Byproduct Processing. EC97M-3116C. 1997 Economic Census: Manufacturing Industry Series. Washington, D.C.: U.S. Department of Commerce. December.

U.S. Small Business Administration. 2004. Small Business Size Standards Matched to North American Industry Classification System, Effective January 28, 2004. Accessed online at http://www.sba.gov/size/sizetable2002.html

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APPENDIX B

MARKET MODEL METHODOLOGY

B.1 Introduction

ERG developed a market model to examine the impacts of EPA's meat products industry effluent guideline on the price and output of various meat products. ERG modified this model to examine impacts of the SRM option on the beef industry. The distinguishing feature of ERG's market model is that it explicitly incorporates cross-market impacts among meat types into the analysis. The demand for meat products such as beef, pork, broilers, and turkey is closely related: a 1 percent increase in the price of beef, for example, may cause a 0.6 percent fall in the quantity of beef demanded and a 0.2 percent increase in demand for pork.

In order to incorporate both cross-market effects and international trade into the model, ERG specified linear supply and demand equations in each market to make the model tractable. The slopes of the equations were derived from estimated price elasticities of supply and demand found in existing research. These elasticities were then converted to slopes at the baseline equilibrium price and quantity. Because domestic supply, domestic demand, import supply, and export demand are all specified as linear functions, the model components are additive, and simultaneous equilibrium can be solved for in multiple markets using linear algebra.

ERG selected a perfectly competitive structure for the meat products market model after performing an extensive literature search. ERG found that most researchers were unable to reject the existence of perfectly competitive markets in the beef and pork markets; in the poultry market, market power was found to exist for meat processors vis-a-vis livestock suppliers, but not against customers in the output market.

Section B.2 presents the basic market model specification and solution. Section B.3 discusses data sources for the model.

B.2 Market Model Approach

First, standard domestic supply, domestic demand, import supply, and export demand equations are developed for each meat product. These equations express quantity as a linear function of a product's domestic price. The linear function's slope is expressed by a price parameter, derived from elasticities in the literature. Domestic demand for each meat product is specified as a function of the price of the other three meat products in addition to its own price. For the market for each meat product to be in equilibrium, U.S. domestic demand for a meat product and foreign demand for U.S. production of that meat product (exports) must be equal to U.S. domestic supply of the product and foreign sales of that product to the U.S. (imports) at its current market price. This equilibrium condition is used to derive an excess demand function for each meat product.

Second, the excess demand equations are solved. Because the excess demand function for each meat product is linear, expressing the equations for the four meat products in matrix form results in a convenient way to solve the equations simultaneously. Given pre-regulatory prices, quantities, and price parameters, linear algebra is used to solve for the pre-regulatory intercept for all four excess demand equations.

Third, the supply curve shift for beef products is calculated. The supply curve shift for beef is estimated as average compliance costs per pound of beef produced (wholesale weight). Once the post-regulatory (i.e., post-shift) supply curve is estimated, the excess demand equation for each meat product is re-written.

Fourth, the post-regulatory excess demand equations for all four meat products are expressed in matrix form. The post-regulatory intercept for each excess demand equation, however, is already known: it is a function of the pre-regulatory intercept, per-unit compliance costs, and the supply equation price parameter. By using linear algebra to invert the matrix containing the price parameters, then multiplying the post-regulatory intercept vector by that inverted matrix, ERG can evaluate the set of meat prices that results in simultaneous equilibrium for all four meat products.

Finally, the individual component equations for each meat product's domestic supply, domestic demand, import supply, and export demand are evaluated using the post-regulatory prices to solve for post-regulatory quantities. Changes in these four quantities for each meat product, as well as changes in the price of each meat product, measure the market-level impacts of the SRM option.

Each of the steps used to model market-level impacts is described in detail below.

B.2.1. Development of Excess Demand Functions for Individual Meat Products

ERG modeled the market for each of the four meat products: beef (B), pork (P), chicken (C), and turkey (T) using four linear equations:

$$Q_i^D = \alpha_{Di} + d_{ii} P_i + \sum_{i \neq j} d_{ij} P_j$$

$$Q_i^S = \alpha_{Si} + s_{ii} P_i$$

$$Q_i^X = \alpha_{Xi} + x_i P_i$$

$$Q_i^M = \alpha_{Mi} + m_i P_i$$

where the U.S. domestic quantity demanded of meat product i, Q_i^D, is a function of both the U.S. domestic price of meat product i, P_i, and the U.S. domestic price of other meat products j, P_j. U.S. domestic supply of meat product i, Q_i^S, is modeled as a function of domestic price, P_i, only, as is "rest-of-the-world" (ROW) demand for U.S. meat product i, Q_i^X (exports), and U.S. demand for ROW meat product i, Q_i^M (imports). Clearly, each meat product's supply and demand (both domestic and foreign) depend on the price of many other factors as well as its own price (and the price of other meat products in the case of domestic demand). However, because ERG is holding the prices of these other factors constant for the purposes of this analysis, it is not necessary to explicitly represent them in the relevant equation.

The parameters d_{ii}, s_{ii}, x_i, and m_i represent the slopes of their respective functions (i.e., the change in quantity of product i for a given change in the price of product i). The d_{ij} parameters shift the demand curve (the change in demand for product i for a given change in the price of product j (holding P_i constant). The parameters α_{Di}, α_{Xi}, α_{Si}, and α_{Mi} are the intercepts of their respective equations.

The values for the domestic demand equation slope and shift parameters are estimated from published estimates of own- and cross-price demand elasticities. One linearizes these elasticities by multiplying the elasticity by baseline quantity and dividing by baseline price. Thus, if:

$$\varepsilon_{ij} = \frac{\partial Q_i^D}{\partial P_j} \frac{P_j}{Q_i^D}$$

then:

$$d_{ij} = \frac{\partial Q_i^D}{\partial P_j} = \frac{Q_i^D}{P_j} \varepsilon_{ij}$$

where ε_{ij} is the elasticity of demand for product i with respect to the price of product j, and both quantity demanded (Q_i^D) and price (P_i) are set equal to their baseline values.

Similarly, the slopes of domestic supply, s_i, import supply, m_i, and export demand, x_i, functions can be defined as:

$$s_{ii} = \frac{\partial Q_i^S}{\partial P_i} = \frac{Q_i^S}{P_i}\ \gamma_{ii}$$

$$m_i = \frac{\partial Q_i^M}{\partial P_i} = \frac{Q_i^M}{P_i}\ \eta_{mi}$$

$$x_i = \frac{\partial Q_i^X}{\partial P_i} = \frac{Q_i^X}{P_i}\ \eta_{xi}$$

where γ_{ii}, η_{xi}, and η_{mi} are elasticities with respect to U.S. domestic price.

In equilibrium, U.S. demand for meat product i (Q_i^D) and foreign demand for U.S. meat product i (Q_i^X) must be equal to U.S. supply of meat product i (Q_i^S) and foreign sales of meat product i to the U.S. (Q_i^M) at the current market price for meat product i:

$$Q_i^D + Q_i^X = Q_i^S + Q_i^M$$

This can then be expressed as an excess demand equation for meat product i:

$$Q_i^D + Q_i^X - Q_i^S - Q_i^M = 0$$

or:

$$(\alpha_{Di} + d_{ii}\, P_i + \sum_{i \neq j} d_{ij}\ P_j) + (\alpha_{Xi} + x_i\, P_i) - (\alpha_{Si} + s_{ii}\, P_i) - (\alpha_{Mi} + m_i\, P_i) = 0$$

Simplifying the excess demand function for each meat product, and making a notational substitution for convenience, results in:

$$(\alpha_{Di} + \alpha_{Xi} - \alpha_{Si} - \alpha_{Mi}) + (d_{ii} + x_i - s_{ii} - m_i)\, P_i + \sum_{i \neq j} d_{ij}\, P_j = 0$$

$$\pi_i + \lambda_i\, P_i + \sum_{i \neq j} d_{ij}\, P_j = 0$$

The solution for the intercept of the individual meat product excess demand function is:

$$\lambda_i P_i + \sum_{i \neq j} d_{ij} P_j = -\pi_i$$

B.2.2 Simultaneous Solution of Pre-Regulatory Excess Demand Equations

To solve the excess demand equations for all four meat products simultaneously, one writes the equations in matrix form:

$$\begin{bmatrix} \lambda_B & d_{BP} & d_{BC} & d_{BT} \\ d_{PB} & \lambda_P & d_{PC} & d_{PT} \\ d_{CB} & d_{CP} & \lambda_C & d_{CT} \\ d_{TB} & d_{TP} & d_{TC} & \lambda_T \end{bmatrix} \begin{bmatrix} P_B \\ P_P \\ P_C \\ P_T \end{bmatrix} = \begin{bmatrix} -\pi_B \\ -\pi_P \\ -\pi_C \\ -\pi_T \end{bmatrix}$$

If this is expressed in vector notation as $A*P = \Pi$, the intercept for each excess demand equation, π_i, can be solved for using known prices and values for the price parameter elements of the A matrix.

B.2.3 Post-Regulatory Excess Demand Functions

The imposition of regulatory costs on beef causes a decrease in the supply of beef. If δ_B represents the per unit compliance costs for beef, the post-regulatory supply curve is:

$$Q_B^S = \alpha_{SB} + s_{BB}(P_B - \delta_B)$$

Substituting the post-regulatory supply curve into the excess demand function and rearranging it (using the notation-simplifying substitutions), the excess demand for beef is:

$$\lambda_B P_B + \sum_{i \neq j} d_{Bj} P_j = - s_{BB}\delta_B - \pi_B$$

B.2.4 Simultaneous Solution of Post-Regulatory Excess Demand Functions

The post-regulatory excess demand functions for each meat product are again placed in matrix form to solve the system of equations for the set of post-regulatory prices that generate

$$\begin{bmatrix} \lambda_B & d_{BP} & d_{BC} & d_{BT} \\ d_{PB} & \lambda_P & d_{PC} & d_{PT} \\ d_{CB} & d_{CP} & \lambda_C & d_{CT} \\ d_{TB} & d_{TP} & d_{TC} & \lambda_T \end{bmatrix} \begin{bmatrix} P_B \\ P_P \\ P_C \\ P_T \end{bmatrix} = \begin{bmatrix} -s_{BB}\delta_B - \pi_B \\ -\pi_P \\ -\pi_C \\ -\pi_T \end{bmatrix}$$

equilibrium in all four markets simultaneously. The system of simultaneous equations is:

In this set of simultaneous equations, the elements of matrix A are known (e.g., λ_i, d_{ij}), as are the elements of the new vector Π^* (e.g., s_{ii}, δ_i, π_i). The set of meat product prices that will result in equilibrium in all four meat product markets can be solved for by multiplying the vector Π^* by the inverse of the A matrix (i.e., $P' = A^{-1}\Pi^*$).

B.2.5 Post-Regulatory Price and Quantities

The new equilibrium price for each meat product, P_i', is substituted back into the component equations to solve for the post-regulatory domestic demand, $Q_i^{D\prime}$, domestic supply, $Q_i^{S\prime}$, export demand, $Q_i^{X\prime}$, and import supply, $Q_i^{M\prime}$, for each meat product:

$$\alpha_{Di} + d_{ii} P_i' + \sum_{i \neq j} d_{ij} P_j' = Q_i^{D'}$$

$$\alpha_{Si} + s_{ii} (P_i' - \delta_i) = Q_i^{S'}$$

$$\alpha_{Xi} + x_i P_i' = Q_i^{X'}$$

$$\alpha_{Mi} + m_i P_i' = Q_i^{M'}$$

The changes in market price ($P_i - P_i'$), domestic demand, ($Q_i^D - Q_i^{D\prime}$), domestic supply, ($Q_i^S - Q_i^{S\prime}$), export demand, ($Q_i^X - Q_i^{X\prime}$), and import supply, ($Q_i^M - Q_i^{M\prime}$) for each meat product are the projected market-level impacts of the SRM option.

B.3 Data Sources for Market Model Analysis

Following is an evaluation of potential publicly available data sources for baseline values and key parameters.

B.3.1 Baseline Market Quantities and Prices

ERG examined a number of possible sources for baseline quantity and price data. Of these, the three most important are: (1) *Economic Census of Manufacturers*, which provides both value and quantity data for a fraction of 1997 industry shipments at the 10-digit product level, (2) USDA *Livestock, Dairy and Poultry Situation and Outlook* (Outlook), which provides quantity and price data for relatively aggregated meat products: carcass weight of beef and pork, ready-to-cook (RTC) weight for broilers and turkeys,[15] and (3) USDA *Food Consumption, Prices, and Expenditures, 1970-97* (Putnam and Allshouse, 1999), which provides quantity of meat products by carcass weight (RTC weight for poultry), retail weight, and boneless weight.[16]

ERG selected Outlook data for the baseline price and quantity. Although ERG's first choice would have been to use Census data where the price could be calculated as each product's transactions price weighted by output share, too many observations were missing in the Census data. Outlook's primary advantage over Putnam's data is that it is more up to date.[17] Given the highly aggregated nature of Outlook data, and given that the Outlook data are tracked at the carcass weight level, ERG selected Outlook's wholesale price measures to use as baseline price; these are best interpreted as indicator prices rather than the explicit price of all output. ERG used USDA-derived conversion factors to estimate wholesale meat production from the carcass weight data presented in Outlook. A summary of baseline market data is presented in Table B-1.

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[15] Carcass weight of beef is defined as the chilled, hanging carcass, including the kidney and attached internal fat (kidney, pelvic, and heart fat), but not the skin, head, feet, and unattached internal organs. Carcass weight of pork is defined as the chilled, hanging carcass, including the skin and feet, but excluding the kidney and attached internal fat. RTC weight of poultry consists of the entire dressed bird, including bones, skin, fat, liver, heart, gizzard, and neck (Putnam, 1999).

[16] Retail and boneless weights adjust for those parts of the carcass not generally bought by consumers. These are not directly calculated, but instead are estimated using conversion factors. For beef, retail weight is 70 percent, and boneless weight is 67 percent, of carcass weight. For pork, retail weight is 78 percent, and boneless weight is 73 percent, of carcass weight. For broilers, retail weight is 87 percent, and boneless weight is 61 percent, of RTC weight. For turkeys, boneless weight is 79 percent of RTC weight (Putnam, 1999).

[17] Putnam cites small quantities of broiler and turkey imports (e.g., 5 million pounds, RTC weight for broilers, less than 0.02 percent of domestic production), while both Outlook and the FATUS database report no imports for these two meat products. ERG used Putnam's import quantity data for chicken and turkey rather than Outlook's data.

Table B-1: 2003 Baseline Quantity and Price Data for Market Model

Data Source	Meat Product			
	Beef	Pork	Chicken	Turkey
Meat and Poultry Product Output (millions of pounds carcass/ready-to-cook weight)				
U.S. Domestic Production	26,248	19,843	32,749	5,650
U.S. Imports	3,006	1,185	5	1
U.S. Exports	2,523	1,717	4,932	483
Conversion factor: carcass to wholesale weight	0.793	0.758	1.00	1.00
U.S. Cattle Slaughter (1,000 head)	35,454	NA	NA	NA
U.S. Wholesale Prices ($/lb)				
Beef, Central, Boxed, Choice, 550-700 lb.	$1.4324			
Pork, Central, Cutout, Composite		$1.0064		
Broilers, 12 City Average			$0.6198	
Turkey, Eastern, Hens, 8-16 lb.				$0.6208
U.S. Steer Price ($/cwt)	$83.76			

Sources: *Livestock, Dairy and Poultry Situation and Outlook.* Washington, D.C.: U.S. Department of Agriculture, Economic Research Service. Various dates.

B.3.2 Price Elasticities

B.3.2.1 Price Elasticities of Demand

Domestic price elasticities of demand are widely available from a variety of sources, including USDA and academic research. The results of the literature search for demand elasticities are documented in the record. For use in its market model, ERG selected K. S. Huang's *A Complete System of U.S. Demand for Food* (1993).

The advantage of Huang's estimates is that they were generated in a single, coherent, consistent framework that satisfies theoretical constraints of symmetry, homogeneity, and Engel aggregation. This should make using them better than selecting individual elasticities from among several sources with varying methodologies, degrees of aggregation, and time horizons.

The internal consistency of Huang's work is of particular importance because ERG is modeling cross-product impacts in the market model. The own- and cross-price elasticities of demand are presented in Table B-2.

B.3.2.2 Price Elasticities of Supply

ERG undertook a literature search for estimates of the price elasticities of meat supply for EPA's concentrated animal feeding operations (CAFOs) and meat and poultry products (MPP) effluent limitations guidelines (ELG). This search resulted in a wide range of estimated elasticities with little apparent consensus. Because of this lack of consensus, ERG decided to use the elasticities selected for the CAFOs model with the concurrence of EPA's expert consultants (U.S. EPA, 2001). It is reasonable to use these elasticities for meat products because meat (in the form of both live animals for slaughter and meat products) makes up the majority of material costs in the meat products industry (79 percent in animal slaughtering, 63 percent in meat processing, and 76 percent in poultry (U.S. Census Bureau, 1999a through 1999d). In addition, the other major cost component of meat production is unskilled labor, and the price elasticity of primarily unskilled supply tends to be large. Thus, the CAFOs supply elasticities should represent a reasonable lower-bound estimate for the price elasticity of meat supply. The supply elasticities selected for use in the model are also presented in Table B-2.

B.3.2.3 Import and Export Elasticities With Respect to U.S. Domestic Price

ERG used an Armington-type specification to model the effects of international trade on U.S. meat products markets. If foreign-produced and domestically produced goods are perceived as perfect substitutes for each other, that is, if consumers do not differentiate between foreign- and domestically produced goods, then one would expect a country to either import those good or export them, but not to both import and export them simultaneously. However, if consumers perceive foreign and domestically produced goods in a particular class as close but not perfect substitutes, then their country may import and export that class of products simultaneously. The United States both imports and exports meat products; the Armington specification that ERG selected incorporates product differentiation in the meat products industry market model.

The derivations of the Armington elasticities used in the market model will be described in the remainder of this section, which is not yet complete. However, the import and export price elasticities used in the market model are presented in Table B-3.

B.4 References

Armington, Paul S. 1969a. A theory of demand for products distinguished by place of production. *International Monetary Fund Staff Papers*. 16(1):159-177.

Armington, Paul S. 1969b. The geographic pattern of trade and the effects of price changes. *International Monetary Fund Staff Papers*. 16(2):179-199.

Gallaway, Michael P., Christine A. McDaniel, and Sandra A. Rivera. 2000. *Industry-Level Estimates of U.S. Armington Elasticities.* Office of Economics Working Paper. Washington, D.C.: U.S. International Trade Commission. September.

Huang, K. S. 1993. *A Complete System of U.S. Demand for Food*. Technical Bulletin Number 1821. Washington, D.C.: U.S. Department of Agriculture, Economic Research Service.

Outlook. Various dates. *Livestock, Dairy and Poultry Situation and Outlook*. Washington, D.C.: U.S. Department of Agriculture, Economic Research Service.

Putnam, Judith J., and Jane E. Allshouse. 1999. *Food Consumption, Prices, and Expenditures, 1970-97*. Statistical Bulletin Number 965. Washington, D.C.: U.S. Department of Agriculture, Food and Rural Economics Division, Economic Research Service.

Unnevehr, Laurian J., Miguel I. Gómez, and Philip Garcia. 1998. The Incidence of Producer Welfare Losses from Food Safety Regulation in the Meat Industry. *Review of Agricultural Economics*. 20:186-201.

UN FAO data: downloaded 2/20/01 from: http://apps.fao.org/page/collections?subset=agriculture Agricultural Production/Livestock Primary & Processed/World+,United States of America/.

U.S. Census Bureau. 1999a. *Animal (Except Poultry) Slaughtering. EC97M-3116A. 1997 Economic Census: Manufacturing Industry Series.* Washington, D.C.: U.S. Department of Commerce. November.

U.S. Census Bureau. 1999b. *Meat Processed From Carcasses. EC97M-3116B. 1997 Economic Census: Manufacturing Industry Series.* Washington, D.C.: U.S. Department of Commerce. November.

U.S. Census Bureau. 1999c. *Poultry Processing. EC97M-3116D. 1997 Economic Census: Manufacturing Industry Series.* Washington, D.C.: U.S. Department of Commerce. November.

U.S. Census Bureau. 1999d. *Rendering and Meat Byproduct Processing. EC97M-3116C. 1997 Economic Census: Manufacturing Industry Series.* Washington, D.C.: U.S. Department of Commerce. December.

U.S. EPA. 2001. *Economic Analysis of the Proposed Revisions to the National Pollutant Discharge Elimination System Regulation and the Effluent Guidelines for Concentrated Animal Feeding Operations*. EPA-821-R-01-001. Washington, D.C.: U.S. Environmental Protection Agency, Office of Water. January.

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