Western Economics Forum

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The Western Economics Forum

A peer-reviewed publication from the Western Agricultural Economics Association

Purpose

One of the consequences of regional associations nationalizing their journals is that professional agricultural economists in each region have lost one of their best forums for exchanging ideas unique to their area of the country. The purpose of this publication is to provide a forum for western issues.

Audience

The target audience is professional agricultural economists with a Masters degree, Ph.D. or equivalent understanding of the field that are working on agricultural and resource economic, business or policy issues in the West.

Subject

This publication is specifically targeted at informing professionals in the West about issues, methods, data, or other content addressing the following objectives:

- Summarize knowledge about issues of interest to western professionals
- To convey ideas and analysis techniques to non-academic, professional economists working on agricultural or resource issues
- To demonstrate methods and applications that can be adapted across fields in economics
- To facilitate open debate on western issues

Structure and Distribution

The *Western Economics Forum* is a peer reviewed publication. It usually contains three to five articles per issue, with approximately 2,500 words each (maximum 3,000), and as much diversity as possible across the following areas:

- Farm/ranch management and production
- Marketing and agribusiness
- Natural resources and the environment
- Institutions and policy
- Regional and community development

There are two issues of the *Western Economics Forum* per year (Spring and Fall).

Editor

Dr. Rhonda Skaggs
Dept. of Agricultural Economics & Agricultural Business
New Mexico State University
MSC 3169 Box 30003
Las Cruces, NM 88003
Phone: 505-646-2401
Fax: 505-646-3808
email: rskaggs@nmsu.edu

Indemnifying Asset Value Losses Related to Livestock Disease Announcements

Cheryl S. DeVuyst and Eric A. DeVuyst[1]

Introduction

The recent history of livestock disease outbreaks, including Bovine Spongiform Encephalopathy (BSE) and foot-and-mouth disease in the U.K. and BSE in the E.U., Canada, and Japan[2], demonstrate how devastating these outbreaks can be for livestock producers and related industries. The U.K. foot-and-mouth disease cost at least £9 billion (Campbell and Lee 2005). The U.K. BSE cases led to a 40% decrease in U.K. beef prices and decreased beef consumption across the E.U. As cases of BSE were found in the E.U., beef consumption fell by 30% (Fox and Peterson 2004) and export markets closed. As late as 2000, decreases of 20-50% of E.U. beef consumption were still being realized and in 2003 they were still 5% below previous levels (Jordan 2003). Burton and Young (1996) had previously predicted a 4.5% decline in market share through 2003. Fox and Peterson (2004) report that in 2001 alone the European Union paid over one billion euros to control BSE.

After the first reported case of BSE in Japan in September 2001, 60% of Japanese consumers ceased beef consumption (USDA FAS 2002; Mattson et al. 2005) and imports of Japanese beef were banned in nearby export markets. Retail beef sales fell 40-50% and wholesale prices fell 30-60% (Fox and Peterson 2004).

Even though identified BSE cases in Canada appear to have been very isolated, total economic impacts were valued at C$6.3 billion by November 2003, with C$3 billion attributed to equity loss in the Canadian cow-calf sector (Serecon Management Consulting Inc. 2003b). Although domestic demand was unaffected (LeRoy and Klein 2003), lost export markets were estimated to be C$500 million per month (Serecon Management Consulting Inc. 2003a; Fox and Peterson 2004), and live cattle prices fell by over 70% (LeRoy and Klein 2003). Cull cow prices plummeted to almost zero. Monchuk (2003) reported a producer receiving a net revenue of C$1.27 for a cull cow. More recent estimates put lost income alone at C$5 billion and perhaps as high as C$8 billion (Leiss 2005) with billions more lost by related businesses–trucking, input supply, equipment dealers, rural tourism, etc.

The United States has also had cases of BSE, the most recent being confirmed in June 2005, but the economic impact has been minimal. While experiencing an 82% decline in export markets, the U.S. domestic market has remained strong due, in part, to maintained consumer confidence in the safety of U.S. beef supplies. Since the first confirmed U.S. case of BSE, consumer confidence that U.S. beef is free of BSE has continually been over 89% (McCarty 2005). However, a loss of U.S. consumer confidence coupled with lost export markets would have devastating impacts similar to those experienced in the United Kingdom and Canada. Estimated BSE-induced losses from lost domestic consumer confidence and export markets range from $3.2 billion to $4.7 billion (Coffey et al. 2005). Based on 2004 beef production, Mattson et al. (2005) estimate that the U.S. cattle industry lost $1.38 billion. It is reasonable to expect that losses in related sectors would also be in the hundreds of millions, if not billions. Further, the losses estimated by Coffey et al. (2005) and Mattson et al. (2005) are

[1] The authors are Assistant Professor and Associate Professor, Department of Agribusiness and Applied Economics, North Dakota State University. Senior authorship shared equally. The authors are grateful to Tim Petry, two anonymous reviewers and Rhonda Skaggs for comments on previous drafts.

[2] For an excellent history of the U.K., E.U. and Japan BSE cases, see Fox and Peterson (2004).

income losses, not equity losses associated with specialized beef production assets–breeding livestock, corrals, fencing, waterers, feed bunks and rangeland.

While the U.S. beef industry has mercifully been spared the double-whammy of lost export and domestic markets, the relevant policy question is how should the U.S. cattle industry and USDA prepare for this eventuality? There have been changes in regulations regarding the feeding of ruminant byproducts, slaughter restrictions on downer animals, and removal of nervous tissues prior to processing. While reducing the likelihood of BSE-infected animals reaching the food supply, these steps do not address the potential for unprecedented economic damage to an agricultural sector. We argue here that there is a need for tools that address the risk of low prices and asset value losses due to catastrophic disease-induced market events, such as BSE outbreaks. Further we suggest ways that USDA's Risk Management Agency (USDA RMA) could alter existing insurance programs to cover this eventuality. In the absence of such a program, there is little doubt that ad hoc disaster payments will be required if disease-induced catastrophic event is realized. Our proposed product would shift at least part of these payments to private insurers.

Beef Prices and Asset Values

The link between beef prices and beef production specific assets, such as pasture land, is clearly indicated by microeconomic theory. The demand for these assets, termed derived demand, is positively related to output price, i.e., beef price. So, if beef prices fall dramatically, it is economically rational to expect that the demand for the services of beef producing assets will decline, i.e., the value of these assets will also decline.

A simple time-series regression model empirically demonstrates the relationship. We regress county average pasture land values on beef prices and lagged beef prices in an AR(2) model. Data from 50 North Dakota counties from 1989 to 2003 are taken from North Dakota Agricultural Statistics Service (various years). The other three North Dakota counties are omitted due to insufficient data. All prices are inflated to 2003 dollars. The results, reported in Table 1, indicate that a decline of $1/cwt in beef price will result in a $0.78/acre decrease in pasture land value[3]. Coffey et al. (2005) estimate a decrease of $0.12 to $0.17/lb in carcass price after export markets are lost. Assuming a 63% dressing percentage, that equates to a reduction of $7.56 to $10.51/cwt for live beef price. The associated reduction in North Dakota pasture land value ranges from $5.90 to $8.35/acre. Given that there are approximately 12.4 million acres of pasture land in North Dakota (USDA NASS 2004), the loss in pasture value ranges from $73.1 million to $103.5 million.

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[3] Most of North Dakota's range land has low value in alternative uses. As demonstrated by Torell et al. (2003), grazing land may have other uses that tend to support prices. With our econometric model we do not attempt to explicitly incorporate the impact of those uses due to a lack of data on other land uses/prices. To test for the effect of omitting this information, we estimated another model which included resident and non-resident hunting license sales as proxies for the impact of recreational uses on land values. These variables were significant; however, the coefficient on beef prices was only slightly changed to $0.776 from the original model of $0.784. So, it seems likely that the analysis in the paper reasonably captures the impact of beef prices on land values. Also note that the Torell et al. (2003) values are location specific. Ranch land in New Mexico provides amenities that are considerably different from North Dakota grazing lands. New Mexico's climate is considerably warmer than North Dakota's. (That's an understatement!) New Mexico grazing lands support larger elk, mule deer and antelope herds, and New Mexico offers more resident and non-resident hunting licenses. The more mountainous terrain of New Mexico may have more amenity value than the flat to rolling prairie of North Dakota.

Table 1. Regression results.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	169.1594	34.61852	4.886385	0.0000
BEEF	0.784101	0.075591	10.37294	0.0000
BEEF(-1)	0.050539	0.092497	0.546387	0.5850
AR(1)	0.814598	0.040081	20.32398	0.0000
AR(2)	0.129176	0.041019	3.149188	0.0017
R-squared	0.834441	Adjusted R-squared	0.833328	
Log likelihood -	2273.847	F-statistic	749.7202	
Durbin-Watson stat	1.932938	Prob(F-statistic)	0.000000	

This estimate is actually a conservative estimate of pasture land value declines. Coffey et al. (2005) report the decrease in price due to a loss in export markets, but no comparable number is given for a loss in domestic consumer confidence. Further, total lost asset value would be considerably higher. A total accounting would need to consider the reduced value of beef production specific assets, such as feed bunks, corrals, livestock trailers, etc., and some related assets, such as haying equipment.

The results demonstrate that beef cattle prices are important determinants of the value of beef production related assets. If producers are to be protected from the impact of catastrophic price fluctuations, the risk management strategy needs to consider asset value impacts in addition to annual price variability.

Livestock Insurance Products

USDA's Risk Management Agency currently offers two insurance plans, Livestock Gross Margin (LGM) and Livestock Risk Protection (LRP), to indemnify producers for income and price risks. The LGM provides insurance coverage on the difference between the expected market value of swine and feed costs (USDA RMA 2004a) and is currently only available in Iowa. LGM is similar to options except it is "a bundled option that covers hog price and feed costs (ibid)."

The LRP insurance programs, currently available in selected states, are identical to out-of-the-money put options. Coverage levels range from 75% to 95% of "expected ending value" which is equal to 95% of the futures price. Endorsement periods range from 13 weeks to 52 weeks. As some futures contracts are thinly traded, not all levels of coverage levels and endorsement periods are available. A producer can insure 1,000 feeder cattle at any given time and up to 2,000 feeder cattle per year. Premium schedules are available for heifers and steer calves under 600 pounds and for feeder heifers and steers between 600 and 900 pounds. USDA RMA provides a 13% subsidy on premiums (USDA RMA 2004b).

Proposed Livestock Insurance Products

The LGM and LRP products offer producers protection against income and price risks, but, as experienced in Canada, producers also face asset value and equity losses as livestock prices fall drastically. Given the demonstrated relationship between beef prices and pasture land values and likely relationships between beef prices and other assets, it is possible to employ the LRP in a cross hedge strategy to insure against asset value losses. This would involve a livestock producer insuring multiples of his/her calf crop or fed cattle, something that is not currently allowed under LRP and would be cost prohibitive under the current LRP premiums.

Using the 26-week contract, we estimate that North Dakota producers would need to purchase insurance on 9.38 times their expected calf crop to insure their calf-crop price, the value of their beef animals, and pasture land values for a full year. (A higher multiple would be needed to protect the value of other assets.) For North Dakota producers the cost of these premiums, net of the 13% subsidy, would range from $30.2 million for 85.4% coverage level to $75.9 million for 93.3% coverage level. These are the lowest and highest coverage levels currently available for the 26-week endorsement. These premiums represent about 4.3% and 10.8% of the value of North Dakota beef production in 2004 and, so, are likely cost prohibitive.

Although theoretically possible, the problems with using the current LRP program to insure asset values are: 1) the cost of premiums are tied to all downside price fluctuations, as the program is designed to protect from downside price risk; 2) the program does not allow producers to insure multiples of their annual calf crop; and 3) the program is not available in all states. The latter two issues are regulatory in nature and would need to be addressed by USDA RMA. It is the first of these issues that are of concern to us. In particular, our concern is with price fluctuations that are due to catastrophic market events that are likely enduring, so have large negative impacts on producer income and asset values.

With some modification, however, an LRP-type product could be used to protect price and asset values against losses due to catastrophic market events. Our proposed modification is to use a two-stage trigger for indemnity payments. The first stage would be the announcement of a human-health threatening event, such as multiple confirmed BSE cases or confirmed cases of variant Creutzfeldt-Jakob Disease (the human version of BSE). The second stage would be large price reductions within a short time period (probably measured in days or weeks) following the announcement. As with LRP, price reductions must be large enough to trigger strike prices in the underlying options market. The first trigger, the disease announcement, occurs with a low probability, so the likelihood of indemnity payments is reduced. Assuming that USDA RMA premium subsidies would be applied to the modified program, premiums would then be a fraction of the current LRP schedule, due to the reduced likelihood of indemnity payments.

To demonstrate, we return to our previous North Dakota example. Assume for demonstration purposes that the likelihood of a catastrophic market event is 10%. In the previous example, we estimated that North Dakota producers would pay $30.2 to $75.9 million to insure the value of the pasture land, breeding livestock, and calf crop. Multiplying those estimates by the reduced probability of indemnity payments (10% in this example), yields premiums of just over $3 million to just under $7.6 million annually, or 0.43% to 1.08% of the annual value of beef production. While these are non-trivial amounts, they do not appear to be cost prohibitive.

Several issues would need to be addressed prior to offering this insurance product including the eligibility of producers in all cattle producing states, current rules do not allow insuring multiples of annual calf crop, and the development of a risk profile. USDA RMA has regulatory authority on the first two issues and could develop new rules or a new product to cover asset values. The third issue is of more interest to researchers. Fortunately for the cattle industry, few data exist regarding the likelihood and severity of a widespread or a low-level, enduring disease outbreak in the United States. It is worthy to note that the United Kingdom does have insurance products to cover foot and mouth disease and associated impacts. Producers can purchase coverage for up to 25% of the value of their animals. Combined with government compensation (100% of animal value), producers can receive up to 125% of the value of their animals. Rural businesses, including livestock markets, can also purchase coverage to protect against lost revenues during nearby outbreaks (Minoli 2003). (Perhaps similar products could be developed for U.S. beef-related and other rural businesses.)

Summary

To date, U.S. producers have been fortunate that domestic consumers have maintained their confidence in the safety of U.S. produced beef despite isolated BSE confirmations. U.S. exports of beef have declined by 82%. Further announcements, or cases of other transmissible diseases, could erode domestic demand. Coupled with lost export markets, U.S. producers would face reduced incomes, asset values, and equity, as have Canadian beef producers. Assets employed in beef production, including pasture land, may have lower value in alternative production and recreational activities. Real estate, pasture and cropland, continues to be the largest asset category on agricultural producers' balance sheets. Current market-based and government-subsidized risk-sharing products do not cost effectively enable livestock producers to insure non-current asset values in the face of probabilistic BSE and other potentially transmissible disease outbreaks.

LRP, as currently designed, protects producers from large negative price fluctuations. With some simplifying assumptions, we show that the LRP insurance could be modified to cost effectively protect calf price and equity of beef producers. Although our demonstration is limited to North Dakota producers, the concept is generally applicable to all areas of U.S. beef production.

The importance of protecting farm equity to agricultural industries and rural economies cannot be overstated. In many livestock producing regions, such as the Great Plains, regional economies are driven by the jobs and wealth created by livestock production and related activities. Without the equity of livestock producers to finance producers' purchases of goods, services and capital equipment, rural communities would suffer further out-migration and declining economic fortunes.

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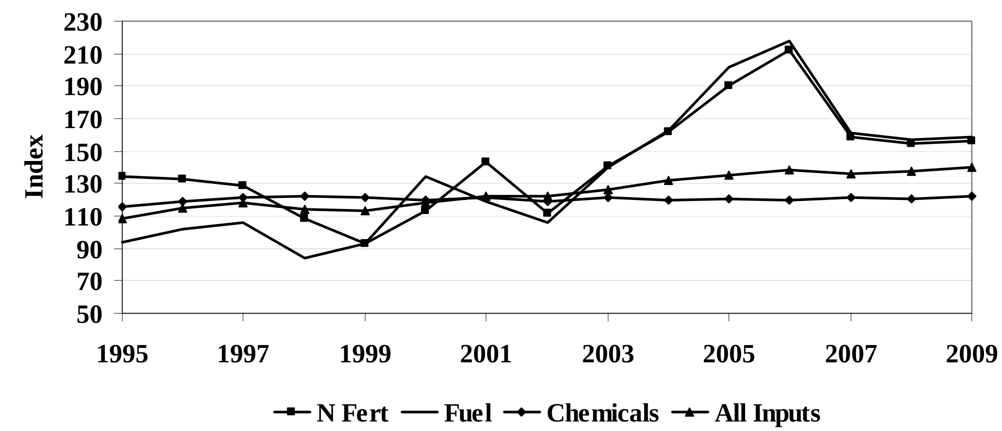
The Impact of Rising Energy Prices on Income for Representative Farms in the Western United States

J. Marc Raulston, George M. Knapek, Joe L. Outlaw, James W. Richardson, Steven L. Klose and David P. Anderson[1]

Introduction

Recent increases in prices of natural gas and fossil fuel based energy sources have had a large negative impact on the financial condition of agricultural producers across the nation. In addition to higher fuel costs for trucks, equipment, and irrigation motors, the cost of nitrogen fertilizer is closely linked to energy prices and has also increased significantly (Figure 1). Agriculture is especially vulnerable to increases in input costs due to the narrow profit margins realized for most commodities.

Figure 1. Indices of Prices Paid for Nitogen Fertilizer, Fuel, Chemicals, and All Inputs, 1995-2004, with FAPRI's Projections for 2005-2009.



This study quantifies the impacts of these increases on the economic viability of various types of agricultural producers in the western United States. Commodity-specific differences are revealed, along with differences between farms using alternative cropping practices and farms involved in various land tenure arrangements. The primary objective of this research is to evaluate the economic and financial impacts of increases in energy prices on net incomes of representative farms, dairies, and ranches located throughout ten western states (Washington, Montana, Wyoming, Idaho, Oregon, Nevada, California, New Mexico, Texas and Colorado).

Data and Methods

This study utilizes primary representative farm data coupled with a whole farm simulation model to examine the effects of rapidly increasing fuel prices on agricultural producers in the western United

[1] The authors are with the Agricultural and Food Policy Center, Department of Agricultural Economics, Texas A&M University

States. Thirty representative farms, dairies, and ranches created through a focus group interview process were analyzed assuming alternative input inflation rates using the farm level simulation model (FLIPSIM) developed by Richardson and Nixon (1986) at Texas A&M University. Each farm is representative of the farms in its region. A summary of the representative farms is included in the appendix. Included in the representative farm data set are three feedgrain farms, four wheat farms, eight cotton farms, two rice farms, six dairies, and seven cow/calf operations. The entire spectrum of non-irrigated versus irrigated cropping systems is represented across this set of farms, allowing comparison among a wide range of agricultural energy consumers (Appendix Table). The representative crop farms display a wide variety of land tenure ranging from 100% ownership to 100% leasing. Lease arrangements include both cash lease and sharecropping, allowing the quantification of the value to producers of cost sharing in categories closely linked to energy price. With the exception of three crop farms (TXNP1750, TXPG3760, and CAC2400), all of the farms share with landowners to some degree in the cost of fertilizer and/or other expenses closely tied to fuel price.

The FLIPSIM model draws random crop yields, livestock production variables, and prices from a multivariate empirical probability distribution allowing projections to incorporate production and price risk. A description of FLIPSIM is provided in Richardson and Nixon (1986) and the procedure for simulating random values is described by Richardson, Klose and Gray (2000). Each inflation rate alternative was simulated 100 times (iterations) for an eight-year (2002 to 2009) projection period using random prices, yields and livestock production for 2005-2009. Annual mean crop and livestock prices were obtained from the August 2005 Baseline reported by FAPRI (Tables 1 and 2) (FAPRI 2005).
Three general assumptions were made in this analysis: 1) long-term and intermediate-term debt beginning in 2002 is 20% of beginning asset market value for crop farms, 30% for dairies, and 1% for long-term and 5% for intermediate debt on beef cattle operations; 2) the provisions of the 2002 Farm Bill are assumed to continue throughout the entire projection period; and 3) cash rents and share lease arrangements remain constant throughout the study period.

Table 1. FAPRI August 2005 Baseline Projections of Crop and Livestock Prices, 2002-2009

	2002	2003	2004	2005	2006	2007	2008	2009
Crop Prices								
Corn ($/bu.)	2.32	2.42	2.07	2.04	2.10	2.18	2.25	2.31
Wheat ($/bu.)	3.56	3.40	3.40	3.09	3.20	3.32	3.40	3.47
Cotton ($/lb.)	0.4450	0.6180	0.4280	0.4361	0.4788	0.5038	0.5146	0.5224
Sorghum ($/bu.)	2.32	2.39	1.75	1.89	1.92	1.98	2.05	2.11
Soybeans ($/bu.)	5.53	7.34	5.80	5.98	5.44	5.34	5.33	5.37
Barley ($/bu.)	2.72	2.83	2.48	2.38	2.53	2.59	2.64	2.66
Oats ($/bu.)	1.81	1.48	1.48	1.47	1.52	1.57	1.61	1.65
Rice ($/cwt.)	4.49	8.08	7.30	7.31	7.30	7.30	7.29	7.40
Soybean Meal ($/ton)	173.19	244.22	176.45	179.82	166.33	164.46	162.04	160.06
All Hay ($/ton)	92.40	85.50	89.70	95.49	94.93	95.04	96.17	97.51
Peanuts ($/ton)	364.00	386.00	378.00	309.72	334.27	364.62	377.57	386.64
Cattle Prices								
Feeder Cattle ($/cwt)	86.34	95.21	111.79	115.14	107.50	101.92	96.49	91.89
Fat Cattle ($/cwt)	67.04	84.69	84.75	84.93	82.27	80.54	77.52	75.18
Culled Cows ($/cwt)	39.23	46.62	52.35	53.22	52.06	50.32	48.60	46.53
Milk Price								
U.S. All Milk Price ($/cwt)	12.11	12.55	16.13	15.02	13.72	13.41	13.17	13.08

Source: Food and Agricultural Policy Research Institute (FAPRI) at the University of Missouri-Columbia and Iowa State University.

Table 2. FAPRI August 2005 Baseline Assumed Rates of Change in Input Prices and Annual Changes in Land Values, 2003-2009

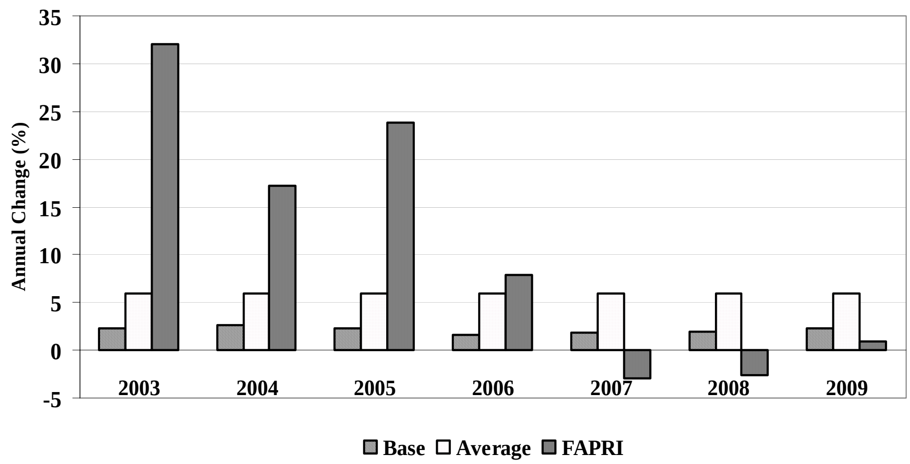
	2003	2004	2005	2006	2007	2008	2009
Annual Rate of Change for Input Prices Paid							
Seed Prices (%)	8.45	2.44	1.18	1.10	1.39	1.16	1.69
N Fertilizer Prices (%)	25.89	13.83	17.63	11.34	-3.27	-2.69	1.1
P & K Fertilizer Prices (%)	1.87	11.01	6.06	3.46	2.1	1.87	2.07
Herbicide Prices (%)	0.00	0.89	0.56	-0.29	-1.07	-0.58	0.80
Fungicide Prices (%)	-0.85	-0.64	2.7	1.01	1.32	1.68	2.36
Insecticide Prices (%)	4.29	-1.78	-1.01	-1.71	-0.47	0.22	1.38
Custom Application (%)	32.08	17.26	23.83	7.89	-2.93	-2.58	0.93
Scouting (%)	2.5	0.61	1.91	1.28	2.16	2.81	3.18
Irrigation Fuel (%)	32.08	17.26	23.83	7.89	-2.93	-2.58	0.93
Fuel and Lube Prices (%)	32.08	17.26	23.83	7.89	-2.93	-2.58	0.93
Drying & Hauling (%)	32.08	17.26	23.83	7.89	-2.93	-2.58	0.93
Ginning (%)	2.5	0.61	1.91	1.28	2.16	2.81	3.18
Machinery Prices (%)	-1.96	7.87	2.38	1.28	2.49	3.05	3.49
Wages (%)	2.61	1.91	1.93	2.61	2.64	2.70	2.48
Supplies (%)	1.63	1.80	1.63	-1.78	-0.97	-0.33	1.06
Repairs (%)	2.99	3.02	3.48	1.53	1.68	1.9	2.06
Services (%)	2.50	0.61	1.91	1.18	2.16	2.81	3.18
Taxes (%)	1.59	1.56	2.80	-0.17	1.43	1.15	1.85
PPI Items (%)	4.20	5.24	0.59	0.25	1.10	1.35	1.91
PPI Total (%)	3.28	4.43	1.12	0.59	1.32	1.54	1.96
Annual Change in Consumer Price Index (%)	2.27	2.66	2.28	1.63	1.83	1.98	2.29
Annual Rate of Change for U.S. Land Prices (%)	4.96	7.09	11.00	3.28	0.07	0.25	1.34

Source: Food and Agricultural Policy Research Institute (FAPRI) at the University of Missouri-Columbia and Iowa State University.

The following fuel cost scenarios are analyzed and changes are reported relative to the **Base** situation:

- **Base** - Assumed the percent change in Consumer Price Index from the FAPRI 2005 Baseline is the annual inflation rate for fuel related expenditures (custom application cost, irrigation fuel, tractor fuel and lube, drying and hauling) and nitrogen fertilizer, i.e., fuel and fertilizer prices increased 1.6 to 2.3% per year (Figure 2);
- **Average** - Used historical inflation rates for fuel from a more favorable era, 1996-1999, to calculate an average inflation rate (5.97%) as the assumed inflation rates for fuel related expenses and nitrogen fertilizer throughout the 2003-2009 study period (Figure 2);
- **FAPRI** - Utilized inflation rates for fuel related expenses and nitrogen fertilizer from the FAPRI August 2005 Baseline (Figure 2).

Figure 2. Three Assumed Rates of Inflation for Fuel, Fuel Related Expenses, and Nitrogen Fertilizer, 2003-2009.



The effect of each alternative is evaluated based on the projected 2005-2009 average net cash farm income (NCFI). Net cash farm income is defined as total cash receipts minus cash expenses. The NCFI was used to show the impact of higher energy costs on the net income available to service debt, family living, and replace machinery.

Results

Net Cash Farm Income (NCFI) was calculated under three inflation rate assumptions for thirty representative farms and reported as an average NCFI for 2005-2009 or a change from the **Base** (Table 3). Impacts of each inflation rate assumption are described in this section as the decreases in NCFI due to the higher inflation rate scenarios relative to the **Base**.

The representative farm operations are grouped into six categories based on the primary commodity produced. Changes in NCFI for each scenario were averaged by commodity group for comparison. Wheat farms experience the smallest reduction in NCFI due to higher energy costs under the **Average** and the **FAPRI** inflation rates for fuel. Their average NCFI would decrease $10,700 for the **Average** inflation rate scenario relative to the **Base** and $17,700 for the **FAPRI** projection scenario. The wheat farms are 100% non-irrigated and all participate in at least some form of input cost sharing. The cotton farms are disadvantaged the most when energy prices rise, based on NCFI decreases. On average, annual NCFI for cotton farms decreases $55,300 for the **Average** scenario and $208,100 for the **FAPRI** scenario. If energy prices increased at their historical average rates, NCFI for the California cotton farm (CAC2400) would decline $122,600; but, given the higher inflation rates projected by FAPRI, NCFI declines $449,200 per year for 2005-2009. The next largest decrease in NCFI due to energy price increases was experienced by the feedgrain farms, followed by the rice, dairy, and beef farms. The dairies and beef ranches spend much less on fuel and fuel-related inputs than do the crop farms, thereby reducing the adverse impacts of higher fuel and energy prices on NCFI.

Much of the cost of irrigation, especially for those farms irrigating from wells rather than surface water, is associated with fuel to run the power units for pumping water; thus the irrigated operations are more negatively impacted by rising fuel costs. For the **Average** energy inflation rate scenario, dryland farms experience a $17,000 decrease in NCFI relative to the **Base** scenario. These dryland farms can expect a $51,200 annual decrease in NCFI under the higher energy inflation rate projections in the **FAPRI** scenario. For the irrigated farms, a far greater decrease is observed; a $67,800 decrease in NCFI results under the **Average** scenario and a $214,000 decrease in NCFI occurs as a result of the higher inflation rates associated with energy in the **FAPRI** scenario.

Table 3. Average Annual Net Cash Farm Income for Representative Farms in the Western United States Under Three Assumed Inflation Rates for Fuel, 2005-2009.

		Change in NCFI from Base	
	Base NCFI[1]	Average[2]	FAPRI[3]
	--$1,000--	--$1,000--	--$1,000--
Irrigated	185.6	-67.8	-214.0
Non-Irrigated	142.1	-17.0	-51.2
No Cost Share	303.9	-98.8	-280.8
Cost Share	135.4	-32.2	-106.7
Feedgrain	125.1	-61.8	-144.4
TXNP1750	192.4	-50.8	-190.1
TXWG1400	86.2	-11.7	-40.2
TXPG3760	96.7	-122.8	-203.0
Wheat	140.6	-10.7	-17.7
COW3000	151.7	-7.4	-15.6
MTW4500	155.1	-13.0	-19.1
ORW4000	142.4	-9.7	-15.8
WAW1725	113.1	-12.8	-20.3
Cotton	234.9	-55.3	-208.1
CAC2400	622.7	-122.6	-449.2
TXSP2239	160.0	-43.8	-171.1
TXRP2500	84.9	-8.4	-33.4
TXCB1850	136.3	-21.6	-79.0
TXVC4500	274.1	-71.9	-272.5
TXPC2500	173.6	-53.1	-201.1
TXMC3500	267.1	-51.8	-186.1
TXEC5000	160.3	-69.2	-272.7
Rice	-4.6	-37.9	-83.3
CAR550	-19.4	-51.5	-124.8
TXR1350	10.2	-24.4	-41.7
Dairy	819.6	-30.5	-75.0
TXCD500	38.2	-16.6	-62.2
CAD1710	1198.8	-77.5	-178.5
NMD2125	1396.7	-21.4	-50.6
IDD1000	383.5	-14.7	-34.7
TXED1000	669.4	-16.4	-38.8
TXND2400	1230.9	-36.2	-85.0
Beef	34.9	-5.6	-19.8
MTB500	116.9	-4.8	-19.2
WYB500	11.2	-5.8	-23.0
NMB240	-14.3	-2.0	-8.1
CAB500	-52.0	-10.8	-44.4
SDB450	66.4	-4.4	-16.8
NVB700	41.0	-8.3	-19.4
TXRB500	75.0	-3.1	-7.5

1 Base NCFI: Increase fuel and nitrogen fertilizer prices using annual change in Consumer Price Index.

2 Average: Increase fuel and nitrogen fertilizer prices using historical average annual fuel inflation rate, 1996-1999.

3 FAPRI: Increase fuel and nitrogen fertilizer prices using annual fuel inflation rates from FAPRI 2005 August Baseline.

A similar pattern is revealed in the comparison between the farms with landlords who share in input costs versus those operations that are either entirely cash leased or do not share input costs. A $32,200 decrease in NCFI is observed under the **Average** alternative and a $106,700 decrease in annual NCFI occurs as a result of the **FAPRI** scenario for the farms that share some costs with landowners. For farms that do not practice input cost sharing, a $98,800 decrease in NCFI occurs with the **Average** scenario and a $280,800 decrease in NCFI results from the **FAPRI** scenario. As expected, farms sharing the cost of fertilizer and other input costs closely related to fuel prices are less affected by the rising cost of energy. Cash leases that are increasingly tied to farm program direct payments leave producers more vulnerable to energy related cost increases.

Conclusions

This paper illustrates how rising energy costs adversely affect the financial health of farms across the western United States. As expected, farms with less energy consumption and farms that share a portion of the energy costs with landowners are less vulnerable to the rising costs, but no one is completely insulated from this trend. The results suggest that farmers will likely face increasing cashflow pressures that may accelerate their adoption of energy conserving crop rotation patterns and production systems. Further study may be necessary to determine if higher energy prices will push farmers to no-till and reduced tillage farming systems as they seek to reduce fuel expenses.

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Appendix Table of Characteristics of Representative Crop, Dairy, and Beef Cattle Farms.

Farm[1]	Acres	Irrigated Land	State	County	Sales	Corn	Sorghum	Wheat	Cotton	Rice	Other	Dairy	Beef
		--%--			--$1,000--	--Acres--	--Acres--	--Acres--	--Acres--	--Acres--	--Acres--	--Cows--	--Cows--
TXNP1750	1750	79	Texas	Moore	580.2	640	240	870	0	0	0	0	0
TXWG1400	1400	-	Texas	Williamson	291	900	250	100	150	0	0	0	50
TXPG3760	3760	87	Texas	Castro	1890.1	1344	0	0	1472	0	380	0	0
COW3000	3000	-	Colorado	Washington	262.3	600	0	970	0	0	905	0	0
MTW4500	4500	-	Montana	Chouteau	467.7	0	0	2475	0	0	0	0	0
ORW4000	4000	-	Oregon	Morrow	296.4	0	0	1600	0	0	400	0	0
WAW1725	1725	-	Washington	Whitman	485.4	0	0	1121	0	0	604	0	0
CAC2400	2400	83	California	Kings	2188.7	0	0	0	1000	0	1400	0	0
TXSP2239	2239	34	Texas	Dawson	682.9	0	0	0	1616	0	453	0	0
TXRP2500	2500	-	Texas	Jones	258.1	0	0	825	1122	0	0	0	12
TXCB1850	1850	-	Texas	San Patricio	560.1	150	775	0	925	0	0	0	0
TXVC4500	4500	16	Texas	Willacy	1352.1	0	1888	0	2388	0	225	0	0
TXPC2500	2500	78	Texas	Deaf Smith	910.7	125	308	883	1184	0	0	0	0
TXMC3500	3500	-	Texas	Jackson	1313.5	875	875	0	1750	0	0	0	0
TXEC5000	5000	58	Texas	Crosby	1265.8	0	300	400	4300	0	0	0	0
CAR550	550	100	California	Sutter	448.7	0	0	0	0	500	0	0	0
TXR1350	1350	100	Texas	Colorado	321.8	0	0	0	0	450	0	0	0
TXCD500	500	-	Texas	Erath	1635.3	0	0	0	0	0	500	500	0
CAD1710	1100	-	California	Tulare	6123.9	0	0	0	0	0	1100	1710	0
NMD2125	0	-	New Mexico	Chaves	7576.7	0	0	0	0	0	0	2125	0
IDD1000	0	-	Idaho	Twin Falls	3989.3	0	0	0	0	0	0	1000	0
TXED1000	750	-	Texas	Lamar	3529.2	0	0	0	0	0	750	1000	0
TXND2400	180	-	Texas	Bailey	8463.6	0	0	0	0	0	180	2400	0
MTB500	640	-	Montana	Custer	313.5	0	0	0	0	0	640	0	500
WYB500	300	-	Wyoming	Washakie	285.2	0	0	0	0	0	300	0	500
NMB240	0	-	New Mexico	Union	127.1	0	0	0	0	0	0	0	240
CAB500	0	-	California	Tehama	301.4	0	0	0	0	0	0	0	500
SDB450	960	-	South Dakota	Meade	274.1	0	0	0	0	0	960	0	450
NVB700	1300	-	Nevada	Elko	358.2	0	0	0	0	0	1300	0	700
TXRB500	0	-	Texas	King	333.6	0	0	0	0	0	0	0	500

[1] The farm name indicates the state (first two letters) and farm size in acres or number of cows (numbers). The remaining letters in the name indicate the region or crop (G for grains, W for wheat, C for cotton, R for rice, D for dairy, and B for beef).

Who Are Public Land Ranchers and Why Are They Out There?

John A. Tanaka, L. Allen Torell and Neil R. Rimbey[1]

Cattle ranching is one of the traditional uses of public lands recognized under various federal laws and has occurred on those lands well before the existence of those laws. The federal government is the largest landowner in the 11 western states with about 42% of the total land base, which varies from 22% in Washington to 86% in Nevada. The Bureau of Land Management (BLM) and the U.S. Forest Service (USFS) manage most of the federal lands where grazing occurs. Local communities have been established and evolved throughout the rural parts of the western United States with varying degrees of dependency on a ranching industry that has incorporated public land forage as an important part of seasonal forage supply. The questions we address here are who the public land ranchers are, what might be their motivations for owning the ranch, and how that information can be used in policy formulation and analysis.

Approximately 85% of federal land is grazed by domestic livestock (CAST 1996). The two management agencies administer about 29,925 grazing permits across the West with 21,018 unique permittees (Gentner and Tanaka 2002). These permits included approximately 21.6 million federal animal unit months (AUMs) of grazing in the early 1990s (CAST 1996). Public land grazing use during 2002-03 was lower at about 13.5 million AUMs (Vincent 2005).

Grazing permit holders account for over half of the commercial beef cattle in the 11 western states (CAST 1996). Levels of yearlong dependency on public forage vary across the West; some ranches utilize federal lands for a minimal amount of seasonal grazing capacity while others depend on federal lands for most, if not all, of yearlong grazing capacity. In 1983 the USDA/USDI (1986) estimated that 88% of the cattle produced in Idaho, 64% in Wyoming and 63% in Arizona grazed at least part of the year on public rangelands. Nearly half of the sheep producers with more than 2,500 head used public rangeland.

Opinions vary greatly about the current status of the ecological condition and health of public rangelands. Controversy about the desired management of public rangeland has intensified with a shift from focusing on the condition of rangeland for grazing use – the capacity of the land to produce forage for livestock – to an increased emphasis on non-livestock benefits and services provided by healthy rangelands, including open space, wildlife habitat, water, and biological diversity. In recent years there has been increasing pressure by various interest groups to either significantly reduce or eliminate public land grazing. There has also been pressure for the land management agencies to implement livestock management plans to accommodate and enhance other uses of public lands. These changes will affect public land ranchers as well as local communities, regional economies, and to some extent the national economy.

Individuals affected by policy changes must be identified and land-use policies defined in a way that is relevant to the situation. The western ranching industry is no exception. Fowler and Gray (1988) defined the "double infinity" of ranching. The first infinity arises from the wide array of physical variation

[1] The authors are Associate Professor, Agricultural and Resource Economics, Eastern Oregon Agricultural Research Center, Oregon State University, Union, Oregon; Professor, Dept. of Agricultural Economics and Agricultural Business, New Mexico State University, Las Cruces; and Professor, Agricultural Economics and Rural Sociology, University of Idaho, Caldwell.

existing across western grazing lands. The second infinity stems from the different rancher characteristics, such as managerial ability, skill and knowledge. The typical production function approach has been difficult to apply to the ranching industry due to these heterogeneities and a lack of a strong profit motive.

Differences in social and economic characteristics and differences in ranch ownership motives were summarized in a survey of public land ranchers conducted in 1999 (Gentner and Tanaka 2002). We also know that public land ranchers do not consider profit to be the most important goal in terms of why they ranch (Smith and Martin 1972, Gentner and Tanaka 2002, Rowe et al. 2001, Torell et al. 2004). Subgroups of public land ranchers seek to fulfill a continuum of management goals ranging from economic satisficing and the desired rural lifestyle to strict profit maximization and wealth building.

In the Gentner and Tanaka (2002) survey of public land ranchers, ranchers were asked to rank the importance of many goals and objectives that ranged from profit-motivated to lifestyle objectives. Goals were defined to be: 1) Owning land and a ranch is consistent with my family's tradition, culture and values; 2) A ranch is a good place to raise a family; 3) Living on a ranch allows me to live closer to my friends and family; 4) I want to obtain a good return on my investment; 5) With my skills it would be difficult to obtain a job outside of the ranch; 6) I own a ranch primarily for environmental purposes; and 7) I continue ranching so I will have a business to pass on to my children. Survey responses were separated into eight groups using cluster analysis (Figure 1). Two broad categories were also evident based on whether the rancher appeared to be part-time or full-time. Selected characteristics of the eight different clusters are given in Table 1.

Figure 1. Types of public land ranchers (Gentner and Tanaka 2002).

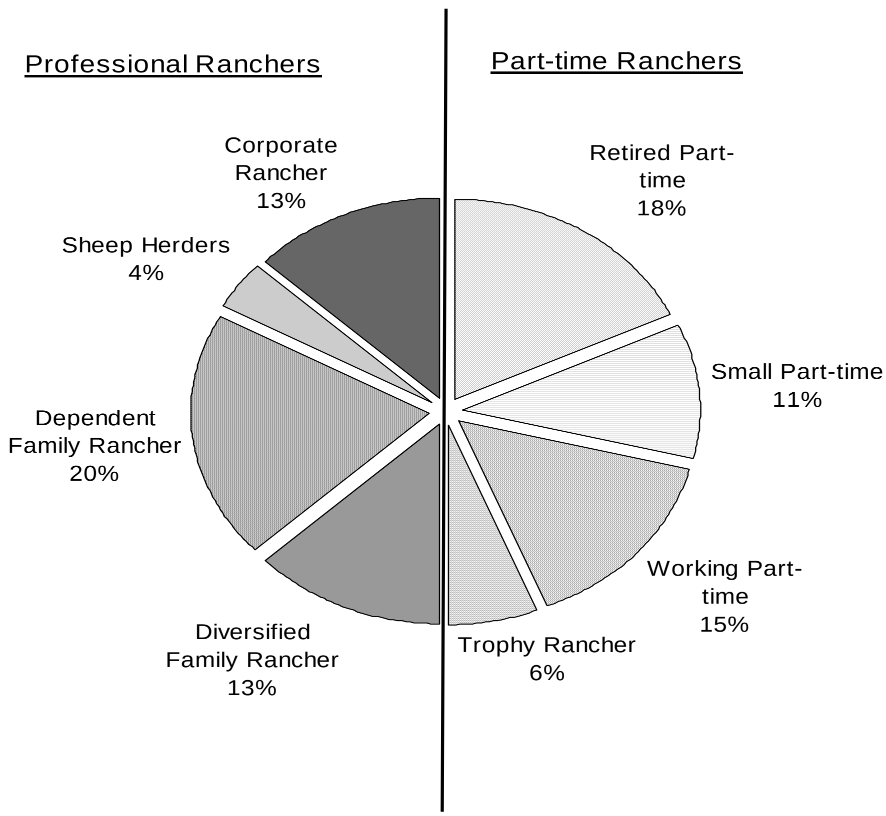

Table 1. Selected characteristics of public land ranchers (Gentner and Tanaka 2002).

	Part-Time				Full-Time			
	Small Part-Time	Retired Part-Time	Working Part-Time	Trophy Rancher	Diversified Family Rancher	Dependent Family Rancher	Corporate Rancher	Sheep Rancher
Reasons to Own a Ranch (1 = least important, 5 = most important)								
Tradition, Values, Culture	3.7	4.6	4.5	3.4	4.1	4.9	4.5	4.4
Good Place to Raise a Family	3.7	4.6	4.6	3.3	4.2	4.9	4.5	4.5
Pass to Future Generations	1.5	4.3	4.0	2.4	2.3	4.8	4.1	3.8
Live Closer to Family and Friends	2.8	3.9	3.5	2.1	2.9	4.4	3.5	3.2
Profit	2.6	3.7	3.6	2.6	3.7	4.2	3.6	3.5
No Other Skills	1.5	2.3	1.8	1.3	2.0	3.3	2.3	2.3
Environmental Purposes	2.4	2.2	2.3	2.1	1.9	2.3	2.0	2.0
Income (% by Source)								
Livestock	13.0	21.5	18.2	21.1	74.9	84.7	71.9	80.8
Other Ranch	4.5	21.4	2.3	7.7	7.7	6.0	9.2	2.1
Off-Ranch	57.2	5.1	77.4	15.7	7.6	4.8	9.2	6.2
Retirement	12.9	36.5	0.5	9.1	1.4	2.5	2.6	0.7
Investments	11.7	8.8	1.2	40.7	3.2	1.4	3.3	7.1
Other	1.8	5.9	0.4	5.1	2.2	0.5	3.7	3.0
Net Income ($)	65,857	44,602	53,491	94,245	42,970	46,926	50,116	53,000
Business Organization								
Sole Proprietor	70.1	66.7	69.1	22.2	80.3	65.3	9.4	378.0
Partnership	23.1	33.2	27.1	15.8	13.4	39.8	20.3	31.1
Corporation	6.9	12.2	3.7	62.0	6.3	14.3	70.3	30.1
Deeded Acres	1,398	2,620	1,563	11,134	4,765	4,058	12,554	14,849
# of Animals								
Cows	79.5	122.0	143.0	466.7	276.2	295.7	615.2	385.8
Ewes	27.5	4.4	10.1	0.8	7.8	10.6	3.1	796.0
Age (years)	57.5	64.0	51.3	59.0	53.9	61.1	55.6	57.8
History (years)	22.4	29.2	36.9	13.3	35.3	29.5	33.0	32.0
Labor (person-months/year)								
Family	10.5	17.2	14.9	13.5	20.7	24.6	26.7	27.5
Hired	4.5	4.8	2.3	28.2	4.3	3.6	32.0	45.3

The stated goals and objectives of public land ranchers varied from a high ranking for lifestyle amenities for identified part-time ranchers, to a stronger emphasis on profit for professional ranchers more dependent on ranch income. This was similar to the findings of Young and Shumway (1991) who also found that small, part-time ranchers were driven more than the large, full-time ranchers by objectives other than profit. Gentner and Tanaka (2002) found that all types of public land ranchers ranked lifestyle attributes above profit maximization. All groups listed the complementary relationship between land ownership and family tradition, culture and values as a primary reason for owning the ranch. Yet, all ranchers were economic satisficers with varying degrees of importance placed on profit and earning potential from the ranch. The survey indicated a nearly equal split with about half of the ranchers depending on the ranch for less than 22% of annual disposable income and half depending on the ranch for over 80% of annual income.

Other studies have shown similar results to the Gentner and Tanaka (2002) survey and demonstrated that the lack of a strong profit motive is common for private land ranchers and farmers. Recent ranch value studies in New Mexico, Idaho, Eastern Oregon and northern Nevada have found that only 5 to 30% of the total value of a ranch can be attributed to the production of cattle (Torell et al. 2004). Gosnell and Travis (2005) concluded that recent ranch buyers are more likely to be lifestyle seekers than professional ranchers. This profile of ranch buyers is also reflected in numerous other studies that asked farmers and ranchers about their motives and concluded, as did Gentner and Tanaka (2002), that the desired lifestyle is the over-riding reason for farm and ranch ownership (Harper and Eastman 1980, Liffman et al. 2000, Rowe et al. 2001, Blank 2002, Sulak et al. 2004). However, the question of purchasing ranches for their long-term capital appreciation value should not be overlooked and may explain some of the behavior of ranch purchasers as a wealth building strategy (Blank 2005).

Another indication that profit is not the driving motivation for ranch ownership is the observation made by Smith and Martin (1972) over 30 years ago: rates of return from livestock operations are low by any standard investment criteria, and well below comparable average non-agricultural rates. This has not changed. Average annual livestock production returns are reported to range from negative amounts for small part-time ranches to about 3% for large commercial ranches. This range of returns is consistently reported by university and government studies throughout the United States. Similar rates of return have been reported for farms as well. Using Bureau of Economic Analysis (BEA) data, Erickson et al. (2004) found that from 1960 through 2001 rates of return on non-farm assets dominated those of agricultural assets, producing both a higher rate of return and lower risk. But, average rates of return as typically reported do not include estimates of land appreciation, which has traditionally added a significant economic return. Blank (2005) estimated that over the 1960-2002 period agricultural returns from capital gains exceeded returns from crop and livestock production; this included the 1980-86 period of the “farm crisis” when land values declined significantly. Sunderman et al. (2000) found that over the 1989-1997 period all types of Wyoming ranches realized 80% of investment returns (11.4% annual return) from land appreciation. For non-scenic ranches, 68% of investment returns (14.8% annual return) came from land appreciation. Torell et al. (2004) estimated a lower but even more pronounced difference in appreciation rates between high-valued deeded land ranches and relatively low-valued public land ranches. Using a hedonic ranch value model for estimation (http://ranval.nmsu.edu), the market value of a 95% public land ranch in the southwest deserts of New Mexico was estimated to have appreciated in value from $119/AUM in 1996 to $130/AUM in 2002. This represents a 1.34% annual appreciation of market value. The permit ranch would have sold for about $83/AUM ten years earlier in 1986 (Bartlett et al. 2002).[2] In the last 20 years, after adjusting for inflation, public land grazing permits have appreciated very little in market value and have actually decreased on a real-price basis. By comparison, a scenic all-deeded land ranch in the mountains was estimated to have doubled in value over the 1996-2002 period (12% annual increase in nominal value).

Martin and Jeffries (1966) concluded that the major reason for inflated ranch prices must be consumptive-related outputs, and we agree for public land leases, given their minimal appreciation of value and the minimal contribution of ranch income to ranchland value. Public land leases allow the purchase of a bigger ranch, and because the price is less, some individuals who can only afford a relatively low-priced ranch can enter the ranching business and live the desired lifestyle. It may be that for some tax incentives and land appreciation are major factors in the ranch purchase decision, but this has not been shown for ranches primarily composed of public lands. The major objective of western public land ranchers has not changed from what Smith and Martin (1972, p. 218) found over 30 years ago: “to maintain the ranch as a business, home, and way of life”. Public land ranchers prefer to make more money to less and most are not rich. They need to at least break even on the ranching operation and, for many, off-ranch employment is a requirement.

[2] Average permit values in northern states where seasonal grazing is common have generally been about half as much as the yearlong permits of New Mexico and Arizona (Bartlett et al. 2002).

Policy and Management Analysis

The final question we examine is whether the lack of a profit motive has any bearing on how economic policy analysis is conducted (or should be conducted) as it relates to public grazing issues. Others have raised this question before. Smith and Martin (1972) argued that economic models that attempt to explain rancher behavior based only on the profit motive are inadequate and will lead to ill-conceived land-use policies and policy assessments.

Traditionally, production function, profit-maximizing models are developed and used to represent typical ranches in an area. This typical ranch is then used in analyzing the potential impacts of altered policies and management prescriptions. Paying little attention to the warning of Smith and Martin (1972), we have used these models in a variety of settings. While we believe these profit-maximizing models provide an indication of impact direction, we are not sure that they are useful for predicting rancher behavior.

As an example, for a recent symposium at the Society for Range Management's annual meeting, we were given the assignment of evaluating the economic impacts of various cattle-management practices to improve grazing distribution. These included livestock herding, off-stream water development, fencing, strategic supplementation, and others. We developed a multi-period linear programming model to represent a typical ranch in northeastern Oregon and evaluated the economic impacts of each practice. While the results of our model indicated the changes in management and production practices that should be made to maximize profit with expanded management and production options, it did not tell us whether a rancher would really do that. If the model did show that herding cattle away from riparian areas was profitable, we also have to realize that the rancher may choose not to implement that kind of practice if it does not fit lifestyle considerations.

As another example, many range improvements are implemented even though economic studies indicate that added forage and livestock production will not pay for the project. Preferring more money to less, ranchers typically seek cost share funds to finance many of these "unprofitable" improvement practices. Yet, many range improvements are implemented knowing full well that the economics of the practice is dismal.

Public land ranchers represent a continuum of economic behavior ranging from consumption of ranching as a good to ranching for profit. Ranching for profit does not appear to be a straightforward concept because even the dependent family and corporate ranchers value the consumption of ranching as a good. This fits with previous results that even large ranch businesses may act as economic satisficers – producing an income that is satisfactory and enough to pay the bills, while consuming ranching as a good (Smith and Martin 1972). It may also be, as Biswas et al. (1984) concluded, that ranchers have multiple objectives but ultimately behave in a manner that is consistent with profit maximization. But, as we have noted, there is substantial evidence that this is not the case: ranch returns are low by any standard investment criteria, inflated prices are paid for ranches, and "unprofitable" improvements and investments continue to be made based on criteria unrelated to profit. The continuum of observed behaviors and motivations helps to describe the heterogeneity of ranchers across the West through differences in socioeconomic and demographic attributes.

Policies crafted that are based on economic analyses using the profit-maximizing assumption will not always provide desired outcomes since all public land ranchers cannot be broadly categorized under the classical profit-maximizing assumption. While a utility-maximizing model would be more appropriate, those models cannot be quantified and defined. A household production-function approach would be most appropriate for ranchers on the consumptive side of the continuum, while a more typical production-function approach would be more appropriate for ranchers on the profit-oriented end of the continuum. By defining the subgroups of the population and modeling behavior based on placement in the continuum, more informed choices could be made based on the specific attributes of that sub-group. As noted by Sayre (2004), qualitative and descriptive research tools may be more appropriate for many policy assessments.

The reason we have continued to use the profit-maximizing criteria to describe and predict the behavior of public land ranchers is that it provides an objective, measurable estimate and criterion for evaluating management and economic changes when policies and conditions change. Profit remains important as long as decisions lead to at least breakeven situations; it does not explain all of the behavior of public land ranchers. Without the profit motive we are left with relying on ranchers to describe how they might adjust to altered land use policies and whether they are motivated and willing to adopt some new technology. Most agricultural economists are not comfortable with this subjective assessment. Perhaps, though we should heed the warning of Smith and Martin (1972) and be less comfortable reporting and believing policy assessments that rely on the profit-maximizing criteria. New approaches to both ranch decision and policy analysis models are needed to incorporate the non-profit goals of the public land rancher.

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As Ecosystem Services Are Demanded of Agriculture, What of Agricultural Economists?

Scott M. Swinton[1]

What society needs from agricultural economists is changing. But what we have to offer is often misperceived and sometimes not perceived at all. The rapid spread of the ecosystem services paradigm presents an opportunity to contribute and a challenge to be relevant. This article examines our comparative advantages and impediments to communicating them, closing with suggestions for seizing this opportunity and ones like it.

What society asks of agriculture is changing. As recently as 1989, the National Research Council characterized agriculture as a "system of food and fiber production" (National Research Council (NRC) 1989, p. 4), echoing a report fifteen years earlier (National Academy of Science (NAS) 1974). If reports by the NRC offer a broad scientific view of the national interest, then that interest was for agriculture to produce food and fiber efficiently with minimal harmful environmental impacts.

In response to rising human pressure on global resources, society in the United States and elsewhere is now beginning to ask farmers to provide a host of new goods and services. The Kyoto Protocol on global climate change is stimulating the creation of markets for carbon sequestration by land managers, even in the United States, which famously is not a signatory. Cities are paying farmers to protect their water supplies. Land trusts are purchasing development rights for farm lands with the proviso that they be kept in farming and land uses that conserve green space. U.S. agricultural programs are paying farmers to provide wildlife habitat. The diverse ecosystem services of climate regulation, water quality regulation, aesthetic landscapes and wildlife habitat go far beyond agriculture's traditional role of food and fiber provision.

The pattern of ecosystem services provided by farms may be diverse, but it is also extremely patchy and *ad hoc*. Few of the new ecosystem services sought from agriculture have established markets. Indeed, the services themselves are often costly to measure, yet inexpensive and widely acceptable proxy measures are few. As a result, it is difficult to compare across sites the quality of diverse sets of ecosystem benefits that are potentially available. So when they exist at all, farmers' opportunities to profit from providing such services tend to be serendipitous, rather than representative of demand and supply conditions.

To develop an understanding of the ecosystems managed by farmers and the potential resulting ecosystem services is a huge and hugely multidisciplinary research challenge. It is huge, because the ecosystem services involved reach far beyond the fences bounding farm fields. It is hugely multidisciplinary because not only does it require the "regular" mix of agricultural scientists, it also requires a broad array of non-agricultural scientists, such as wildlife biologists, microbial ecologists, botanists, climatologists, hydrologists, and others. The next step after understanding agricultural ecosystem functions better is to understand and to influence people's choices in managing those systems. This step, of course, is where social scientists enter the picture.

A broad array of ecological and other biological scientists is already deeply engaged in understanding ecosystem functions and associated ecosystem services. One well-organized example is the U.S. Long-Term Ecological Research (LTER) network of 26 sites (http://www.lternet.edu/), which is currently

[1] The author is with the Department of Agricultural Economics, Michigan State University, East Lansing, MI.

engaged in a major network-level planning effort. A major objective of the planning effort is to link social science research more effectively with ecological research in the network. The push to integrate social scientists is motivated by the belief that research into human behavior with respect to the ecosystem could contribute to a more ecologically sustainable future. But when LTER ecologists refer to social scientists, they typically do not mean economists. Indeed, applied economists have had little role in the LTER system until recently (Redman, Grove and Kuby 2004). Why? Are economists ill equipped?

Among agricultural ecosystems, agricultural economists have a strong track record at conceptualizing and modeling human behavior as ecosystem managers (Antle and Capalbo 2002; Antle et al. 2001). On multidisciplinary agricultural research teams, economists often reveal a knack for framing the problem. Our grasp of economic incentive design and its institutional foundations can contribute to effective policy recommendations. Environmental economists have made great headway in developing methods for estimating the value of environmental goods and services that lack markets.

If economists are well-equipped as social scientist partners in ecological research and policy design, why don't we show up in the ecologists' address book? Based on personal observation, the primary reason would be that we are largely undifferentiated from the mass of social scientists. A few ecologists who distinguish us from other social scientists view economists as the enemy – defenders of the economic forces polluting the planet.

More effective communication that reaches scientific disciplines outside of agriculture can make a difference – even when related to agricultural applications. At the getting-started end of the research continuum, new funding opportunities exist to support cross-disciplinary research. The National Science Foundation several years ago opened a new program in Coupled Human Natural Systems; that program has been followed by the current Human and Social Dynamics program. Both programs call for multidisciplinary proposals linking biophysical with social sciences. At the results-reporting end of the continuum, the American Association for the Advancement of Science (AAAS) is also opening doors to social scientists as never before. At the publication stage, precious few applied economists consider submissions to journals like *Science* or *Nature*. Yet these journals have huge cachet across all disciplines, with journal citation index factors 30-50 times higher than the main disciplinary outlets in agricultural and environmental economics.

Understanding how others view what we bring to the table is key. The biggest drawing card for economists in multidisciplinary research, at least with ecologists, is probably nonmarket valuation expertise. The appeal of such expertise is exemplified by notorious attempts by ecologists at benefit transfer to place values on the Earth's ecosystems. Bioeconomic modeling skills are also highly relevant (Antle et al. 2001), although many biophysical scientists will need education in how such models can be constructed. Modelers share a common language of inputs, outputs, process equations and validation procedures that is robust across disciplines and can facilitate collaboration. Some of the most valuable contributions by economists in multidisciplinary research are appreciated only after it is agreed to collaborate, once research is being conceptualized. Skills at framing research problems and designing policy recommendations that are grounded in understanding of incentive design theory and policy precedents are good examples. Just as young business college graduates are counseled that they will be hired for their sales or number crunching skills rather than their grasp of strategic management, so too economists seeking a foot in the door with other disciplines need to appreciate which of our tools is sought by potential collaborators.

Why Partners Outside Agricultural Sciences Are Needed to Think About Agriculture

This essay began by stressing the diversity of ecosystem services that society increasingly seeks from agriculture. Major gaps in our understanding of how those ecosystem services are provided and how to induce greater provision create urgent needs for collaboration between economists and ecological scientists (Robertson and Swinton 2005). Ecosystems that are directly managed by humans are easier to manipulate than those we influence indirectly. Agricultural ecosystems cover the largest land area of any class of managed ecosystems in the world (Millennium Ecosystem Assessment 2005). Managed to meet private objectives (chiefly profitability and food security), agricultural ecosystems have well understood drivers. Finally, agroecosystems already have a successful history of collaboration between economists and agricultural scientists (Antle et al. 2001).

Unlike many other areas of human intervention in ecosystem functioning, there is a strong precedent for government intervention to affect behavior with regard to management of agricultural ecosystems. In the United States, Japan and the European Union, farm subsidies are well entrenched. The historic justifications of alleviating rural poverty, protecting rural communities, and ensuring food supplies are being undermined by changing realities. In the United States, at least, the recipients of most farm subsidies are now richer than average, farm subsidies have not stemmed the tide of emigration that undermines rural communities, and food security concerns have waned with ample supplies. Meanwhile, the Doha Round of world trade negotiations faces failure if the wealthier countries will not sharply reduce subsidies that distort food supplies and prices (Josling 2005). Supporting farmers to provide ecosystem services from agriculture represents a means to maintain the precedent of supporting farm incomes without distorting the prices of traded agricultural goods, while at the same time addressing the underprovision of ecosystem services from agriculture.

Agricultural ecosystems constitute an ideal place to begin because they cover such a vast land area, the incentives and constraints of farmers are familiar, government intervention has a strong precedent, and the Doha trade talks and the upcoming U.S. farm bill debate make agricultural policy a timely issue. Despite this familiar base, the diversity of ecosystem services now sought from agriculture creates both new interest and the need to engage new partners. The moment is propitious.

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The Cow That Stole Christmas? Exploring the Role of Media Coverage in Recent BSE Outbreaks

James Pritchett and Dawn Thilmany[1]

Introduction

Estimating economic impacts of food safety scares, such as the concern surrounding beef supplies when bovine spongiform encephalopathy (BSE) is found in domestic cattle, is important to food industry analysts, policymakers and scientists. Accurate estimation is particularly important to stakeholders who weigh the relative benefits and costs of information systems designed for quality assurance, source verification and trace-back capability. Yet, determining potential implications on marketing channels often involves quantifying decreased demand for affected foods and the increased demand for substitutes directly related to the shock, an issue that requires careful methodological approaches and data interpretation.

Food safety demand shocks may be difficult to extract with primary data – after all, the event is unexpected making it costly and difficult to gauge consumers' responses in supermarket aisles. More often than not, *ex post* statistical analysis of secondary data identifies the impact that a food safety scare has had on consumer purchases. In this context, a challenge is how the event should be modeled. For example, should the demand shock be estimated with a single period dummy variable suggesting a sudden shift in consumer demand and eventual return to "normal?" Or alternatively, can word counts of print media be used to proxy initial consumer response, the increasing intensity of consumer awareness, and then a gradual return to initial/new demand conditions?

The purpose of this article is to consider alternative specification of consumer demand response to food safety shocks, or more generally, how the influence of media can be integrated into demand systems. Recent incidence of BSE in North American cattle is used as a specific event to illustrate opportunities and challenges in demand modeling. Several specifications are considered including simple dummy variables and word count indices. Findings are juxtaposed against similar empirical studies, and a final discussion reflects on lessons learned and opportunities for future work.

An Example: Canadian and U.S. BSE Events' Impact on Retail Meat Purchases

The announcement of Canada's single case of BSE (also known as mad cow disease) in May 2003 focused media attention on the safety of retail beef supplies. Although the BSE event in North America did not appreciably increase the risk of disease transmission, consumer beef demand may have been impacted given intensive media focus and public misconceptions surrounding that event. The Canadian event motivated the United States to close its border to Canadian beef products and live animal trade. Only seven months following the Canadian BSE event, the United States announced detection of BSE in a single cow in Washington. Subsequently, this event closed borders to trade between the United States and its export markets, perhaps reinforcing consumer concern over beef supplies.

Did a significant consumer response follow the BSE announcements? One way to answer this question is to cast consumer purchases within a meat demand system and attempt to capture the disease event

[1] The authors are Assistant Professor and Associate Professor in the Department of Agricultural and Resource Economics, Colorado State University.

with a suitable proxy. To this end, a linear almost ideal demand system (LAIDS) model was posited for meat demand with six specific meat share equations: ground beef (a meat cut identified as the most susceptible to BSE contamination), beef ribeye, beef top loin, pork center cut chops and boneless/skinless chicken breasts. Monthly point of purchase data (January 2001 to February 2005) comprises the price and share data used for the analysis.[2] In the LAIDS model, informational shift variables, such as a BSE event, can be incorporated into an individual share equation's shift parameter. But, the construction of the informational shift variable is worth further discussion.

Table 1 lists the alternative BSE event proxies considered in this study. Simple dummy variables are among those compared and include a variable equal to "1" in the month of the Canadian BSE event (May 2003) and a "0" otherwise, while another places a "1" beginning in May 2003 and extended to the remainder of the data set. In this case, parameter estimates and hypotheses tests will indicate whether the BSE event had a single month impact or if a longer structural effect is present. Likewise, the U.S. BSE event is given a single month proxy (a "1" in December 2003) and an extended dummy variable (a "1" in December 2003 and beyond).

Table 1. Description of BSE Event Variables.

Variable	Description
Simple Dummy	A "1" in the month of the event, a "0" otherwise.
Extended Dummy	A "1" in the event month continuing through subsequent months.
Negative Article	Word count of articles coded as "Negative."
Negative Article Squared	Word count of articles coded as "Negative" squared (quadratic impact).
Net Article	The word count of negative articles subtracted from a word count of positive articles.
Net Article Squared	A squared series of the "Net Article" data.
Brown and Schrader	The "Net Article" variable multiplied by the ratio of the "negative article" variable to the sum of negative and positive word counts.

The media is a primary source of food information for consumers, but the impact that the media has on consumer purchases is empirically difficult to disentangle. One approach is to construct media proxies from word counts. A LexisNexis™ search of articles using the terms "mad cow disease" "BSE" and "bovine spongiform encephalopathy" was performed, and words in each article counted to form a monthly data series ranging from January 2001 to February 2005. Media coverage is coded into two types: "Negative" for articles that suggest that beef food safety is questionable; and "Positive," indicating that beef food safety has been described in favorable terms. Examples of positive articles could include but are not limited to, new or more efficient testing methods to detect the presence of BSE (assuring efficiency with regard to food safety), a suspected case having a negative test result, assurances of the safety of the meat system and how no diseased animal made it into food marketing channels, or detailed descriptions of the safeguards developed and implemented to prevent BSE incidences. Examples of negative articles are reports of faulty systems or testing methods, negative test results, or descriptions of how the disease could easily occur in the United States. The word counts of negative and positive articles are summed in a given month to create the respective data series. A third data series, "Net," is created by subtracting the word count of monthly negative articles from the monthly positive articles.

Five BSE event variables are created from the previously mentioned word count series and these are summarized in the lower portion of Table 1. The first variable is the word count sum of "Negative" monthly articles. Next, the negative word count sums are squared, indicating a stronger overall impact on consumer's preferences. A third BSE proxy is the "Net" variable that subtracts positive word counts

[2] A more detailed description of the empirical procedure and the data can be found in Johnson et al. (2005).

from negative word counts giving a quantitative measure of overall media coverage. The fourth media index variable squares the monthly net article word count sums. The final index follows Brown and Schrader (1990), in that the index is created when the net word count is multiplied by the ratio of negative word counts to the total word count in each respective month. With this index, the net effect of coverage is given more emphasis as negative articles take a larger share of overall media coverage.

An iterated seemingly unrelated regression procedure was used to derive parameter estimates, and the parameter estimates for the event proxies are shown in Table 2 (other parameter estimates are suppressed as they are beyond the scope of this paper, but demand estimates were robust across all specifications). The various BSE event parameter estimates are found in columns ranging from the "Negative Article Squared" to "Brown and Schrader" following the approaches described in Table 1.

Table 2. Comparing BSE Event Proxies in a LAIDS Meat Demand System.

Share Equation	*Negative Article Squared*	*Negative Article*	*Net Article Squared*	*Net Article*	*Extended Dummy Variable*	*One Month Dummy*	*Brown and Schrader*
Ribeye Share	-5.98E-23	-2.66E-13	-3.14E-13	8.84E-09	-1.46E-03	-1.40E-03	1.62E-08
(t-stat)	-0.71	-0.65	-0.68	0.29	-1.03	-0.73	0.50
Chuck Share	-7.79E-23	-3.69E-13	-4.26E-13	2.19E-08	-1.61E-03	-1.80E-03	2.73E-08
(t-stat)	-1.77	-1.70	-1.74	1.30	-2.02	-1.78	1.53
Ground Share	-2.51E-22	-1.20E-12	-1.36E-12	6.54E-08	-4.90E-03	-5.81E-03	8.42E-08
(t-stat)	-1.96	-1.89	-1.91	1.33	-2.06	-1.98	1.62
Pork Share	6.91E-22	3.35E-12	3.81E-12	-2.18E-07	7.64E-03	1.59E-02	-2.62E-07
(t-stat)	1.85	1.82	1.83	-1.54	1.09	1.86	-1.74
Chicken Share	-1.34E-22	-7.27E-13	-7.95E-13	7.00E-08	3.61E-03	-3.05E-03	7.38E-08
(t-stat)	-1.00	-1.11	-1.08	1.42	1.28	-1.00	1.40

At first glance, neither the ribeye share nor the chicken breast share indicates a statistically significant impact from any BSE event formulation. In the three remaining share equations, the beef products (ground and chuck roast) experience a negative impact, indicating that consumers purchased less of these two beef products. The greater negative impact occurred with ground beef, which in the print media was portrayed as the beef product with the greatest risk of contamination from BSE infected tissue. Conversely, the BSE event dummies have a positive impact on the pork share equation indicating that pork may have been a substitute choice among those consumers concerned about the beef market events.

The event dummy variables (Extended Dummy Variable, One Month Dummy) have a greater impact on meat shares when compared to the media index variables. Moreover, the simple dummy variables tend to be statistically significant across more share equations than the media index variables, perhaps because the dummy variables capture more complex information shifters including electronic media, whereas word count variables are specific to the print media. Alternatively, media attention on the BSE event provides no additional information on consumer demand response. This may partially be due to the fact that we are examining monthly changes, and in today's 24-hour media age, events pass out of public attention quickly.

Related Empirical Demand Shock Studies

A limitation of our study is its monthly data series – after all, a food safety scare may come and go within a month's time muting the demand shift. A more geographically focused, weekly study of the same BSE event is found in Peng, McAnn-Hiltz and Goddard (2004). The authors estimate a BSE media index variable using weekly point of purchase scanner data for fresh and refrigerated beef, pork and chicken (acquired from AC Nielsen) from Alberta retail stores. The beef products were split into ground beef and "other" beef. Results confirmed the assumption that the newspaper articles addressing BSE had a negative (small in magnitude) and statistically significant impact on the Alberta consumers' demand for beef (cuts other than ground).

More generally, Kalaitzandonakes, Marks and Vickner (2004) argue that acute media focus on food safety is temporary and small in its impact when examining a short-term media event (e.g., unapproved corn mixed in the human corn food supply chain) and the more sustained media coverage of biotechnology in foods. In the latter case, consumers did not change purchasing patterns during the analysis period. In the former case, acute media coverage affected purchases, but the overall response was limited. Interestingly, specific brands mentioned in media coverage absorbed the brunt of losses. Attempts to uncover lagged effects from media coverage proved fruitless.

Media index variables used in this study focus on print articles and word counts within the articles. This data construct is a limitation to the study. As noted by a reviewer, the media reports newsworthy events in "pulses" or "cycles" among many different media types including television, Internet, radio and print. An example of media pulse modeling is Dahlgren and Fairchild (2002) who perform a case study of chicken contaminated with salmonella. In the case study, a negative poultry report is first broadcast on the television news program *60 Minutes*, and then media coverage expands quickly from other sources. The authors' media proxy considers a count of weekly keyword appearance in television and print news coverage, but weights the appearance by the audience size to gain insight into overall consumer exposure to the event. The formulation is negative and statistically significant in some, but not all of the models considered. It should be noted too, that simple weekly word count and simple dummy variables were used in preliminary modeling efforts. Exposure, or the reach of BSE news, is not considered in our event study.

In addition to news exposure, the current generation of consumers may pay more attention to headlines (of all media types) rather than the full content of reports. If this is true, constructing a media index from headlines may provide a more accurate portrayal of how consumers' perceptions and buying behavior are impacted by food safety events. As an example, Verbeke and Ward (2001) proxied consumer awareness with a media index based on the number of positive and negative television reports, rather than full-fledged word counts, in Belgium. Using a linear AIDS model and a monthly panel data set of consumer purchases, the authors find that the TV coverage had a significant and negative impact on beef/veal consumption and a positive, significant effect on pork consumption.

If ERS-USDA data were available in a weekly time series, we might better be able to match the media exposure of the BSE event to the cycle of consumer purchases. Repeating the analysis with closer attention to these dynamics may provide more statistically significant results vis a vis simple dummy variables. Such is the experience of Kalaitzandonakes, Marks and Vickner (2004) who first create a daily media coverage series based on print media, radio transcripts and television transcripts, count the number of times that "Starlink" or similar phrases appear in the coverage, and then aggregate the daily series to exactly match the weekly scanner data set that they have for purchases. Dahlgren and Fairchild (2002) also make use of weekly media information, but must adapt their consumer purchase data from a monthly to a weekly data series with proxies.

Concluding Remarks

Conventional wisdom argues that the public response to the U.S. discovery of BSE in December 2003 would have been more substantial had it not occurred in the holiday season – a season when beef consumption is low, and consumers' attention is diverted from the media. This lends support to the proposition that, as rational as the proposition is, using media indices as indicators of consumer awareness/concern is not always an appropriate or effective methodology. Additionally, construction of media indices is quite costly relative to the inclusion of simple dummy variables.

This is not to say that construction of media indices and their use in economic studies is without value. In fact, media study may be particularly appropriate when public institutions are perceived to perform inadequately. For instance, when consumers have less assurance that government institutions can respond to food safety issues, the role of media may be enhanced. After the mishandling of BSE in the United Kingdom, European consumers look to third party validation including the media, rather than government, to assure them of a safe food supply whereas a large majority of U.S. consumers still trust the USDA's oversight of the food system. Another instance when media may be an important influencer is when branded products are addressed, an increasing issue with more source assurance claims being made by private marketers. Media indices may be useful in examining both the lost flow of demand for these goods, and may also be particularly useful in describing the erosion of brand equity (a stock effect).

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