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).

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Ranchers Diverse in Their Drought Management Strategies

Christopher T. Bastian, Siân Mooney, Amy M. Nagler, John P. Hewlett, Steven I. Paisley, Michael A. Smith, W. Marshall Frasier and Wendy J. Umberger[1]

Introduction

Portions of the western U.S. are experiencing the worst drought in 80 years (Piechota et al. 2004). Figure 1 indicates that Wyoming has experienced multiple periods where precipitation was below normal for consecutive years, with the most recent period being between 2000 and 2005. Average annual precipitation has been trending downward since 1895 when official records were kept. Moreover, research suggests that drier summers could become more common as the global climate changes (Hengeveld 2000). The most recent period of drought has reduced range productivity, lowered irrigation water supplies and ultimately forced some ranchers to reduce herd sizes. Many producers culled their herds at a time when cattle prices were below the cyclic peak (between the years of 2000 to 2004), resulting in lower sales revenue. They also incurred higher feed costs to maintain the remaining herd. Together, these factors contribute to reduced profitability. Additionally, breeding livestock purchased now to restock drought liquidated herds would be done so at or near the peak of the most recent cattle price cycle. Current forecasts suggest that cattle prices are likely to start their cyclical decline within the next two years (Livestock Marketing Information Center 2006). Livestock purchased now or in the next several years would likely generate negative returns throughout their productive life, even if a ranch had the available feed resources, causing restocking to be less desirable at this time (O'Neill et al. 1998). The economic consequences of restocking at this point in time coupled with smaller herd sizes from drought liquidation puts ranchers in a weaker financial position to survive the downside of this most recent price cycle. The combined effect of these events has concerned many ranchers, and they are turning to professionals from land grant universities and elsewhere for help or they are selling off their ranches altogether.

Unfortunately, research literature regarding optimal drought management strategies during extended periods of drought is limited. Foran and Smith (1991) indicated that for droughts lasting two years or longer, maintaining a lower-than-average stocking rate was most profitable in the long-run. Hall et al. (2003) found that producers believed that below normal stocking of pastures, storing more hay, and adjusting stocking rates to current grazing capacities were the best drought management strategies available. Lardy and Poland (1997) indicate that providing additional feed supplements, herd liquidation, renting additional pasture and grazing crop residues are all effective strategies for stretching tight forage supplies during periods of drought.

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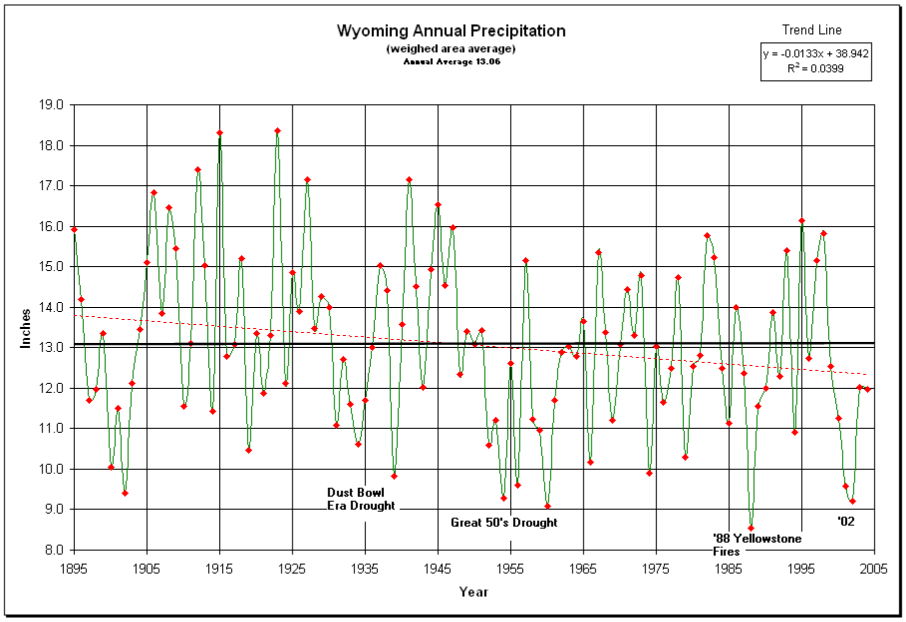
Figure 1. Wyoming annual precipitation from 1895 -2005 compared to average and trendline (http://www.wrds.uwyo.edu/wrds/wsc/climateatlas/drought.html).



Heitschmidt et al. (1999) studied the effects of grazing on range under drought conditions from 1993-1996. The authors concluded that grazing has a smaller impact on the range ecosystem than drought conditions. Hild et al. (2001) conclude that drought limited subsoil root production regardless of grazing treatments. Thurow and Taylor (1999) conclude that management and policy tools must improve the integration of economic and ecological aspects of drought-induced de-stocking decisions.

While the above literature suggests that grazing and stocking decisions are important during periods of drought, and that other strategies exist to extend existing forage resources, the economic consequences of those strategies are not well understood. Moreover, little is reported in the literature regarding how livestock producers respond to extended periods of drought, which could provide useful insights into strategies for coping with this phenomenon. The lack of available research that examines optimal management strategies during extended periods of drought coupled with ranch incomes currently being affected by this phenomenon prompted a multidisciplinary team from Wyoming and Colorado to conduct a pilot study on this issue. The objectives of this project were to gather detailed information from cattle producers regarding their management strategies, resource issues and recent responses to drought. Wyoming cattle producers were chosen for the initial survey under this project. Future research under this project will utilize their responses to construct a variety of economic models that can be used to examine the financial consequences of alternative drought management strategies. This paper presents a detailed picture of the concerns and responses of cattle producers to the recent drought they have experienced.

Data and Methods

A survey of Wyoming cattle producers was conducted during the spring of 2005 by the USDA National Agricultural Statistics Service on behalf of the University of Wyoming. A stratified, random sample of beef cattle producers was drawn from the population of beef cattle producers within Wyoming based on number of breeding-age cows as of the 2000 Agricultural Census.

There were three strata in the sample: small producers (20-299 cows), medium producers (300-999 cows), and large producers ($\geq$ 1,000 cows). A modified Dillman mail survey design was used, including a cover letter and survey, then postcard reminder and a final mailing including final cover letter and survey (Dillman 1978). Moreover, non-respondents were re-sampled and telephone interviews were conducted using the full survey instrument to allow testing for non-response bias in future work. The survey instrument contained questions about the producer's resource base and production practices, marketing practices, drought impacts and management strategies, sagebrush management and demographics. A copy of the complete survey instrument is available at http://agecon.uwyo.edu/WYLivestock/default.htm.

Results

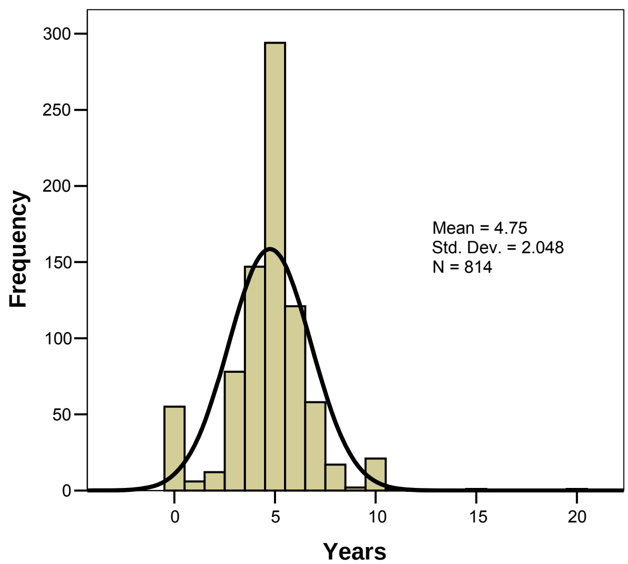
The overall survey response rate was 40% with 1,190 responses received from a sample of 3,000 producers. The total number of responses represented slightly over one-sixth of the total population of cattle producers in Wyoming. A number of respondents had liquidated their breeding-age cows to below 20 head at the time they received the survey. The original survey questions and the strata were designed for producers with 20 or more breeding-age cows, and thus, those respondents with less than 20 head were dropped from the analysis. Dropping respondents from the analysis that had less than 20 breeding-age cows at the time they received the survey reduced usable responses to 814 for a final useable response rate of 27%.

Respondents indicated the length of time that their operations had been negatively impacted by the most recent drought ranged from 0 to 10 years (Figure 2). The overall median and mode was 5 years with a mean of 4.75 years. The vast majority (69%) of responses ranged from 4 years to 6 years. The mean response for small operations was 4.7 years, while the mean response for medium and large operators was 4.9 years. Moreover, in response to a series of Likert scale questions (5- strongly agree; 1-strongly disagree) respondents were strongly in agreement (median score of 5) with the statement "a drought contingency plan is important for beef producers in Wyoming." These results suggest that Wyoming cattle producers needed to consider contingency plans that assume a drought period of nearly five years. If this is the case, future economic analyses of management strategies need to incorporate a longer term view of drought response.

Survey respondents characterized how drought affected grazing, irrigation water supplies, winter feed production, sale weights, weaning and owner equity between the years 2000 and 2004 as a percentage compared to a "normal" year. It should be noted that a standardized definition of drought was not provided to participants. Table 1 reports the mean responses for those producers that indicated their operations had been negatively impacted for at least one year by the most recent drought. Generally, the responses show that the severity of drought impact increased over time. The greatest change is attributed to reduced grazing capacity, irrigation water supplies, and consequently, reductions in winter feed production. Mean changes in grazing capacity ranged from a reduction of 16% in 2000 to 31% in 2004. Mean reduction in irrigation water increased from 12% to 22%, and the resulting winter feed reductions increased from 18% to 35% between the years 2000 and 2004.

Reduced feed availability coupled with other responses to drought also reduced sale weights and weaning percentages. Respondents estimated that, on average, sale weights were reduced between 4% and 7%, while the percentage of calves weaned dropped between 4% and 6%. Not surprisingly, respondents also reported negative impacts to owner equity, with reductions ranging between 4% and 7% over the same time period. These impacts may not be as large as one might expect given the severity of some of the other impacts, however. This could be the result of policy programs and off-farm income. It is important to note that the standard deviations indicate wide variation in responses which is expected given the temporal and geographic dispersion associated with drought across Wyoming. Overall, these results suggest that future analyses and recommendations regarding drought management strategies need to account for the potential cumulative effects of drought over time.

Figure 2. Consecutive years operation negatively impacted by the most recent drought.



Wyoming cattle producers were asked to identify all of the potential drought management strategies they used each year during the years 2000 through 2004. Table 2 presents the frequency with which each reported a drought management strategy was used across years and operation size. The most frequently cited management strategies across all years and operation sizes were purchasing additional winter feed, partial herd liquidation and participating in some type of government feed assistance program. The next two most frequently used strategies were leasing or purchasing additional forage and early weaning of calves to reduce feed requirements. The least common response was total herd liquidation. No respondents within the large size class (≥ 1000 cows) indicated they had used this strategy. Given the potential for specialization and long term genetic improvement programs for herds, it is not surprising that larger operations were less willing to consider total herd liquidation in response to drought. The responses received for this strategy could understate the frequency with which this strategy was adopted because producers that no longer had cattle when they received the survey may have declined to participate or were eliminated from the analysis. Medium and large size operations were more likely to lease or purchase additional grazing as the length of drought increased. These results support the conclusion that larger operators are less willing to use total herd liquidation as a strategy in dealing with drought.

Not surprisingly, a much higher percentage of respondents in the small and medium operation size categories indicated that they earned more off farm income as a strategy to cope with drought (Table 2). Large operations were much more likely to add alternative crop or livestock enterprises compared to respondents in the small and medium size categories. It is possible that larger producers face fewer resource constraints related to feed and financial resources which may also partially explain the differences observed between the small, medium and large producers concerning their strategies related to the sale of retained yearlings. Smaller producers with less feed resources may be less likely to add yearlings as an enterprise, and they may be less able to adjust to changing cash flows and/or withstand large variations in income that may come from large fluctuations in the yearling enterprise. Table 2 shows that medium and large size operations are more likely to sell retained yearlings in response to drought than are small operators.

Table 1. Reduction in productivity attributed to drought as a proportion of normal expectations (for all respondents).

	Year				
	2000	**2001**	**2002**	**2003**	**2004**
Changes Experienced			n = 759[1]		
Grazing capacity reduction	16%[2]	20%	28%	28%	31%
	(22.9)[3]	(23.2)	(25.9)	(25.0)	(27.5)
Irrigation water reduction	12%	15%	21%	21%	22%
	(23.6)	(24.6)	(29.6)	(29.1)	(30.9)
Winter feed production reduction	18%	21%	30%	28%	35%
	(26.6)	(27.1)	(31.4)	(30.6)	(36.1)
Average sale weight reduction	4%	5%	7%	7%	6%
	(13.5)	(13.1)	(15.1)	(15.8)	(15.4)
Percent weaned reduction	4%	5%	6%	6%	6%
	(14.9)	(16.3)	(17.1)	(16.6)	(17.0)
Owner equity reduction	4%	5%	7%	7%	7%
	(13.0)	(14.1)	(16.9)	(16.7)	(17.5)
Other	<1%	<1%	1%	1%	1%
	(1.9)	(2.8)	(5.4)	(5.1)	(6.9)

[1] Sample size. Respondents who answered "0" to number of years impacted were deleted, reducing n by 55.
[2] Mean percentages (rounded to the nearest whole percent).
[3] Standard deviation in parentheses.

Figure 3 shows the mean number of strategies used in response to drought by survey respondents by year. As the length of the drought increased, respondents were more likely to use multiple strategies to mitigate its impacts. During the years 2000 and 2001 producers used one to two strategies on average while between the years 2002 and 2004 the mean number of strategies utilized increased to between 2 and 3 strategies in a given year. Overall the results reported in Table 2 and Figure 3 indicate that producers adopted increasingly diverse responses to the most recent drought. This was true both across years and operation size. This presents a significant challenge to agricultural researchers and educators. It is likely that they can better serve clientele if their analyses and recommendations consider a broad number of alternatives and combinations of strategies when addressing extended periods of drought for western livestock production systems.

One common recommendation from agricultural economists in this most recent drought has been to sell breeding livestock and take advantage of income averaging from a tax liability standpoint (Tronstad et al. 2002). Producers experiencing relatively high income in a given year because of breeding stock liquidation could use this as a strategy to reduce tax liability and ultimately maximize after tax income. However, to take advantage of this tax break producers are required to replace breeding livestock to normal levels within 24 months of the liquidation, unless the government decides to grant an exception.

Table 2. Proportion of producers using drought management strategies by operation size (n=759).

Management Strategy	Operation Size	2000	2001	2002	2003	2004
		Year				
Partial Herd Liquidation	*Small*	27%[1]	33%	48%	43%	43%
	Medium	30%	42%	57%	51%	49%
	Large	29%	36%	57%	50%	36%
Total Herd Liquidation	*Small*	1%	2%	2%	2%	2%
	Medium	2%	3%	3%	2%	5%
	Large	-	-	-	-	-
Selling Retained Yearlings	*Small*	5%	7%	9%	10%	10%
	Medium	6%	10%	18%	15%	19%
	Large	14%	14%	21%	21%	21%
Lease/Purchase Addl. Grazing	*Small*	15%	20%	27%	29%	32%
	Medium	19%	24%	32%	37%	36%
	Large	14%	21%	43%	36%	50%
Purchase Addl. Winter Feed	*Small*	34%	41%	56%	54%	57%
	Medium	39%	51%	66%	64%	64%
	Large	50%	64%	79%	71%	64%
Early Weaning to Reduce Feed	*Small*	11%	14%	26%	30%	33%
	Medium	11%	18%	35%	36%	36%
	Large	14%	14%	36%	29%	36%
Gov't. Feed Assistance Program	*Small*	14%	21%	49%	52%	39%
	Medium	20%	30%	63%	64%	52%
	Large	7%	21%	57%	93%	43%
Gov't. Income Assist. Program	*Small*	4%	6%	10%	11%	9%
	Medium	4%	7%	13%	13%	13%
	Large	-	-	7%	14%	7%
Earn Off-Farm Income	*Small*	41%	45%	47%	49%	49%
	Medium	22%	24%	28%	31%	32%
	Large	14%	14%	14%	14%	14%
Added Alt. Livestock Enterprise	*Small*	4%	4%	4%	6%	7%
	Medium	1%	1%	3%	4%	5%
	Large	-	7%	21%	21%	21%
Added Alt. Crop Enterprise	*Small*	1%	1%	2%	2%	3%
	Medium	1%	1%	2%	2%	5%
	Large	-	7%	14%	14%	7%
Other	*Small*	3%	3%	4%	4%	4%
	Medium	2%	3%	3%	5%	4%
	Large	-	7%	7%	7%	7%

[1] Frequency of binary response for category being checked (indicated as a 1), reported as percentage of respondents indicating negatively impacted by drought (n = 759; small 20-299 bred cows n = 569; medium 300-999 bred cows n = 176; large ≥1000 bred cows n = 14).

Given the importance of herd liquidation as a strategy and the related potential for reducing tax liability, producers were asked to answer several questions regarding whether they took advantage of this tax break and whether they had repopulated their herd to pre-drought levels. Tables 3 and 4 provide responses to those questions. Table 3 shows that 27% of all respondents who answered this question had used income averaging to reduce their tax liability. Medium size operators responded they had done this more frequently (38%) than large and small operators (20% and 24%, respectively). Interestingly, only 11% of respondents repopulated their herds to pre-drought levels (Table 4). Large operators were most likely to have repopulated their herds (33%) compared to small operations (9%) and medium (13%)

sized operations. These responses suggest that a number of producers may face an additional tax burden at a time when their income potential may be reduced by drought. This result points to a potential policy prescription regarding tax liability forgiveness from drought liquidation sales should extended periods of drought become more frequent in the future.

Figure 3. Mean number of drought management strategies used by respondents.

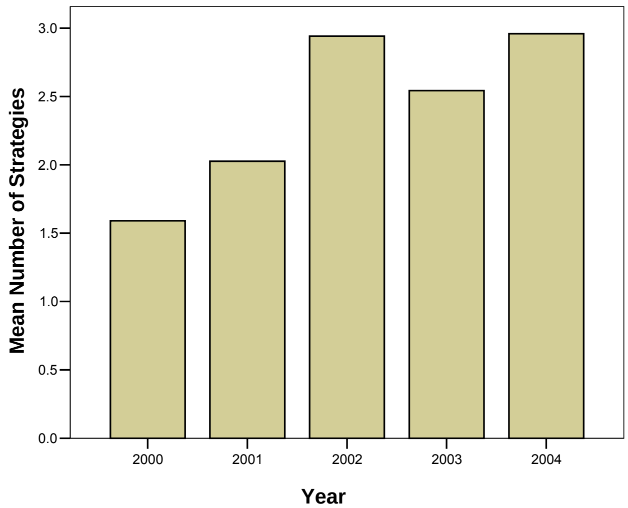


Table 3. Producers using income averaging to reduce tax liability if they liquidated some or all of herd with intention of replacement within 24 months.

All Ranches	By Operation Size		
	20-299 Bred Cows	300-999 Bred Cows	≥ 1000 Bred Cows
n = 598	n = 439	n = 144	n = 15
27%[1]	24%	38%	20%

[1] Percentage of respondents answering question and indicating "yes."

Table 4. Producers replacing liquidated animals with purchased breeding livestock to pre-drought levels.

All Ranches	By Operation Size		
	20-299 Bred Cows	300-999 Bred Cows	≥ 1000 Bred Cows
n = 571	n = 418	n = 144	n = 9
11%[1]	9%	13%	33%

[1] Percentage of respondents answering question and indicating "yes."

At a time of cyclically high prices a number of producers may already have reduced herd sizes compared to pre-drought levels. As Wyoming cattle producers face the downside of the price cycle, a larger number of them may confront increased financial pressures and be less able to liquidate as a strategy to address declining incomes and reduce costs in response to lower prices. This suggests that the point at which drought occurs within the price cycle may matter and producers could face path dependencies related to drought management strategies. These too are issues to consider for future drought analyses and drought management recommendations to livestock producers.

Conclusions

As ranchers turn to professionals for management recommendations in response to drought, they find a paucity of research regarding optimal drought management strategies during extended periods of drought. As part of a multidisciplinary research project, researchers from Wyoming and Colorado conducted an extensive survey of Wyoming cattle producers to investigate the relevant issues and strategies to be considered in economic analyses. Our results indicate that Wyoming producers were diverse in their responses to this most recent drought. This was true both across years and by operation size. Overall, our results suggest that researchers and educators must consider a number of alternatives and combinations of strategies if they are to be relevant to clientele. This suggests a systems approach is most likely needed. Moreover, our survey results suggest there could be great value in developing research techniques that can account for the potential cumulative effects of drought, potential path dependencies and the importance of cycle dynamics in analyses of drought

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More Change Than You Think: Tracking Oregon Farmers' Markets and Their Managers 1998-2005

Larry Lev, Linda Brewer and Garry Stephenson[1]

Introduction

In recent years, the number of farmers' markets has increased rapidly in both the United States and Oregon (Thilmany and Watson 2004). According to USDA statistics, the number of markets in the United States grew by 111% over the period 1994 to 2004 to a total of 3700 markets in 2004. (USDA-AMS 2006). Focusing only on the net increase in markets, however, hides the full extent of change. The 1753 markets in the 1994 USDA database were not simply joined by 1947 new markets over that ten year period. A more complete accounting must track all of the markets that opened over that period and also all that closed. In this paper, we carry out that task for Oregon and document that for the period 1998-2005 the net increase of 30 markets is exceeded by the 32 markets that closed and dwarfed by the 62 new markets that opened.

It should be no surprise that not all farmers' markets succeed. Brown (2002) has previously documented highly variable growth rates in numbers of markets as well as long stretches in which the number of markets declined. But her research looked at net changes rather than the actual numbers of new and failed markets. Related research on small business survival rates provides a more useful basis for beginning this study. According to Bureau of Labor Statistics data, about 10% of all small businesses close in a given year and a similar percentage of new businesses open. More specifically, this research documents that new businesses are less likely to survive than existing businesses with 34% of new businesses failing in their first two years and a total of 56% failing in the first four years (Knaup 2005).

This article fills a significant gap in our understanding of farmers' markets and a caution to the nearly unrestrained enthusiasm for their spread by providing a more detailed examination of the changes in market numbers and market management for the period 1998-2005 in Oregon. This additional information should challenge prospective markets to more carefully consider their startup decisions and should motivate existing markets to take a hard look at their own performance and plans. The data presented here will also help the diverse organizations including universities, state departments of agriculture and state farmers' market associations that provide educational services to markets and managers to recognize the size and nature of the challenge that they face.

In this report, we track the status of individual markets and examine annual data for:

- The net increase in markets.
- The number of new markets that open.
- The number of markets from the previous year that closed. Technically these are markets that did not reopen and therefore the change is noted in the subsequent year.
- Changes in market managers from the previous year.
- Changes in market location from the previous year.

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[1] All three authors are at Oregon State University. Lev is a Professor in Agricultural and Resource Economics, Brewer is a Research Associate in Horticulture and Stephenson is an Associate Professor in Crop and Soil Science. This research was supported by a USDA/IFAFS grant. The authors acknowledge the reviewers' useful suggestions.

All of the tables except Table 4 present the data for seven regions within the state in order to further highlight the year to year variability in results. This paper focuses on quantifying these changes and provides only limited discussion of the underlying reasons.

The data cited here were gathered from the *Oregon Farmers' Markets* brochure for 1998-2005 inclusive. Prior to 1998, no organization compiled a list of all markets in the state. The Oregon Department of Agriculture published the brochure from 1998-2002, and the Oregon Farmers' Markets Association thereafter. The information was taken from the brochure as published with a limited number of exceptions detailed in the Appendix.

The number and regional distribution of Oregon farmers' markets for the years 1998 to 2005 are shown in Table 1. For this period, the number of markets increased by 30 or an average of 4.3 markets per year. The growth was uneven, however, as the state gained as many as twelve markets in one year (2000-2001) but actually lost a market in another (2003-2004).

Table 1. Number of markets by region

	1998	1999	2000	2001	2002	2003	2004	2005
Portland Metro	13	18	17	20	18	21	22	25
Willamette Valley	10	12	13	17	20	19	18	18
Southern Oregon	8	6	7	8	9	8	7	6
Eastern Oregon	1	1	1	2	5	5	5	5
Oregon Coast	4	4	6	9	7	7	7	9
Central Oregon	1	1	1	1	1	1	1	3
Columbia Gorge	1	1	1	1	1	1	1	2
Annual total	**38**	**43**	**46**	**58**	**61**	**62**	**61**	**68**

New Markets and Closed Markets

While most government reports and press accounts focus only on the growth in the number of markets, further analysis of the annual market listings provides the opportunity to gain a more detailed understanding of the changes in this sector. Table 2 provides annual information on new markets and closed markets from the base year of 1998 until 2005. As an example, Table 1 indicates that the number of markets in Oregon grew from 38 in 1998 to 43 in 1999. Table 2 more precisely documents that between the end of the 1998 season and the beginning of the 1999 season, 11 new markets opened and 6 existing markets closed. Over the entire 1998-2005 period, 62 markets opened and 32 closed for a net gain of 30. These are startling numbers, even for those familiar with the sector. The number of new markets for this period is much higher than is generally recognized and averages nearly 9 markets per year or 14% of the total markets open. This is significant because new markets request much more assistance than established markets and therefore the workload for education providers varies more as a function of the number of new markets rather than as a function of the net increase in markets.

The number of markets that closed during this period of substantial growth in markets is equally surprising. These 32 failed markets highlight the fragility and risk associated with operating a farmers' market and is a part of the story rarely mentioned in the glowing articles on the development of this sector. The overwhelming majority of markets that closed had short life spans as 15 markets (nearly 47%) did so following their first season and 24 of the 32 failed markets (75%) closed during the first three years of operation. Examination of the 16 markets that opened in 2001 reveals that eight or 50% failed within the first four years. Both sets of data demonstrate that failure rates for new markets are broadly similar to failure rates for small businesses. Most markets that close are small. They close for a combination of four reasons: (1) an inability to attract sufficient vendors (supply), (2) an inability to attract sufficient consumers (demand), (3) low administrative revenue, and (4) insufficient management often provided by a poorly paid or volunteer manager. (Stephenson 2006; Stephenson et al. 2006) Although failed markets are an unpleasant experience for their organizers, vendors, and customers, the "churning" within the overall market sector that these data portray, the opening of new markets at the same time that others are closing, should be recognized as having positive aspects as well since poorly performing markets are disappearing while potentially stronger ones are opening.

The last line in Table 2 parallels the results in Table 1 by revealing a high degree of year by year variation in the numbers of both new and closed markets. On average, almost nine markets per year opened, but in 2001 sixteen markets opened while in 2004 only four markets opened. There were no significant federal or state level policy initiatives that were driving these year by year differences; they resulted from independent decisions by the diverse types of groups that chose to open farmers' markets. Neighborhood associations, local governments, groups of vendors, and business associations are the primary market organizers. There was less variation for closed markets as the average was 4.6 and the yearly numbers were all between two and six. The regional data further highlight the season-by-season variation as, for example, new markets that opened in Portland Metro in a given year ranged from one to seven during this period. Figure 1 provides a graphic portrayal of the data from these first two tables.

Table 2. New (N) and closed (C) markets, by region and by year.

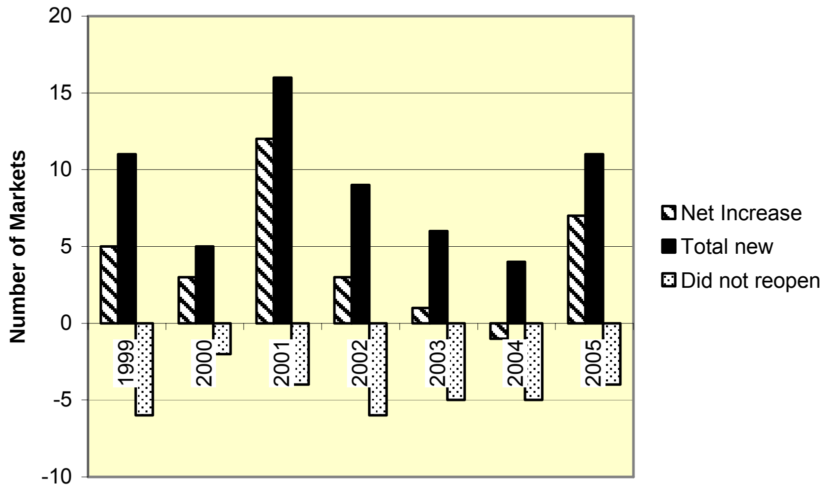
	1998	**1999**		**2000**		**2001**		**2002**		**2003**		**2004**		**2005**	
	***n*=**	**N**	**C**	**N**	**C**	**N**	**C**	**N**	**C**	**N**	**C**	**N**	**C**	**N**	**C**
Portland Metro	13	7	2	1	2	4	1	1	2	4	1	2	1	3	-
Willamette Valley	10	3	1	1	-	5	1	4	1	2	3	-	1	3	3
Southern Oregon	8	1	3	1	-	2	1	1	-	-	1	1	2	-	1
Eastern Oregon	1	-	-	-	-	1	-	3	-	-	-	1	1	-	-
Oregon Coast	4	-	-	2	-	4	1	-	2	-	-	-	-	2	-
Central Oregon	1	-	-	-	-	-	-	-	-	-	-	-	-	2	-
Columbia Gorge	1	-	-	-	-	-	-	-	-	-	-	-	-	1	-
Annual total	38	11	6	5	2	16	4	9	6	6	5	4	5	11	4

New Managers

Table 3 documents the number of markets that began a season with a different manager from the one who finished the prior season. For the seven-year period, 101 existing markets changed manager from one year to the next. This represents an annual average of 14 markets or 25% of markets. As in Table 2, both the annual totals and the regional data show substantial year-by-year variation. With very few exceptions, these new managers had not previously managed a farmers' market.

Since, by definition, all new markets open with a new manager, the 62 new markets can be added to arrive at a grand total of 163 new managers for this period. Once again with rare exceptions, the new markets were managed by individuals without prior market management experience. On a percentage basis, 59% of Oregon markets opened with the manager from the previous year and 41% were either new markets or existing markets with new managers. Table 4 summarizes manager status data on an annual basis.

Figure 1. Tracking year by year changes in Oregon farmers' markets.



From an educational standpoint, one key implication in Oregon has been a consistently high level of demand for the most basic level of market management training and mentoring. These training services have been provided by the Extension Service and the statewide farmers' market organization through annual conferences, print and web publications, a dedicated list serve, and one on one meetings.

Table 3. Existing markets that reopened under a new manager.

	1999	2000	2001	2002	2003	2004	2005
Portland Metro	4	5	4	6	2	8	4
Willamette Valley	2	2	3	6	6	5	1
Southern Oregon	4	0	1	1	2	4	3
Eastern Oregon	0	1	1	1	2	1	2
Oregon Coast	2	2	3	2	2	1	1
Central Oregon	1	1	0	1	0	0	0
Columbia Gorge	1	0	1	0	1	0	1
Annual totals	14	11	13	17	15	19	12

Table 4: Summary of manager status by year.

	1999	2000	2001	2002	2003	2004	2005	Total	Percent
New Markets	11	5	16	9	6	4	11	62	16%
Existing market, New manager	14	11	13	17	15	19	12	101	25%
Existing market, Returning manager	18		29	35	41	38	45	236	59%
Annual totals	43	46	58	61	62	61	68	399	

<u>Location Change</u>

Table 5 shows, by year, the number of markets operating on a new site. Over the seven year period, there were 46 changes in location or an average of just over 6.5 changes per year.

These figures do not include new markets, which also must learn to operate in new sites. Few markets change their site by choice. In almost all instances they have been forced to look for a new site because the former site was no longer available. Location changes add to a management burden that already includes the need to enforce market rules and diverse governmental regulations, to manage the selection of vendors and products, to attract customers and community support, and to meet environmental challenges such as weather, paucity of site amenities and parking space (Stephenson 2006).

Table 5. Number of markets changing locations.

	1999	2000	2001	2002	2003	2004	2005
Portland Metro	0	3	3	4	3	5	1
Willamette Valley	2	1	2	2	2	2	1
Southern Oregon	0	3	1	0	2	1	0
Eastern Oregon	0	0	0	0	1	2	0
Oregon Coast	0	1	1	0	0	1	0
Central Oregon	0	0	0	0	0	0	0
Columbia Gorge	1	0	0	0	0	1	0
Annual totals	3	8	7	6	8	12	2

Summary

Although it has been widely reported that farmers' markets have grown in recent years, few observers have recognized what lies behind the commonly cited numbers. While Oregon saw an increase from 38 markets to 68 markets during the period 1998-2005, the even more dramatic figures from this period are that 62 new markets opened and 32 markets closed. Over this time period, the failure rate among Oregon markets was roughly similar to the failure rate among small businesses. During the same period, 101 existing markets re-opened the following season with a new manager. Adding in the 62 new markets means that 163 markets, or on average 23 per year, opened a season with a new manager. In addition, many markets each year must change their location.

These more complete numbers are important for several reasons. First, they provide dramatic evidence that even in a period of rapid expansion both existing markets and prospective market organizers must recognize that many markets do not succeed. Second, the educational challenges for working with new markets and new managers are much greater than has been previously recognized. For this period at least, there were twice as many new markets as has been assumed, even more new managers, and frequent location changes. The growth of farmers' markets is all the more remarkable given the magnitude and types of changes that individual markets cope with on an annual basis.

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Appendix

- In the *Oregon Farmers' Markets* brochure, the Sherwood Saturday Market was reclassified from the "Willamette Valley" region to the "Portland Metro" region beginning in 2003. Klamath Falls was moved from the "Southern Oregon" region to the "Eastern Oregon" region in 2004, and on to "Central Oregon" in 2005. In this report, each market remains in its original region, and changes in market dynamics are recorded according to markets' original regional designators.
- Although it is not listed in the 1999 brochure, the Beaverton Wednesday market operated that year and is counted as such in these calculations.
- The Eastbank Farmers' Market opened in 2003, but was too late to be listed in that year's brochure. Although it does not appear in the brochure until 2004, we have included it in the figures for 2003.
- Specialty or holiday markets with a separate listing in the brochure have not been treated as separate markets for the purposes of this report. All were closely associated with an established farmers' market.

Malt Barley Risk Management Strategies

Cole R. Gustafson, William W. Wilson and Bruce L. Dahl[1]

Introduction

Malt barley is an important crop to Northern Plains farmers. In regions like Bottineau County North Dakota, barley comprises over 28% of planted acreage (NASS). Prior to the mid-1990s almost all the crop was produced without contracts, marketed on a spot basis, and minimal use was made of crop insurance, excluding hail insurance. At present, a majority of the crop is both contracted before planting and insured with federally subsidized crop insurance.

Farmers who raise a crop under contract receive a price premium if quality specifications are met. Even though the crop is both contracted and insured, malt barley is still a risky crop. While other crops are of comparable risk (Federal Crop Insurance Corp. 2006), the source of risk differs in barley. Price risk is nil due to contracting, but there is substantial uncertainty as to whether crop quality specifications will be met (i.e., acceptance risk). In addition to the vagaries of weather and disease that impact production yields, climatic risks also affect quality parameters such protein, plump, sprout, and deoxynivaleno (DON). In 2005, less than 20% of malt barley raised under contract in eastern North Dakota met quality specifications. When their malt barley crop is rejected, farmers rely heavily on federal crop insurance indemnity payments to meet cash flow needs.

Unfortunately, several provisions of malt barley crop insurance result in “coverage gaps” and limit its attractiveness as a risk management tool. First, the program is among the most complex as it contains two specialized malt quality endorsements, in addition to base multi-peril (APH) program coverage and price election options. Few producers (and even crop insurance agents) are aware of these endorsements, the requirements imposed, and enhanced coverage levels provided, in part due to the complexity involved. Second, quality provisions in the policy often do not align with malt buyer contract specifications, resulting in coverage gaps. Moreover, contract specifications vary by malt buyer. Thus, farmers may have their crop rejected, but are ineligible for a crop insurance indemnity payment.

This paper summarizes a grower education program that was recently delivered to 2,000 Northern Plain’s growers in ID, MT, ND, and WY to assist them in formulating their risk management strategy for raising malt barley in 2006. Data and discussion from dryland North Dakota sessions are used as examples for the remainder of this article. The program began with an overview of existing U.S. Department of Agriculture (USDA) Risk Management Agency (RMA) malt barley crop insurance provisions to educate growers of coverage options. Shortcomings in the program were then reviewed along with RMA proposals being proposed to correct current deficiencies. Grower reaction to these proposals was obtained. Finally, results of a Monte-Carlo simulation model were presented to delineate the additional risk management coverage afforded through increased participation in available crop insurance and contracting programs. Multi-peril crop insurance was found to lessen downside risk of negative net returns

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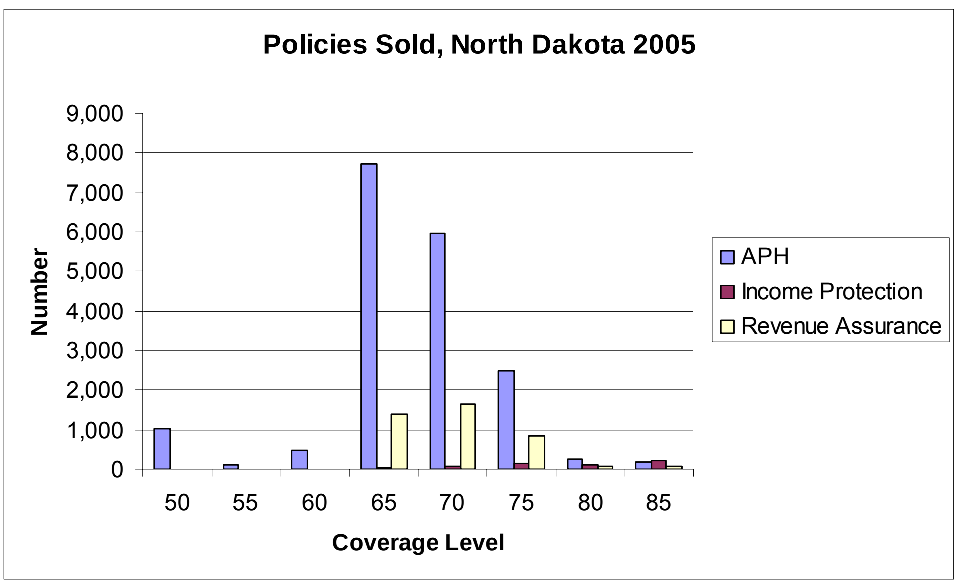
at the expense of lower expected revenue while the addition of contract and malt option endorsement B are both preferred strategies as returns over variable cost increase and downside risk is reduced.

North Dakota Malt Barley Crop Insurance

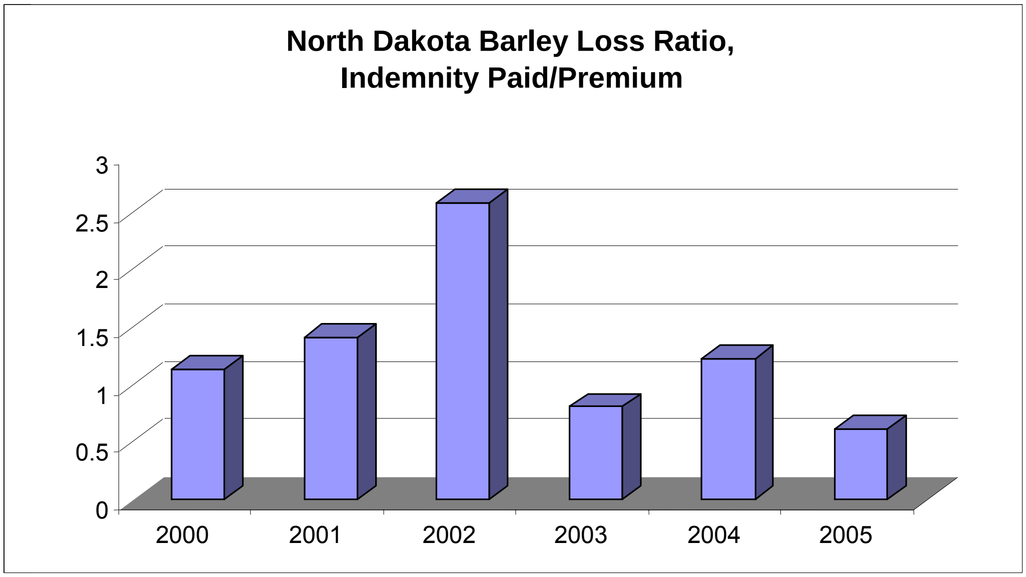
North Dakota barley farmers actively participate in USDA RMA federal crop insurance programs. In 2005, 7,800 APH multi-peril policies with coverage at the 65% level were sold (Figure 1). Nearly all of these selected the highest price election level of $2.35/bushel. Almost as many producers (6,000) selected the higher level APH multi-peril policy with 70% coverage. Participation in the highest levels of APH multi-peril (75%, 80% and 85% coverage), as well as the Income Protection and Revenue Assurance programs, was far less. The rising cost of insurance combined with declining federal subsidy levels make higher coverage levels prohibitively expensive for most North Dakota farmers. About 1,000 growers participated in the basic catastrophic (CAT) level program, primarily because they received a disaster payment in the past and were required to participate in order to be eligible for 2005 federal government payments. Recent adverse weather in North Dakota has resulted in barley growers collecting more indemnity payments than the premium paid, in the past four of six years (Figure 2).

Figure 1. North Dakota malt barley crop insurance participation, 2005.



Two unique endorsements are available to malt barley growers, malt option A and B. Malt option A is for growers who do not have a contract when purchasing their crop insurance. They are either producing for the open market or intend to contract later. In order to purchase malt option A, a grower must have production records documenting that they have successfully raised malt barley in four previous years. These years do not have to be consecutive due to rotational requirements. If purchased, malt option A provides an additional $0.70/bushel. payment if a grower's barley crop is rejected for malt. Growers electing malt option A pay an additional 40% premium surcharge.

Figure 2. North Dakota barley loss experience.



Barley growers with a malt contract can participate in malt option B. This option is particularly attractive to new growers as they are not required to have a history of malt production or acceptance. The value of this option is the difference between their contract price and RMA's price election for feed barley. In 2006, RMA is going to lower the price election for barley from $2.35 to $1.85, which increases the value of the malt option since malt barley contract premiums being offered for 2006 are similar to the 2005 price of $2.80/bushel. The surcharge for malt option B is also 40%.

Example of Malt Option B

	Production Guarantee[1] (a)	Actual Production (b)	Loss (a) – (b)	Value	Payment
Feed Barley	3,000	2,000	1,000	$1.85	$1,850
Malt Barley	3,000	0	3,000	$0.95	$2,850
Total					$4,700

[1]Production (4,615) x .65 yield guarantee = 3,000 bu.

To illustrate malt option B, assume a farmer has some combination of yield and acreage that produces 4,615 bushels/year. If he selected a 65% yield guarantee, he has 3,000 bushels guaranteed at $2.80, the contract price. Assume he has a bad year in 2005 and only harvests 2,000 bushels. Further, assume that due to quality problems, none of his barley makes malting quality (e.g., all of it is rejected). His insured yield loss is then 1,000 bushels for which he would get a payment of $1,850 in 2006. In addition, because he has malt option B, he gets another payment of $2,850 because his crop didn't make malting (3000 x .95):

In 2005, few barley farmers purchased either malt option A (7) or option B (914). Farmers remarked that their crop insurance agent was not aware of these specialized endorsements. Also, both options are on an enterprise basis which implies that all barley acreage within a county is considered as one parcel. This limits the options' attractiveness to producers as they are not able to claim losses on individual parcels of land (units) when average production exceeds guarantee levels on other units, within a county.

Limitations of Current Barley Crop Insurance

Growers participating in the program expressed several concerns about RMA's existing malt barley crop insurance program. Many regions of the Northern Plains have experienced adverse weather in recent years. As a consequence, their yield histories have declined which results in reduced coverage in future years. Growers also expressed concern about rising energy and fertilizer prices. Without an increase in either malt barley contract prices or RMA's price election, a lower proportion of their cash costs will be protected.

Growers attending were most critical of "coverage gaps" in the malt options, especially protein and DON. Quality provisions of option A and B often do not align with malt buyer contract specifications, which results in coverage gaps. Thus, farmers may have their crop rejected, but be ineligible for an indemnity payment. For example, malt buyers reject a grower's crop if protein exceeds 13.5%, but growers are unable to collect a crop insurance indemnity payment unless protein exceeds 14%. Likewise, the malt standard for DON is 0.5 parts per million (ppm) while the standard for crop insurance is 2.0 ppm.[2] Finally, malt buyers utilize a proprietary method of measuring sprout damage while RMA relies on Grain Inspection, Packers, and Stockyards Agency procedures.

Growers in western regions wondered why the malt options were not available on a unit basis in their area. Historically, acceptance levels have been high in their area. They feel that RMA's policy with respect to malt options should vary by county like other crop insurance provisions instead of being uniform statewide.

RMA Proposals for Program Improvement

RMA is proposing to change several key provisions of the malt barley crop insurance program (Federal Register, 7 CFR Part 457). These include:

1) Change the definition and procedure for measuring sprout losses from USDA's "damaged by sprout" to industry's "injured by sprout".
2) Lower the protein standard for two row barley from 14.0% to 13.5%.

[2] Technically, the contract specification is nil, but DON = 0.5 is interpreted as non-detectable.

3) Implement a "good producer discount" whereby growers with a favorable record of raising acceptable barley would be eligible for premium discount.
4) Increase incentives for conditioning barley to meet contract specifications

Growers attending the program complimented RMA for proposing these changes. However, they had several concerns and had hoped that RMA would have corrected more deficiencies. First, six row barley growers desired the same reduction of the protein standard proposed for two row barley. Growers had also hoped the DON gap would have been closed by lowering the existing standard of 2 ppm to the contract specification of 0.5 ppm.

Analysis

In addition to production and price risks faced by other farmers, malt barley farmers also face uncertainty about the value of the crop insurance program. The program provisions are complex and growers have difficulty accessing the tradeoffs between increased premium cost and risk protection being afforded. Moreover, levels of risk protection are somewhat uncertain as various coverage gaps exist.

To illustrate to growers the risk and return implications of their alternatives for 2006 malt barley production, a Monte-Carlo simulation model, developed in @Risk was used to delineate the additional risk management coverage afforded through increased participation in various crop insurance and contracting program options.

The simulation model was calibrated with enterprise variable cost and return data from local farm management recordkeeping systems, 10-year individual farm yield distributions estimated with RMA data, 30-year Winnipeg Grain Exchange price data, and American Malt Barley Association (AMBA) crop quality survey data. Distributions for the yield, price, and quality variables were determined using the distribution fitting algorithms in @Risk (Palisade Corporation 2004). The distributions selected were logistic for yields, discrete for acceptance and quality, and normal for price. Wilson, Gustafson and Dahl (In review) provide a detailed description of model development, methods, and data sources.

Crop insurance premium costs for each policy option were added to cash expenses. Indemnity payments were calculated and added to gross returns in iterations where either yields fell below guaranteed levels or the crop was rejected due to quality problems. As described earlier, coverage gaps did result in outcomes where farmers had a loss but were unable to collect an indemnity payment. One-thousand iterations were run for each policy option.

Results are summarized in Figure 3. Malt barley farmers face substantial financial risk when their crop is raised without crop insurance or contract. Expected returns over variable cost for a North Dakota dryland farmer that purchases the minimum level of catastrophic (CAT) crop insurance and does not have a malt barley contract averages $32.82 per acre as shown in the first panel of Figure 3. More importantly, there is a 10.6% chance of a loss (e.g., variable costs exceed total revenue) and a maximum loss potential of -$19.15 per acre.

Increasing crop insurance coverage to 65% multi-peril (APH) coverage lowers expected returns to $31.82 due to the higher net premium cost (premium less indemnity received), as shown in the second panel of Figure 3. However, downside risk is reduced as the probability of returns over variable cost being negative declines to 8.7% and the maximum loss potential is now only $11.58. Thus, crop insurance lessens downside risk at the expense of lower expected revenues. This tradeoff may appeal to risk averse farmers with either high debt or household cash flow needs.

The addition of a contract and malt option endorsement B are both stochastic dominant as returns over variable cost increase and downside risk is reduced as shown in the third and fourth panels of Figure 3. Having a malt contract and the Option B endorsement, in addition to 65% multi-peril coverage, increases average expected returns to $69.54 as shown in the fourth panel. Downside risk is mitigated and there is no longer any probability of a loss (defined above). Net returns over variable costs are always positive for the simulations. While price risk is mitigated due to having a contract, the impact of the crop not being accepted due to quality concerns increases due to crop quality specifications not being met.

Conclusion

RMA's malt barley crop insurance program is both complex and unique as it contains two specialized endorsements that provide farmers indemnity payments when their contracted crop is rejected due to low quality. The endorsements are not perfect though as provisions of the crop insurance policy do not align with contract specifications. Therefore, farmers face uncertainty in their risk management decision.

To help farmers more fully understand the nuances and merits of the malt barley crop insurance policy, an education program was developed and delivered to 2,000 growers in the Northern Plains region. A Monte-Carlo simulation model was developed to illustrate the risk management benefits of additional crop insurance coverage and contracting. Multi-peril crop insurance lowered expected returns, but reduced downside risk. Malt option B and contracting were stochastic dominant as returns increased and downside risk was reduced.

There are several important implications from this study. First, several gaps in the malt barley crop insurance program limit its attractiveness to growers. These gaps arise because policy provisions do not align with contract specifications. These fundamental problems in the malt barley crop insurance program limit the program's value as a safety net to producers. If contracting and greater quality specificity become more pervasive among other commodities in agriculture, federal crop insurance may not adequately fulfill the risk management needs of farmers. Similar crop quality and insurance issues have already arisen in potatoes and sunflowers (Nicholson 2006).

Second, coverage gaps in malt barley crop insurance exist in part because indemnity payments are triggered by quality losses in addition to production levels. As processors continue to place more emphasis on the quality of other agricultural commodities, additional quality endorsements may need to be developed.

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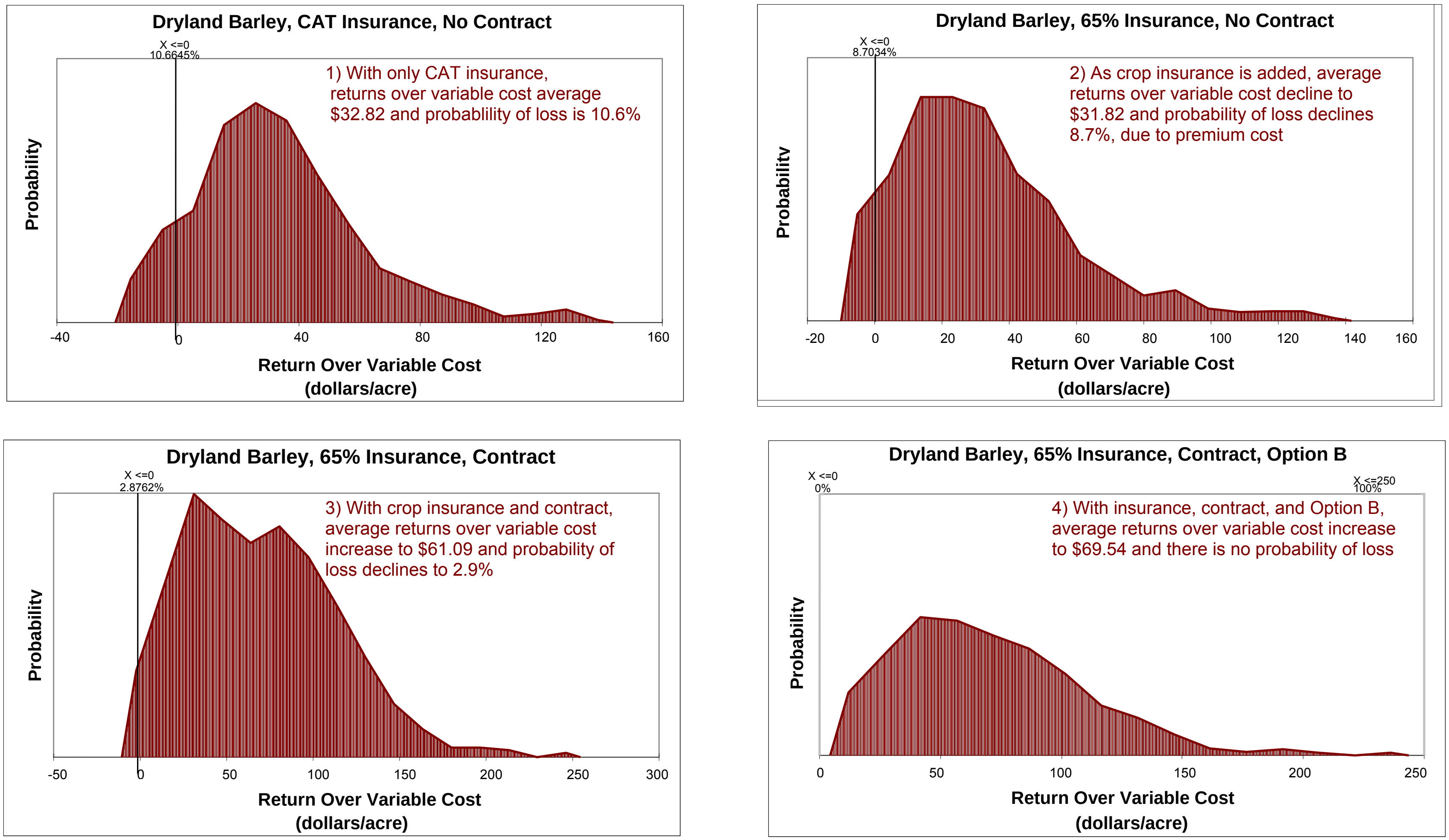
Figure 3. 2006 North Dakota dryland malt barley risk management, alternative crop insurance and contracting choices.



Hedging Irrigation Risk through Water Markets: Trends and Opportunities

Ereney Hadjigeorgalis[1]

Introduction

Risk and agriculture go hand in hand. As the uncertainties of agricultural production cause farm incomes to be substantially volatile, farmers will attempt to hedge or manage their risk through various instruments. Although there exist a number of risk management tools, most are geared towards managing non-irrigation-related production risks. These include yield and revenue insurance, futures and options, contracting sales and purchases, enterprise diversification, debt-level management, credit availability, and off-farm employment (USDA – RMA). Multiple peril crop insurance provides coverage in the event of drought losses, but it does not give farmers the necessary tools to prevent these losses in the first place. This paper describes how and why water markets may provide a workable mechanism to manage irrigation risk by allowing farmers to hedge, spread and share their individual risks through water rights transactions and temporary water rentals.

Documentation of the use of economic instruments to manage irrigation risk abound in the literature (Campos and Studart 2006; Keplinger et al. 1998; Lund and Reed 1995; Gomez, Tirado and Rey-Maquieira 2004; Iglesias, Garrido and Gomez-Ramos 2003; Booker, Michelsen and Ward 2005), but there has been relatively little discussion of the role of water markets as a means of managing the risk of variable water supplies that are implied by recurrent drought (Characklis et al. 2006; Calatrava and Garrido 2005a, 2005b; Beare, Bell and Fisher 1998; Howitt 1998). The inevitability and recurrence of drought, however, spurs the need to develop innovative approaches to irrigation risk management (Pirie, de Loe and Kreutzwiser 2004; Ross, Cancelliere and Guiliano 2005; Wilhite 1997). As we begin to see drought more as a manageable risk, and less as an unpredictable natural disaster (Higgins 2001), we can begin to explore water markets as a viable risk management tool at the individual user level.

Irrigation risk is defined here as the risk of receiving less than the full allocation of water in a growing season. While the irrigation risk may be the same for all farmers in a basin, depending on whether they operate under a priority or correlative system, the relative costs associated with that risk will differ widely among farmers. This is due to a number of factors, which include the debt position of the farmer, the crop mix and its sensitivity to variations in water supply. Some farmers may face higher relative risk costs because of large fixed costs that need to be covered during the growing season or substantial investments made in permanent plantations.

Farmers with higher relative drought costs would also be those that do not have other irrigation risk management options. Cummins and Thompson (2002) identify four main options for managing irrigation risk. Farmers can (1) attempt to more accurately predict shortfalls using available information, (2) improve on-farm water use efficiency, which will free up additional resources, (3) use alternative water sources such as groundwater and on-farm storage or (4) trade water. Our ability to accurately predict shortfalls is admittedly limited. For those farmers that are unable to improve their irrigation efficiency or who do not have access to alternative

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water supplies, water markets may provide an efficient vehicle for spreading, hedging or sharing irrigation risk.

In addition to differences in relative risk costs, some farmers are more risk averse than other farmers. Risk aversion is an intrinsic quality that is not a simple function of crop mix, debt position or other external factors. Some farmers are simply not willing to take on as much unprotected risk as others based on their personal preferences. When these farmers are faced with limited irrigation risk management options, they will seek out instruments in the water market to ensure that they have an adequate water supply.

How can farmers ensure that they have an adequate water supply, even in times of unexpected shortages, given that water is in fixed supply and cannot be produced? One approach is for the farmer to hold a reserve of water rights that go unused in years of normal or abundant water supply. Alternatively, he may be interested in markets that would provide him water on an as-needed basis. In order for these markets to work, however, there must be a parallel group of farmers who are willing to supply water in times of shortages or relinquish rights to water in the long term. These farmers would either face lower relative drought costs or be less risk averse. This is the basis for risk sharing.

Different types of water market arrangements could provide different risk sharing opportunities. Farmers would be attracted to these arrangements to the extent that they addressed their individual risk management needs. Some farmers will seek instruments that will grant them greater security and eliminate more uncertainty whereas others will be satisfied with instruments that reduce some, if not all, of their risk. This demand for differing degrees of risk management could be accommodated by various forms of market transfers.

Water Rights Purchases

At one end of the continuum is the purchase of additional permanent water rights. Supplementary water rights purchases allow a farmer to mitigate the risk of drought as if he were purchasing an insurance policy. The opportunity cost of those unused rights in normal to abundant water years can be viewed as the premium paid to avert catastrophic loss in drought years. However, whereas an insurance policy would compensate the farmer for his loss, the purchase of additional water rights helps the farmer avert the loss altogether

In a correlative system, holding supplementary water rights would guarantee the farmer a higher water supply in times of drought, since water allocations are based on the number of rights held. In a priority system, the purchase of senior rights would serve the same end. The higher a farmer's relative drought costs, or the more risk averse he is, the more water rights he would purchase. These rights would be a reserve that could be drawn on in times of low water supply, but would go unused in times of normal to abundant water supply.

While this approach has worked well for farmers in Chile and Australia where there is no expropriation based on non-use (Hadjigeorgalis and Lillywhite 2004; Hadjigeorgalis 2004, 2000; Chatterton and Chatterton 2001; Bjornlund and McKay 2002; Bjornlund 2003); it would be difficult to maintain in the current institutional framework of Western water rights, which are subject to use-it-or-lose it principles. While forfeiture principles may have been designed to ensure beneficial use of all water under the original institutional framework of water allocation, they may impede efficient risk sharing among farmers in the current water market environment.

Spot Water Purchases

Holding additional water rights that are only exercised in drought may not be the most efficient form of risk sharing afforded by water markets. Although maintaining reserves may work well for those farmers who face the greatest relative drought costs or who are extremely risk averse, there will be other farmers who will prefer instruments that do not necessitate the lost opportunity cost of unused water rights over time. These farmers may rely on spot markets to purchase water from other farmers during drought.

Relying on temporal purchases of water is a riskier approach to obtaining additional supplies than outright water rights purchases. By relying on this market, farmers would be exposing themselves to two additional risks that do not exist in the water rights market: price risk and availability risk. In one sense, while spot water may be available in a drought, its price is likely to be high and uncertain over time. A farmer may find that while water is available, it may not be available at a price that would make it more economical than a drought loss. Other farmers, who may be willing to pay a very high price for water, may find that there is not a sufficient supply or that they will need to purchase from several farmers, thus increasing their transactions costs.

Water Banks

Many states have avoided the inherent riskiness of spot water markets by establishing either temporary or permanent water banks. Two prominent examples are the permanent Idaho water bank and the California drought water bank. In Idaho, water is leased through several different water banks including a state water bank, three local rental pools, and the Shoshone-Bannock Tribal Water Supply. The California Drought Water Bank is an intermittent temporary water bank that only comes into operation in cases of drought. California first instituted a drought water bank in 1991, but by that time the drought had already lasted five years in the state. Subsequent drought water banks were established in 1992 and 1994.

Water banks are excellent risk sharing mechanisms. The water price is fixed and there is sufficient supply at these prices. In this sense, both price and availability risk are eliminated as well as the opportunity cost of holding water rights that will go unused in most years. Water banks that are permanent institutions, such as the Idaho water bank, are preferred to temporary institutions that are only instituted in case of drought, since whether and when a drought water bank will be established introduces another aspect of uncertainty into farmers' decision-making.

Water Derivatives

The next frontier for risk management in water markets would be the establishment of water derivatives such as futures and options. These derivative instruments could serve to reduce the risk inherent in pure spot markets for water while avoiding the need to invest in additional water rights that may go unused in most years. They also would allow for market-determined prices in contrast to the fixed prices afforded by water banks. While derivatives do not remove the risk that accompanies uncertain water supply, they can determine who takes on the speculation and who avoids it (Cummins and Thompson 2002).

A futures market in water would be a set of contracts that promised to deliver specified amounts of water at a future date at a pre-arranged price. This arrangement would obligate the buyer to purchase the water regardless of prevailing water supply conditions at the delivery date. The seller in this arrangement bears the brunt of the price risk in the event that water supplies become scarcer than anticipated at the time of the contract.

In an options market, on the other hand, a farmer could purchase an option to buy (call) a certain amount of water at a pre-arranged price. Unlike futures contracts, the buyer is not obligated to honor the contract. He could let the option expire by failing to exercise it by its delivery date, and the seller would retain the option premium paid. Options are attractive because they protect against insufficient water supplies, but do not require the buyer to purchase water should precipitation increase substantially over the contract period.

California experimented with these kinds of instruments in its 1995 water bank program. In anticipation of a potentially dry year in 1995, the Department of Water Resources (DWR) purchased water supply options from willing sellers for water bank members. In the case of insufficient water supplies, the DWR could exercise these options to meet water supply needs. In the end, DWR bought options on 29,000 acre-feet of water at $3.50 per acre-foot. The negotiated exercise price on these options varied between $36.50 and $41.50 per acre-foot. Abundant rainfall in 1995 negated the need to exercise the options, which expired in May 1995. The sellers retained the original option price paid, which totaled $101,500. DWR attempted to sell the options to a third party, but could not find sufficiently interested parties (Jercich 1997). Options markets such as these have immense potential to help producers manage the risks of cyclical droughts in the Western United States and in drought-prone regions of the world.

Contingent Water Markets

An alternative mechanism that functions similarly to options markets is a contingent or interruptible water market. Rather than a source of water supply for farmers during drought, this mechanism provides farmers with a market for water they wish to sell. Contingent water markets have been proposed as a means of securing water supplies during drought for urban centers, hydropower or environmental concerns (Michelsen 1988; Hamilton, Whittlesey and Halverson 1989; Huffaker, Whittlesey and Wandschneider 1993). Since the value of water in non-agricultural sectors tends to be higher, irrigators could be compensated for their agricultural production loss and associated transactions costs through various payment schemes.

Contingent water markets generally involve long-term leases. Over the lease period, farmers maintain control and use of their water during most years. When trigger conditions emerge, such as low in-stream flows or increased urban demand, farmers relinquish their water temporarily in exchange for just compensation. These markets may provide an income safety net for irrigators who have the flexibility to fallow their land or reduce their acreage significantly during drought. For farmers with less flexibility, such as those that grow permanent crops, other types of markets would be more advantageous.

Policy Challenges for Risk Management Through Water Markets

What are some of the challenges to using water markets as efficient mechanisms to hedge irrigation risk? In the Western United States, holding water rights as reserves is discouraged by the use-it-or-lose-it clause, which does not recognize the risk hedging value of holding additional water rights that are only exercised in times of drought. Under this current institutional structure, farmers risk the loss of their rights for a behavior that may be deemed economically efficient.

Other challenges to risk management through water markets are the immaturity of the markets themselves and institutional frameworks that place significant barriers on the further deepening of these markets. Spot water markets and water derivatives, in particular, demand a more developed framework where information is not costly and transactions can be regularly conducted.

Despite these challenges, water marketing may prove to be the best way to effectively manage irrigation risk in agriculture in the face of increasing uncertainty over future water supplies. As water becomes scarcer in coming years water markets are likely to rise to these challenges despite their criticism in many circles. As they do, researchers and applied economists will pay greater attention to all of the potential roles that these markets can fill – and most importantly how they can help farmers reduce their losses from cyclical water shortages.

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Transboundary Water Resource Management and Conflict Resolution: A Coasian Strategic Negotiations Approach

Justin Scott Baker and David Brian Willis[1]

Introduction

In September 2005 the United States and Mexico resolved a decade-old water allocation dispute. Under the Treaty of 1944, Mexico is required to annually release 350,000 acre-feet of water, the majority of which originates in Mexico's Rio Conchos Basin (RCB), to the U.S. Lower Rio Grande Valley (LRGV) by way of Rio Grande tributaries. Between 1992 and 2003, Mexico failed to fully comply with the annual treaty releases, amassing a cumulative water deficit of 1.5 million acre-feet (MAF) by 2003. After much negotiation, Mexico began repaying the cumulative deficit in late 2004 with complete repayment promised by September 2005. However, repayment schemes requiring water debts to be paid exclusively in water may not maximize the collective economic welfare of the countries involved. Alternative repayment schemes that allow the debt to be repaid over a longer repayment horizon and/or in a combination of dollars and water would have been mutually beneficial to both countries. This paper estimates the potential welfare gains to Mexico and the United States, if a Coasian-based repayment scheme that allowed Mexico to repay its cumulative deficit in dollars and/or water had been negotiated, relative to the negotiated settlement.

Conflict History and Theoretical Methods

Water originating in the RCB flows into the Rio Grande and is stored in one of two internationally managed reservoirs, the Falcon and the Amistad. Water in storage under U.S. control is then allocated to farmers in the LRGV for irrigation purposes. Texas State Agricultural Commissioner Susan Combs (Combs 2003) stated that farmers in the LRGV suffered economic damages in excess of $1 billion as a result of Mexico's deficit. Mexico's water deficit imposed significant economic damages on LRGV farmers because the deficit water would have generated value in agricultural production.

In his seminal article, "The Problem of Social Cost," Coase argues that in the case of externalities, bilateral negotiations can culminate in an economically efficient resource allocation, regardless of the initial property right assignment (Coase 1960). The Treaty of 1944 provides the necessary property right assignment for Coasian negotiations to commence. The treaty specifies the annual allocation of the internationally shared river between the two countries (Treaty 1944). The application of the Coase Theorem in this paper requires information regarding the net marginal benefit and marginal cost of deficit water supplies for the U.S. and Mexico. Mathematical programming models were developed to estimate the net marginal benefit (NMB_w), or shadow price of agricultural water use in the LRGV, and in the Delicias Irrigation District (DID) in the RCB, Mexico. The DID is the primary user of irrigated water supplies in the RCB accounting for 80% of all water use. The models used to estimate U.S. and Mexico agricultural benefits and costs were adapted from Robinson, Michelsen and Gollehon (2005) for the LRGV, and Puente-Gonzalez (2002) for the DID. To control for the impact that irrigation efficiency and transit losses have on the NMB_w of water released by

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Mexico for use in the LRGV, the NMB_w of released water was discounted by 48.8%. Only 51.2% of the water released by Mexico generates agricultural value in the LRGV due to transit and application losses (Brandes 1999).

To simulate Coasian bargaining, the mathematical programming models for each country were used to estimate the NMB_w at alternate supply levels by parametrically varying the water supply level downward in 10,000 acre-foot increments and recording the shadow price (NMB_w) at each level, beginning at the supply level where water supply was not a constraining resource. A complete discussion of the analytic approach is contained in Baker (2005). The appropriate paired NMB_w and water supply values were subsequently used in two regression equations to estimate the NMB_w function for each country as a function of water supply. As would be expected, the NMB_w is negatively related to water supply. The estimated NMB_w functions for the U.S. and Mexico, respectively, are:

$$\begin{aligned} NMB_{US} &= \underset{(305.96)}{1,387.69} - \underset{(-37.23)}{0.00091}(w_{US}) + \underset{(35.01)}{0.00113}(d * w_{US}) \\ &\quad - \underset{(-43.79)}{83.834}(\ln(d * w_{US})) - \underset{(-9.04)}{0.4365}(\sqrt{d * w_{US}}) \end{aligned} \tag{1}$$

$$NMB_M = \underset{(26.89)}{320.5757} - \underset{(-25.18)}{22.6263}(\ln(w_M)) \tag{2}$$

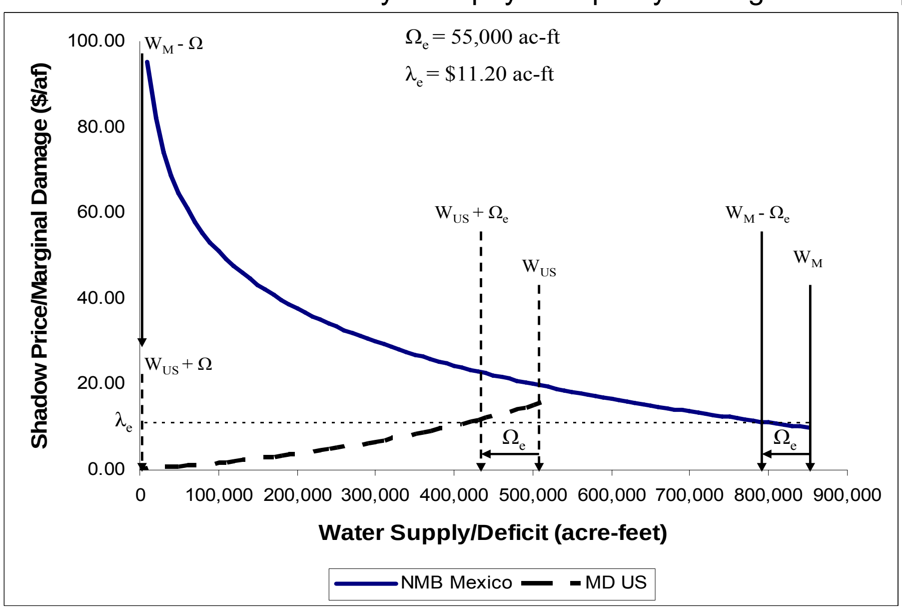
As reported by the t-value in parenthesis below each coefficient value, all estimated coefficients are significant at the .01 level, or higher, in both equations. The R-square statistic for the U.S. net marginal benefit equation is 0.999 and the R-square value for the Mexico net marginal benefit function is 0.858. A slope shifting indicator variable (d) was used in the estimation of the NMB_{US} function to control for the impact that high value citrus and melon crops grown in the LRGV have on the net marginal value of water. High profit citrus and melon crops are the last crops to go out of production as water supply becomes increasingly scarce. The NMB_{US} is approximately \$200 at 330,000 acre-feet of water, but jumps to \$1,165 per acre-foot when water supply is reduced to 320,000 acre-feet. The indicator variable was assigned a value of 1 when U.S. water supply (W_{US}) was greater than 320,000 ac-ft and a value of 0 otherwise. Because the NMB_w is a function of water supply, the value of compensation and the optimal quantity of the deficit repaid in water will vary depending on each country's initial water endowment and size of the water deficit. In a given year, the last unit of water repaid has the lowest net marginal value to the U.S., and the first unit repaid has the highest net marginal value. Conversely, the first unit of deficit repaid by Mexico imposes the lowest marginal cost on Mexico, and the last unit repaid comes at the highest marginal cost.

Graphical Analysis and Empirical Results

The estimated NMB_w functions, for each country, are used to derive the Coasian gains for three alternative water supply scenarios, and three repayment policy lengths. The water supply scenarios considered correspond to a below average, average, and an above average water supply condition in each country, where the supply levels were derived from historic water use records (Rakestraw 2005). Under the first repayment policy the entire 1.5 million ac-ft deficit is repaid in one year as per the current negotiated agreement, whereas the second repayment policy requires the deficit to be repaid over five years in equal installments of 300,000 ac-ft annually, and the third repayment policy has a ten year length, where 150,000 ac-ft is repaid each year.

The Coasian negotiations format is most easily represented and interpreted in graphical form. The NMB_w for Mexico and the MD_{US} curves are plotted in Figure 1 for a one-year contract under average water supply conditions. Here, the marginal damage (MD_{US}) function is simply the mirror image of the NMB_{US} , and estimates the net marginal damage inflicted on the U.S. for each additional unit of deficit water withheld by Mexico. Under average water supply conditions, 900,000 ac-ft of water is available for irrigation use in the LRGV in the absence of any deficit repayment by Mexico, and Mexico's DID has an initial irrigation water supply of 850,000 ac-ft which is designated as W_M in Figure 1. The MD_{US} curve only extends out to 510,000 ac-ft, W_{US} in Figure 1, because given average water supply conditions, the LRGV water supply is 900,000 ac-ft and a maximum of 1.41 MAF can profitably be used by irrigated agriculture in the LRGV in a given year with average weather conditions. Moreover, the MD_{US} curve is drawn under the assumption that the 900,000 ac-ft of water is efficiently used to irrigate the most profitable crops in the LRGV, and that any deficit repayment would be applied to crops generating lower profits per unit of applied water. Thus under average supply conditions, all Mexican deficit repayments in excess of 541,000 ac-ft will have an economic value of zero to LRGV irrigators if reservoir storage is not available. For purposes of simplicity, this illustration assumes no additional reservoir storage is available to store repayments greater then 541,000 ac-ft of water.

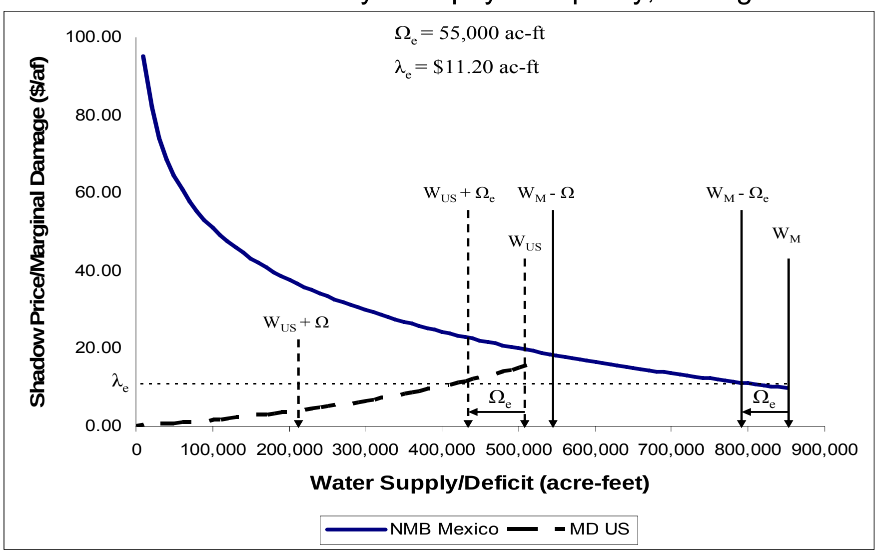
Figure 1. Coasian solution: One-year repayment policy average water supply.



In the absence of Coasian negotiations, the one-year repayment policy would require Mexico to divert the entire 850,000 ac-ft of the DID's water supply to satisfy the repayment obligation. This repayment scheme imposes a heavy compensation cost on Mexico's DID, and much of the water released by Mexico would exceed the LRGV maximum water use level and provide no economic value to agriculture. Under the Coasian solution, Mexico would repay only 55,000 ac-ft of the deficit in water. At this water repayment level, the NMB_w for agricultural production is equal in both countries at a value of $11.20 per acre-foot. If Mexico repaid 55,000 ac-ft of the deficit in water, Ω_e in Figure 1, Mexico's remaining water supply is 795,000 ac-ft and the effective deficit level in the LRGV is decreased from 510,000 to 455,000 ac-ft Repaying more than Ω_e of the deficit in water imposes a greater marginal cost on Mexico than the net marginal economic benefit received by the U.S. If each acre-foot of the residual deficit, Ω-Ω_e, (1,500,000 – 55,000) was repaid at the equilibrium shadow price value, λ_e, in a lump sum payment equal to λ_e *[Ω-Ω_e], Mexico's cost of compensation is less than it would be if Mexico had exclusively repaid the deficit in water, and the net economic benefit of compensation to the U.S. is greater than if compensation had been exclusively repaid in water.

Figure 2 illustrates the Coasian solution for the five-year deficit repayment policy assuming average water supply conditions in each country. Again, the relevant portion of the MD_{US} curve extends to 510,000 acre-feet, and Mexico's NMB_M curve once more has a length of 850,000 ac-ft What differentiates the five-year deficit repayment policy from the one-year policy is that the five-year policy requires Mexico to annually repay 300,000 ac-ft of the accumulated 1.5 million ac-ft deficit over five years ($\Omega = 300{,}000$), instead of repaying the full deficit in one year. As before, the relevant portion of the MD_{US} and NMB_M curves are $w_{US} + \Omega$ and $w_M - \Omega$.

Figure 2. Coasian solution: Five-year repayment policy, average water supply.



Assuming average water supply conditions in each contract year, only 55,000 ac-ft of the contracted deficit repayment is annually repaid in water in each contract year, and the remaining annual deficit (245,000 ac-ft) is repaid at a rate equal to the equilibrium shadow price (λ_e = \$11.20). Over the five-year contract, 275,000 ac-ft of the deficit is repaid in water. The numerical (dollar) welfare gains to the U.S. and Mexico, respectively, derived from the Coasian negotiations format are represented by Equations 3 and 4:

$$\text{U.S. Net Gains} = \lambda_e * \{\Omega - \Omega_e) - \int_{w_{US}+\Omega_e}^{w_{US}+\Omega} [1{,}387.69 - .00091(w_{US}) + .00113(d * w_{US}) - 83.8338(\ln(d * w_{US})) - .4365(\sqrt{d * w_{US}})]dw_{US} \qquad (3)$$

$$\text{Mexico Net Gains} = -\int_{w_M - \Omega_e}^{w_M - \Omega} \left[320.5757 - 22.6263 * (\ln(w_M))\right] dw_M \; - \lambda_e * (\Omega - \Omega_e) \qquad (4)$$

Where:

λ_e = shadow price of water at the intersection of the MD_{US} and NMB_M curves;

Ω_e = optimal quantity of the deficit repaid in water, found as the intersection point of the MD_{US} and NMB_M curves; and

Ω = total water deficit or annual contracted water repayment value.

Results and Policy Implications

Table 1 displays the increased benefits to the U.S., and the decreased costs of compensation to Mexico under the Coasian format for all repayment horizons and initial water supply levels. Also contained in the table are the dollar and water compensation values for each negotiated outcome. The empirical results reveal that the optimal deficit quantity repaid in water and the net marginal value of the last unit repaid vary with the initial water supply level in each country. The equilibrium shadow price of water, λ_e, is $32.25 per ac-ft for the low water supply scenario, $11.20 per ac-ft for the average water supply scenario, and $3.27 per ac-ft for the high water supply scenario. The greater the initial water supply in each country, the lower the marginal cost of water repayment.

By considering the net marginal value of water in each geographic region, and incorporating the expected delivery loss of water into the analysis, the U.S. and Mexico could have reached a more efficient agreement by agreeing to repay the debt over multiple years and using the Coasian strategic negotiation format. When the repayment time horizon was extended beyond one year, and payment was made exclusively in water, the U.S. value of compensation increased and Mexico's cost of compensation decreased relative to the case where the entire deficit was repaid in water in one year as per the current negotiated settlement. Moreover, for a given repayment contract length, additional net benefits accrue to both the U.S. and Mexico when the two countries use Coasian negotiations that allowed repayment to be made in dollars and water instead of exclusively in water. For example, by allowing repayment in dollars, Mexico is able to reduce compensation costs by up to 45% depending on the initial water supply scenario, and the value of compensation to the U.S. is increased by as much as 223% relative to the situation where compensation was paid exclusively in water over the five year repayment schedule.

As the allocation and efficient use of internationally shared fresh water supplies continues to become a conflictual issue, the Coasian negotiations format can alleviate tension in resolving allocation disputes by increasing the economic welfare associated with compensatory agreements. This research indicates that the agreed-upon repayment scheme between the U.S. and Mexican federal governments may not have served the best economic interests of either country. With the current property rights system established by the Treaty of 1944, the U.S. and Mexico have an opportunity to allocate water in an efficient manner which considers the highest and best use of the Rio Grande. In the future, should a similar allocation dispute arise, the bargaining framework can be applied to address potential conflict resolution. This framework is not singular to the U.S./Mexico conflict, however. There are more than 200 international river basins in the world, many of which have comprehensive agreements establishing property rights that define the allocation of shared water supplies within the basins (Wolf 1997). Once well-defined property rights exist for an internationally shared and managed body of water, the Coasian negotiations framework can be applied to resolve allocation disputes which may arise. The Coasian negotiations framework can serve as a useful tool not only in conflict resolution, but in the overall efficient management of water resources. In arid regions where fresh-water supplies are dwindling, Coasian bargaining can facilitate allocating water to its greatest net marginal economic benefit.

Table 1. Coasian gains to the U.S. and Mexico under alternative repayment time horizons and water supply conditions relative to identical contracts that specify payment exclusively in water.

Contract Repayment Length and Water Supply Level	Total Non-Coasian Water Repayment (acre-feet)	Total Coasian Water Repayment (acre-feet)	Coasian Dollar Repayment Mexico to U.S. $(\lambda_e * (\Omega - \Omega_e))$ ($'s)[1]	Coasian Net Gain to Mexico ($'s)[1]	Coasian Net Gain to U.S. ($'s)[1]
One-Year Low Supply	1,500,000	34,000	48,429,276 (48,429,276)	$25,422,911 ($25,422,911)	$38,733,727 ($38,733,727)
Five-Year Low Supply	1,500,000 (300,000 per year)	170,000 (34,000 per year)	8,578,500 (38,325,253)	$5,116,595 ($22,858,865)	$2,700,908 ($12,066,560)
Ten-Year Low Supply	1,500,000 (150,000 per year)	340,000 (34,000 per year)	3,741,000 (25,040,580)	$578,676 ($3,873,896)	$577,818 ($3,834,188)
One-Year Average Supply	1,500,000	55,000	16,184,000 (16,184,000)	$26,949,071 ($26,949,071)	$14,202,904 ($14,202,904)
Five-Year Average Supply	1,500,000 (300,000 per year)	275,000 (55,000 per year)	2,744,000 (12,259,077)	$813,950 ($3,636,396)	$1,068,590 ($4,774,023)
Ten-Year Average Supply	1,500,000 (150,000 per year)	550,000 (55,000 per year)	1,064,000 (7,121,940)	$113,458 ($759,434)	$178,742 ($798,550)
One-Year High Supply	1,500,000	0	4,905,000 (4,905,000)	$28,860,304 ($28,860,304)	$4,601,316 ($4,601,316)
Five-Year High Supply	1,500,000 (300,000 per year)	0	981,000 (4,382,709)	$799,533 ($3,540,715)	$677,316 ($3,025,973)
Ten-Year High Supply	1,500,000 (150,000 per year)	0	490,500 (3,283,188)	$189,499 ($1,268,422)	$208,440 ($2,023,058)

Note: The equilibrium shadow price of water, λ_e, is $32.25 ac-ft for the low water supply scenario, $11.20 ac-ft for the average water supply scenario, and $3.27 for the high water supply scenario.
[1] The first value reported represents the value of compensation cost/benefit in the first year of repayment and the parenthetical values represent the NPV of compensation over the entire contract length using a 3% discount rate.

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University-Retail Industry Research Partnerships as a Means to Analyze Consumer Response: The Case of Mad Cow Disease

Steven S. Vickner, DeeVon Bailey and Al Dustin[1]

Introduction

Quality data are vital to any empirical inquiry into market behavior. Often the econometrician is unable to investigate natural occurring experiments in real-world markets given limited access to data and must resort to experimental or contingent markets for hypothesis testing and statistical inference. Actual market transactions are preferred as they capture what consumers did, not what they might claim to do in a contrived, sterile setting. Establishing an ongoing partnership with food retailers is a means to work with actual market transactions for a variety of research initiatives. In this paper, we cooperated with Salt Lake City-based Associated Food Stores, Inc. to explore the impact of three separate information shocks related to bovine spongiform encephalopathy (BSE), or Mad Cow Disease, on retail meat consumption.

Markets and Mad Cow Disease

The noun 'market' is so familiar to the economist's vocabulary that it is often ambiguously used in expressions like 'market impact' or 'market response'. But with an issue as headline-worthy and far-reaching as BSE, determining exactly what market is impacted and to what extent requires some careful thought and consideration. Several recent publications (Mathews et al. 2006; Blayney et al. 2006) overview and chronicle the events associated with BSE on import markets, export markets and trade flows. Other markets, such as futures, equities, food away-from-home, institutional and food at-home have different buyers and sellers, and hence one might expect different market outcomes. We analyze the food at-home or grocery store market.

On a Tuesday afternoon, December 23, 2003, the U.S. Secretary of Agriculture, Ann M. Veneman and her advisors met with the media in a historic press conference to discuss the test results of a nonambulatory Holstein cow (USDA Transcript 0433.03). At that time it was thought the cow came from a farm in the state of Washington, but was later traced back to a farm in Canada. The cow tested presumptive positive for BSE using immuno-histo-chemistry. The USDA quarantined the farm in Washington and began to investigate the meat packer, Midway Meats, also located in Washington. Despite federal officials emphasizing the safety of the domestic meat supply, the media frenzy began. News broadcasts, talk shows and newspaper headlines covered the topic exhaustively over the ensuing weeks.

Six months later, Dr. John Clifford, the Deputy Administrator for the USDA's Animal Plant Health Inspection Service (APHIS) held a similar press conference on the evening of June 25, 2004 (USDA Transcript 0263.04). He announced that an inconclusive BSE test result was obtained and re-emphasized the safety and quality assurance of the domestic beef supply. Four days

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later, on the evening of June 29, 2004, Dr. Clifford announced another inconclusive BSE test result (USDA Transcript 0266.04). Again the public was assured that the animal did not enter the food supply. On the morning of November 18, 2004, the Associate Deputy Director of the USDA-APHIS, Andrea Morgan, announced yet another inconclusive BSE test result (USDA Transcript 0501.04). Compared to the December 23, 2003 press conference, the media coverage of the three inconclusive BSE test results was virtually nonexistent. That was not surprising as nearly a year had passed and federal officials underscored the safety of the beef supply in that time. Inconclusive BSE test results do not sell newspapers.

Empirical Model and Estimation

The principal empirical objective of this project is to determine how BSE information affects the demand for fresh meats while controlling for their retail prices, real per capita meat expenditure and seasonality in the grocery store distribution channel. Using detailed, representative point-of-purchase scanner data supplied by Salt Lake City-based Associated Food Stores, Inc. we estimate this consumer demand system. The data spanned the weeks beginning May 9, 2004 to May 1, 2005 for twenty of the stores they own. The twenty stores were spatially dispersed throughout their Utah selling region and well-represent the major population centers in the state (i.e., Logan, Ogden, Layton, Salt Lake City, Orem, Provo and Saint George). The data were then aggregated across store into a time series data set resulting in T = 52 weekly observations. Finally, the individual meat items were aggregated to investigate the retail demand for only fresh beef, pork, chicken and seafood. Within this time frame, the three separate USDA-APHIS inconclusive tests were announced on June 25, 2004, June 29, 2004 and November 18, 2004. The media coverage of each event was the same and practically non-existent based on a detailed analysis of the word count frequency of BSE and related terms in the media. Actually, within two months of the December 23, 2003 event the media coverage was effectively over from a word count perspective. The information regarding those three 2004 announcements will be included in the model using dummy shift variables to assess if BSE news influences purchasing patterns for fresh meats.

We build a theoretically consistent empirical model of demand using an Almost Ideal Demand System (Deaton and Muelbauer 1980; Moschini 1995). It is theoretically consistent because we impose symmetry and homogeneity in the demand equations. There is a separate demand equation for beef, pork and chicken, and we control for the effect of relative prices and real per capita expenditure in each equation. Since expenditure shares sum to one, the parameter estimates in the seafood equation are recovered with the adding up restrictions. In each equation we also incorporate non-price and non-income information shift variables for both BSE and seasonality using a framework similar to that proposed by Teisl, Roe and Hicks (2002). These variables allow the demand curves to shift. For example, ceteris paribus, one might expect the demand curve for beef to shift inward or leftward during the week of one of the three USDA press conferences. Our model allows for that possibility. This test involves restricting parameters across all three equations in the nonlinear demand system so we must use a likelihood ratio test (Gallant 1987). The error terms across demand equations are likely contemporaneously correlated given the interrelated nature of the retail meats so estimation is performed using nonlinear seemingly unrelated regression using PROC MODEL in SAS. Autocorrelation correction in the demand system is given by the Berndt-Savin methodology. There are $MT - Ku = (3)(51) - 28 = 125$ degrees of freedom in the unrestricted model, since one time series observation was lost due to the Berndt-Savin methodology.

Results and Discussion

The conditional demand system is given in Table 1. It exhibits reasonable properties for the data set and application. Again the parameters in the seafood equation are not presented but may be recovered using the adding up restrictions in the demand system. The fact that only six price parameters are presented reflects symmetry is imposed on the model. Four of the six price parameters are statistically significant ($p<0.10$). It is noted that these parameters relate price and expenditure share, not quantity demanded, and, as such, may not be interpreted as elasticities. They are assembled with other demand parameters and expenditure shares to obtain price elasticities of demand (Moschini 1995). Two of the three parameters on real per capita meat expenditure are statistically significant ($p<0.05$), and all three intercepts are statistically significant as well ($p<0.05$).

As for the non-price and non-expenditure shift variables in the model, four of the six seasonality parameters are statistically significant ($p<0.10$) indicating expenditure shares exhibit seasonal patterns. However, all nine of the parameter estimates on the BSE shift variables are statistically insignificant ($p>0.10$). This finding is not surprising given the lack of media attention to the three inconclusive BSE tests during the study period. While parameter by parameter inspection of asymptotic *t*-tests is telling, a more thorough test of this hypothesis will involve a system-wide likelihood ratio test as discussed in the next section. The Durbin Watson statistics indicate the parsimonious version of the Berndt-Savin autocorrelation correction procedure (i.e., the same rho parameter in each equation) is successful in purging positive serial correlation from the model. Stability or robustness of the parameter estimates and significance of the parameter estimates are quite good for this model.

Table 1. Retail Meat Demand Model Parameter Estimates

	Beef	*Pork*	*Chicken*
Prices			
Beef	-0.0675**	-0.0128	0.0677**
	(0.0284)[1]	(0.0250)	(0.0299)
Pork		-0.1945***	0.0260
		(0.1042)	(0.0316)
Chicken			-0.1141**
			(0.0437)
Expenditure	-0.0854**	-0.0252	0.1068**
	(0.0386)	(0.0287)	(0.0452)
Intercept	0.3700*	0.1518**	0.5230*
	(0.0928)	(0.0645)	(0.1120)
Seasonality1	-0.0968**	0.1365*	-0.0400
	(0.0437)	(0.0299)	(0.0540)
Seasonality2	-0.1077**	0.0163	0.0943***
	(0.0441)	(0.0283)	(0.0544)
BSE1	-0.0003	0.0434	-0.0602
	(0.0455)	(0.0307)	(0.0560)
BSE2	0.0351	0.0093	-0.0289
	(0.0450)	(0.0292)	(0.0555)
BSE3	-0.0133	0.0034	0.0163
	(0.0437)	(0.0282)	(0.0539)
Autocorrelation	0.2503**	0.2503**	0.2503**
	(0.1002)	(0.1002)	(0.1002)
Durbin Watson	1.8435	2.3560	2.2230
Log Likelihood	53.7386		

[1] Standard error in parentheses. Note: *, ** and *** denote statistical significance at the 0.01, 0.05 and 0.10 levels respectively.

Given the model in Table 1, we remove the effects of the BSE announcements by removing those explanatory variables from the demand equations. The model in Table 1 is the unrestricted model whereas the second regression, without the BSE dummies, is the restricted model. Gallant (1987) outlines a procedure to compare the likelihood surface from the unrestricted nonlinear demand system to that of the restricted system. The test is called a likelihood ratio test and under the null hypothesis it is distributed asymptotically chi-square with nine degrees of freedom in this case (i.e., since nine parameters were removed in the restricted model). The likelihood ratio statistic is 4.4199 and the chi-square critical value is 14.6837 for a 10% level of alpha, so we fail to reject the null hypothesis of no BSE announcement effects. In fact, we find no statistical difference between the unrestricted and restricted models at the 1%, 5% and 10% levels of significance (only the 10% level is reported). This test is considered to be far superior to a simple inspection of the parameter by parameter asymptotic *t*-statistics, especially in small samples. Using any single-equation approach, it is not possible to comprehensively test the BSE announcement effects on the demand system overall. We can conclude for this data set and application, the BSE announcements collectively had no impact on consumer response.

Finally, the uncompensated or Marshallian own and cross price elasticities exhibit reasonable direction and magnitude with the only exception being the cross price effect of pork in the beef equation (i.e., indicating complementarity); own price elasticities are negative and all cross price elasticities but one are positive (Table 2). For example, a 1% increase in the price of beef leads to a 1.0305% decrease in the quantity demanded of beef. Similarly, a 1% increase in the price of chicken leads to a 0.1490% increase in the quantity demanded of beef. The Hicksian elasticities too are quite reasonable and similar too. The conditional expenditure elasticities each show the rates of segment growth as the fresh meat category expenditures rise; beef and pork rise proportionally slower, while chicken and seafood rise proportionally faster.

Table 2. Estimated Price and Expenditure Elasticities.

	Beef	*Pork*	*Chicken*	*Seafood*
Marshallian				
Beef	-1.0305	-0.0011	0.1490	0.0291
Pork	0.0130	-2.3402	0.2218	1.2820
Chicken	0.0244	0.0480	-1.6172	0.0670
Seafood	0.2039	3.5260	0.3829	-5.1846
Hicksian				
Beef	-0.5332	0.1205	0.3398	0.0729
Pork	0.4928	-2.2230	0.4059	1.3243
Chicken	0.8855	0.2585	-1.2868	0.1427
Seafood	0.8284	3.6787	0.6226	-5.1297
Expenditure	0.8535	0.8234	1.4778	1.0719

Conclusion

In 2004, the USDA made three press releases regarding inconclusive BSE test results. Based on the data collected by Associated Food Stores, Inc. we were able to isolate our attention on just one retail market, the grocery store distribution channel, which could have been affected by that information. For our data set, the results definitively show that there was no change to the retail demand for fresh meats and those results were not surprising. The media covered the presumptive positive test result from December 23, 2003 in great detail but did not address the inconclusive tests in 2004. Over the course of 2004, the USDA also took many steps to assure the quality and safety of the domestic beef cattle supply and make these efforts known to domestic consumers.

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