AJAE appendix for 'Consumer and Market Responses to Mad-Cow Disease'

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Note: The material contained herein is supplementary to the article named in the title and published in the American Journal of Agricultural Economics (AJAE).

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Data Appendix

Descriptive statistics of our data set are shown in Table A1. The location of the 298 supermarkets in our scanner data are displayed in Figure A1. The variables included in the scanner data set are:

Variable	Description
date	exact date (day, month, year)
store id	id that uniquely identifies a store
UPC	Universal Product Code - unique id for each product
qtyWeight	total quantity of a UPC that is sold in a store on a given day
netSales	total sales (dollar) of a UPC that is sold in a store on a given day

We had an additional meta data set for UPCs. The variable *subclass* groups together UPCs with closely comparable product characteristics, e.g., all "Beef Rib Steaks," or "Beef Rib Roasts." The next aggregation level is a meat *class* which groups similar meat types together, e.g., all "Beef Rib" (both steak and roast), or "Beef Loin." Finally, meat category lumps together *all* beef sales in a store.

There are UPC codes that are not sold on every single day and do not show up in our data for certain days. Our daily data covers the time span of 35 days prior to December 23 and 91 days past December for each of our four winters 2001/2002 through 2004/2005. We exclude the event day itself (day 0), as well as Christmas, when many stores are closed, to end up with 125 days for each of our 4 winters. The maximum number of observations in each meat category is given by 4 winters x 125 days per winter x 298 stores = 149,000 observations. Note that most stores sell at least some beef during each day, as the number of observations is 143,298 in column 5 of Table A1, which is rather close to 149,000. On 3.8 percent of all possible store-day combinations no beef products are sold. On the other hand, there are stores that don't sell any turkey products (a highly seasonal item) or lamb products (a specialty meat) on 12 and 17 percent of all possible store-day combinations, respectively.

Figure A2 displays the number of newspaper articles that include the word "mad cow" on any given day compared to the event dates. General newspaper coverage increased significantly following the discovery of the first infected cow (black lines), while it did not change much following the Oprah Winfrey show (gray lines).

Additional Results and Sensitivity Checks

Table A2 examines the sensitivity of our results to various aggregation levels. If products are sold infrequently, the fluctuation between zero and any positive number will induce tremendous fluctuations in log quantities (which incorporate relative changes). Therefore, we limit the sample to include only subclass, classes, or overall beef sales that are sold on average in no less than 30 days of our 35 day (5-week) period. The results are very robust to the chosen aggregation level.

Table A3 displays the sensitivity of the baseline results to various assumptions about the seasonality parameters $\beta_n, \beta_n^{WA}, \theta_{n,2003}$. If there was a sale spike/drop in one of the control periods (periods besides the event period 2003/2004) due to another event, the seasonality components might be biased. In such a case we might wrongfully attribute a reversion to mean consumption levels as an impact due to the discovery of the first infected cow in the event period.[1] In a first check, columns (1)-(3) of Table A3 use the same specification as column (1) in Table 1 except that each of the control periods is dropped from the analysis. Analogously, one of the control periods is dropped in columns (5)-(7) of Table A3, which replicates the specification of column (3) in Table 1. The estimated abnormal change in the purchased quantity in the first row remains rather robust. In a second check, columns (4) and (8) drop all periods but the event period (and the seasonality components β_n, β_n^{WA}, and λ_n can no longer be identified). The interaction with the dummy for Washington State becomes significant, suggesting that the seasonal components differ between our two regions, yet the estimated impact in the first row still remains negative and highly significant. These sensitivity checks make it unlikely that our results pick up a spurious reversion to mean consumption levels.

Table A4 includes an interaction of the socio-economic variables with a dummy for Washington State to measure the additional effect in Washington State. It reveals that the coefficient on income is only observed in Washington State, but not the DC metropolitan area, while all other coefficients are robust.

Figure A3 displays smoothed abnormal changes in log quantity sold for the meats besides beef. There is no clear discontinuity in purchases compared to the one we observe for beef in Figure 1 of the main paper.

Figure A4 replicates the graph of abnormal futures returns *without* accounting for movements in the commodity market index. The results are very close to the ones we obtain in Figure 2.

[1] We would like to thank one of the anonymous referees for pointing out this sensitivity check.

Table A1: Descriptive Statistics

Panel A: Scanner Data Set from Supermarket Chain							
	UPC	Subclass			Meat Total		
	Obs.	Obs.	Mean	Std.	Obs.	Mean	Std.
				Beef			
Log Quantity (lbs)	5,475,791	2,522,671	2.44	1.28	143,298	6.02	0.62
Log Price ($)	5,475,791	2,522,671	1.35	0.45	143,298	1.21	0.24
Log Sales ($)	5,475,791	2,522,671	3.79	1.22	143,298	7.23	0.57
				Pork			
Log Quantity (lbs)	2,782,412	1,563,633	2.05	1.23	143,281	4.98	0.78
Log Price ($)	2,782,412	1,563,633	1.11	0.46	143,281	1.00	0.28
Log Sales ($)	2,782,412	1,563,633	3.15	1.09	143,281	5.98	0.64
				Chicken			
Log Quantity (lbs)	2,582,363	1,189,132	2.85	1.42	143,290	5.68	0.74
Log Price ($)	2,582,363	1,189,132	0.79	0.60	143,290	0.66	0.29
Log Sales ($)	2,582,363	1,189,132	3.64	1.34	143,290	6.34	0.65
				Turkey			
Log Quantity (lbs)	608,093	377,334	2.07	1.48	131,204	3.15	1.61
Log Price ($)	608,093	377,334	0.84	0.50	131,204	0.79	0.40
Log Sales ($)	608,093	377,334	2.91	1.22	131,204	3.94	1.34
				Lamb			
Log Quantity (lbs)	391,435	292,985	0.99	0.95	123,120	1.83	1.06
Log Price ($)	391,435	292,985	1.59	0.52	123,120	1.49	0.37
Log Sales ($)	391,435	292,985	2.58	0.88	123,120	3.31	1.08

Panel B: Socio-economic Data For Zip-Code in Which Supermarket is Located					
	Obs.	Mean	Min	Max	Std.
Income ($10,000)	298	56.5	21.2	154.8	20.8
Black or Hispanic (%)	298	18.9	1.1	98.4	21.2

Panel C: Consumer Expenditure Survey					
	Obs.	Mean	Min	Max	Std.
Log Beef Sales ($)	9,562	2.01	-1.05	5.77	0.757
Log Pork Sales ($)	8,843	1.79	-1.20	5.64	0.755
Log Poultry Sales ($)	7,905	1.85	-2.04	5.01	0.648

Notes: Panel A displays descriptive statistics for the scanner data. The first column gives the number of observations in the data (observations are total UPC-levels sales in a store on a given day). The next three columns give the number of observations if we aggregate all UPCs with the same subclass. The last three columns aggregate all UPCs for each meat. Panel B displays socio-economic characteristics of the zip codes in which the stores are located. Panel C summarizes beef sales of respondents in the diary files of the Consumer Expenditure Survey during the time span that is covered by the scanner data.

Table A2: Sensitivity of Abnormal Changes in Log Beef Purchases to Various Aggregation Measures

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Period 1	-0.231	-0.200	-0.202	-0.202	-0.200	-0.158	-0.176	-0.176
	(21.37)**	(13.68)**	(24.74)**	(15.63)**	(5.20)**	(3.76)**	(3.49)**	(6.40)**
Period 1 x WA	0.043	-0.003	-0.012	-0.067	-0.032	-0.076	-0.066	-0.111
	(0.94)	(0.07)	(0.25)	(2.93)*	(0.61)	(1.33)	(0.98)	(3.07)**
Period 2					-0.236	-0.233	-0.223	-0.194
					(3.79)**	(3.78)**	(2.92)**	(5.11)**
Period 2 x WA					0.00185	0.0308	0.00928	0.0236
					(0.03)	(0.40)	(0.10)	(0.42)
Period 1 x Income					-0.0134	-0.0146	-0.0101	-0.0113
					(2.80)*	(2.89)**	(1.99)	(2.28)*
Period 2 x Income					-0.00313	-0.00659	0.00271	-0.00741
					(0.75)	(1.51)	(0.62)	(1.14)
Period 1 x Minority					-0.00168	-0.00189	-0.00159	-0.00101
					(6.96)**	(4.76)**	(4.03)**	(2.99)**
Period 2 x Minority					-0.00193	-0.00139	-0.00096	-0.00084
					(8.00)**	(3.39)**	(2.06)	(1.70)
Log Price	-1.91	-2.07	-1.07	-1.26	-2.16	-1.99	-1.19	-1.22
	(9.61)**	(21.43)**	(9.95)**	(9.07)**	(12.22)**	(22.09)**	(10.38)**	(6.15)**
Data Set	scanner	scanner	scanner	scanner	scanner	scanner	scanner	scanner
Min. Days	0	30	30	30	0	30	30	30
Aggregation	subclass	subclass	class	category	subclass	subclass	class	category
Observations	56077	27333	17995	2290	84598	41087	27055	3440
R-squared	0.973	0.984	0.987	0.992	0.945	0.977	0.978	0.988

Notes: Table displays changes in log meat purchases. Columns are ordered by increasing aggregation levels, i.e., an increasing number of UPCs are lumped into one observation. All columns use aggregation-class by winter by store fixed effects, as well as period fixed effects. Periods are five-week aggregates, i.e., period 1 is December 24 - January 27, while period 2 is January 28 - March 2. Income is the demeaned average income in the zip code the store is located (in 10,000 dollars). Minority is the demeaned percentage of the population that is either African-American or Hispanic. The row "minimum day" indicates on how many days out of the 35-day period a product has to be sold in a store to be included in the data set. T-values are given in brackets. One star indicates significance at the 5% level, while two stars indicate significance at the 1% level.

Table A3: Sensitivity of Abnormal Changes in Log Beef Purchases to Assumptions about Seasonality Estimates

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Period 1	-0.240	-0.217	-0.236	-0.194	-0.204	-0.194	-0.202	-0.162
	(19.62)**	(38.16)**	(14.27)**	(20.01)**	(3.51)**	(7.11)**	(6.68)**	(13.91)**
Period 1 x WA	-0.001	0.069	0.056	0.025	-0.073	0.005	-0.032	-0.052
	(0.02)	(1.62)	(0.77)	(67.82)**	(1.09)	(0.15)	(0.52)	(4.03)*
Period 2					-0.250	-0.168	-0.303	-0.127
					(2.63)*	(4.19)**	(5.05)**	(4.64)**
Period 2 x WA					-0.0189	-0.0315	0.0584	-0.101
					(0.19)	(0.75)	(0.93)	(8.07)**
Period 1 x Income					-0.0153	-0.0117	-0.0132	-0.0185
					(3.79)**	(2.07)	(2.21)*	(4.22)**
Period 2 x Income					-0.00170	-0.00078	-0.00694	-0.0149
					(0.41)	(0.18)	(1.55)	(4.75)**
Period 1 x Minority					-0.00181	-0.00151	-0.00176	-0.00197
					(6.65)**	(5.86)**	(5.66)**	(12.86)**
Period 2 x Minority					-0.00194	-0.00179	-0.00208	-0.00237
					(7.57)**	(6.73)**	(7.41)**	(10.24)**
Log Price	-2.08	-1.73	-1.92	-1.91	-2.30	-2.13	-2.14	-2.31
	(9.97)**	(13.39)**	(7.87)**	(6.07)**	(13.50)**	(9.07)**	(9.99)**	(5.27)**
Data Set	scanner	scanner	scanner	scanner	scanner	scanner	scanner	scanner
Min. Days	0	0	0	0	0	0	0	0
Aggregation	subclass	subclass	subclass	subclass	subclass	subclass	subclass	subclass
Periods Excl.	2001/2002	2002/2003	2004/2005		2001/2002	2002/2003	2004/2005	
Period Incl.				2003/2004				2003/2004
Observations	42622	42416	41374	14258	63824	64078	62753	21459
R-squared	0.974	0.973	0.972	0.971	0.949	0.944	0.945	0.949

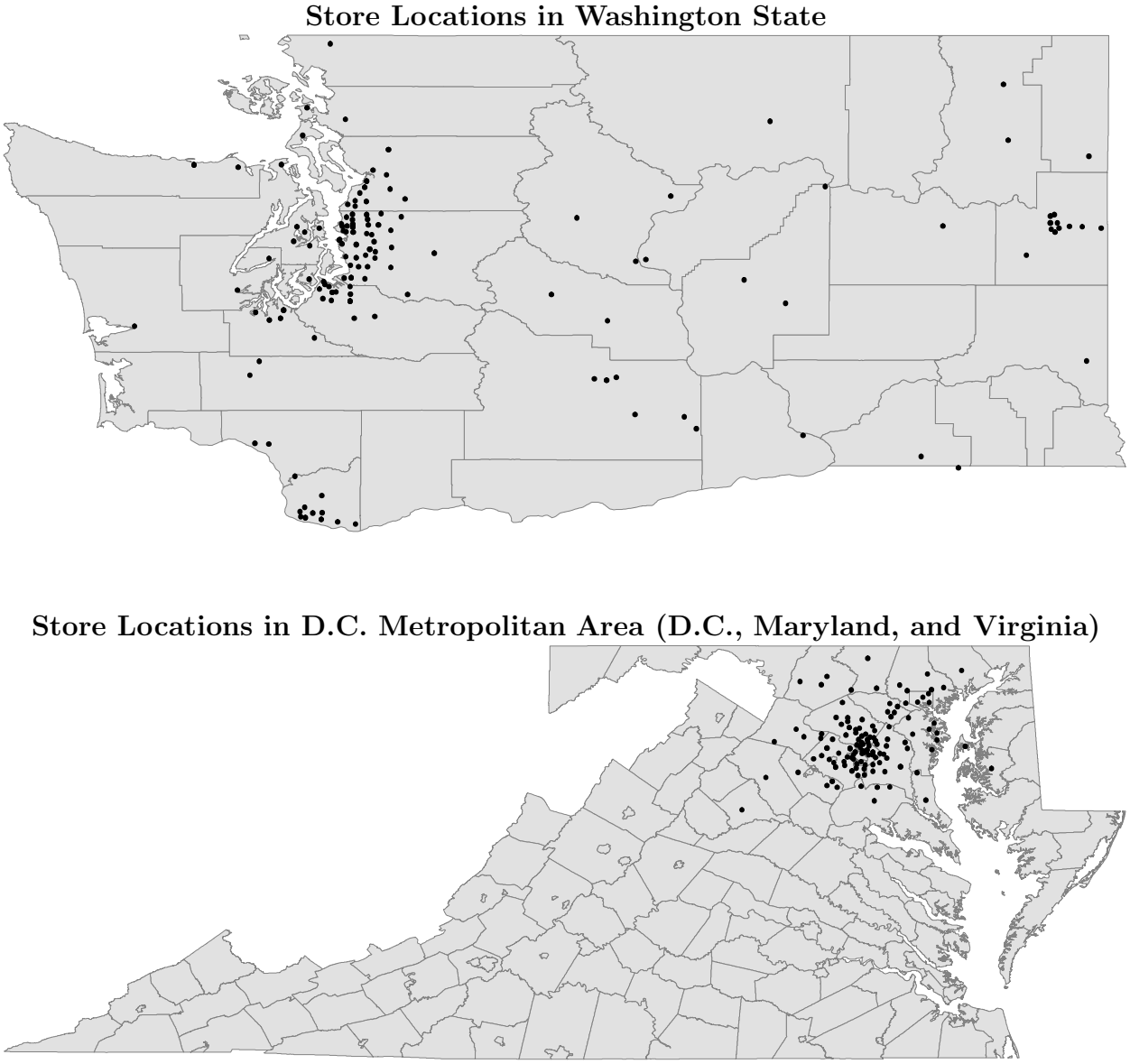
Notes: Table displays changes in log meat purchases. Columns use various sub-periods to estimate the seasonality components. Columns (1)-(3) and (5)-(7) drop one of the three control periods from the analysis. Columns (4) and (8) only use the period in which the event occurred with *no* estimate of the seasonality component. All columns use subclass by winter by store fixed effects, as well as period fixed effects. Periods are five-week aggregates, i.e., period 1 is December 24 - January 27, while period 2 is January 28 - March 2. Income is the demeaned average income in the zip code the store is located (in 10,000 dollars). Minority is the demeaned percentage of the population that is either African-American or Hispanic. The row "minimum day" indicates on how many days out of the 35-day period a product has to be sold in a store to be included in the data set. T-values are given in brackets. One star indicates significance at the 5% level, while two stars indicate significance at the 1% level.

Table A4: Sensitivity of Abnormal Changes in Log Beef Purchases to Interaction of Socioeconomic Variables with Washington

	(2) log Q	(2a) log Q	(4) log Q	(4a) log Q
Month 1	-0.194	-0.205	-0.200	-0.208
	(21.61)**	(38.28)**	(5.20)**	(5.57)**
Month 1 x WA	-0.021	-0.015	-0.032	-0.025
	(0.49)	(0.39)	(0.61)	(0.50)
Month 2			-0.236	-0.244
			(3.79)**	(4.01)**
Month 2 x WA			-0.00185	0.00383
			(0.03)	(0.06)
Month 1 x Income	-0.0133	-0.0052	-0.0134	-0.0067
	(2.53)*	(1.39)	(2.80)*	(1.76)
Month 1 x Income x WA		-0.0241		-0.0201
		(4.22)**		(3.55)**
Month 2 x Income			-0.00313	0.00260
			(0.75)	(0.86)
Month 2 x Income x WA				-0.01700
				(3.05)**
Month 1 x Minority	-0.00176	-0.00171	-0.00168	-0.00175
	(8.88)**	(7.17)**	(6.96)**	(6.36)**
Month 1 x Minority x WA		0.00106		0.00143
		(2.08)		(2.71)*
Month 2 x Minority			-0.00193	-0.00184
			(8.00)**	(7.90)**
Month 2 x Minority x WA				0.00042
				(0.85)
Log Beef Price	-1.91	-1.91	-2.16	-2.16
	(9.62)**	(9.61)**	(12.22)**	(12.22)**
Data Set	scanner	scanner	scanner	scanner
Min. Days	0	0	0	0
Aggregation	subclass	subclass	subclass	subclass
Observations	56077	56077	84598	84598
R-squared	0.973	0.973	0.945	0.945

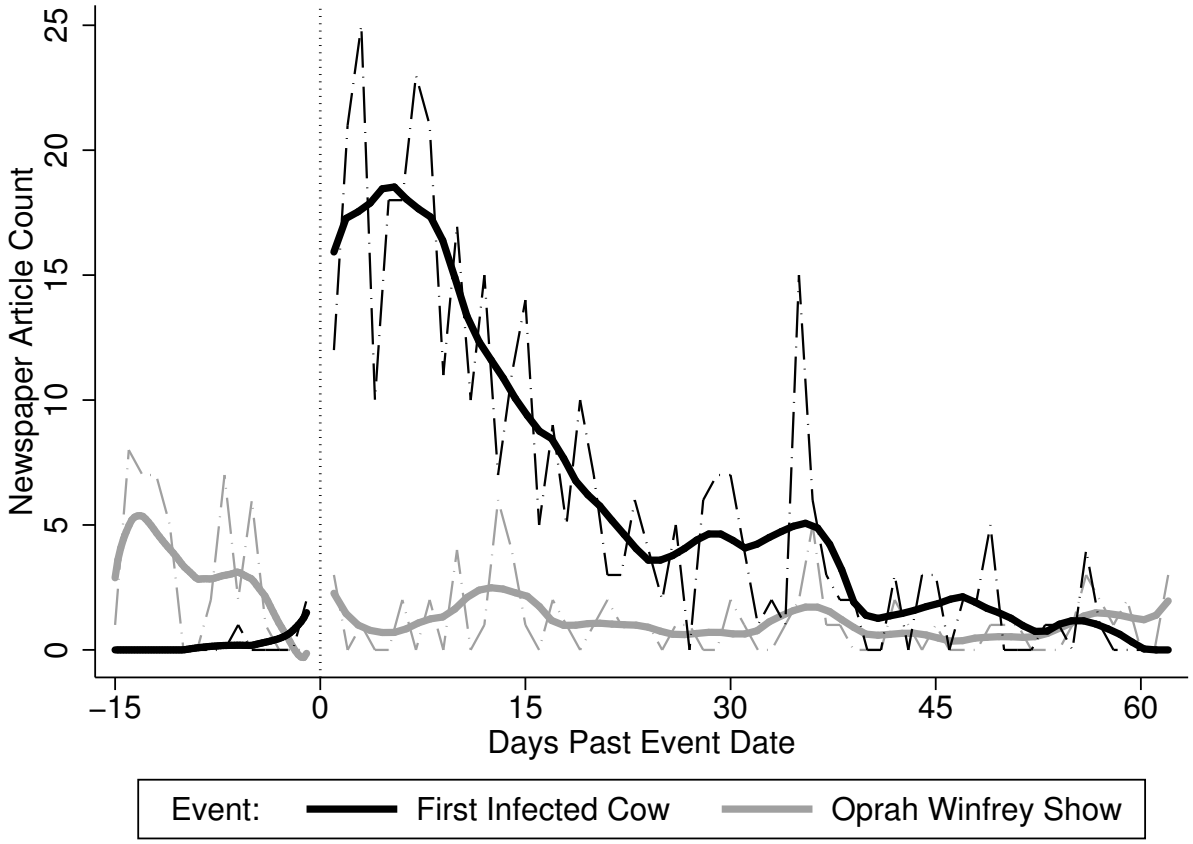
Notes: Table examines the sensitivity when socioeconomic variables are interacted with a dummy for Washington in columns (2a) and (4a). Columns (2) and (4) are taken from Table 1 in the main paper. The dependent variable the log of the purchased quantity. All columns use subclass-by-period-by-store fixed effects and period fixed effects to account for seasonal purchasing patterns. Periods are five-week aggregates, i.e., period 1 is December 24 - January 27, while period 2 is January 28 - March 2. Income is the demeaned average income in the zip code in which the store is located (in 10,000 dollars). Minority is the demeaned percentage of the population that is either African-American or Hispanic. The row "minimum day" indicates on how many days out of the 35-day period a product has to be sold in a store to be included in the data set. T-values are given in brackets. One star indicates significance at the 5% level, while two stars indicate significance at the 1% level.

Figure A1: Store Locations in Scanner Data



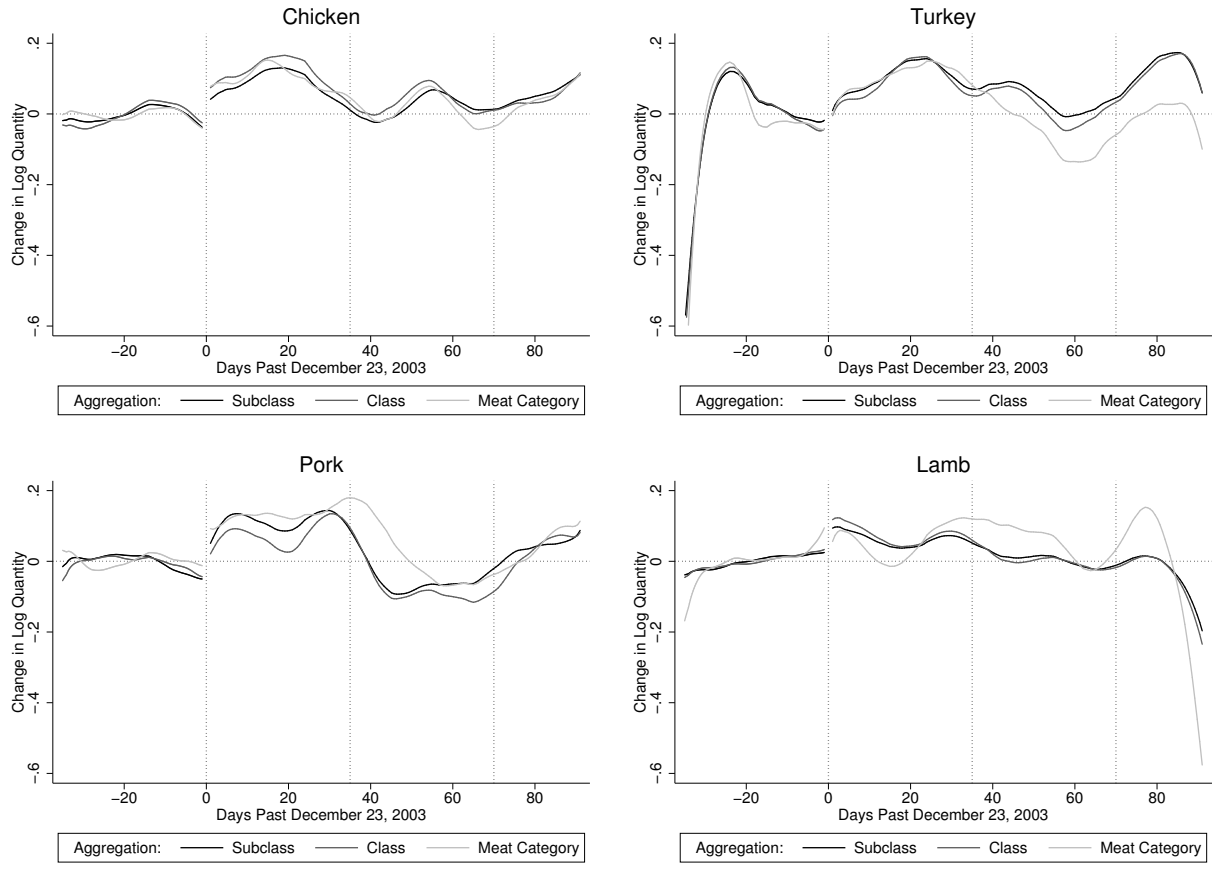
Notes: Panels display the location of the 164 stores in Washington State, as well as the 134 stores in the Washington D.C. metropolitan area.

Figure A2: Newspaper Coverage



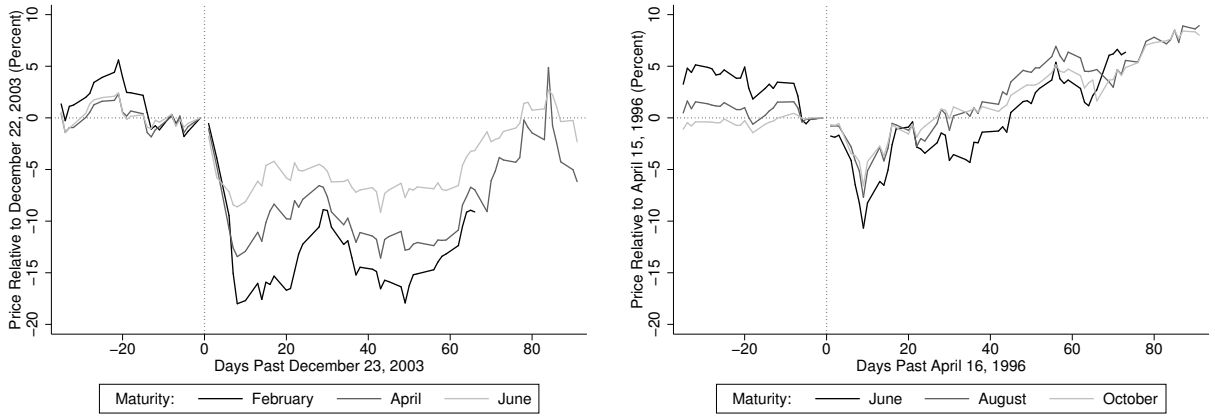
Notes: Figure displays the number of articles in major newspapers that include the word "mad cow" on a given day. Gray lines use April 16, 1996 as the event date (Oprah Winfrey show), while black lines use December 23, 2003 as event date (first infected cow is reported). Thin dashed lines plot the daily article count, while thick solid lines plot the result from a locally weighted regression with a bandwidth of 4 days.

Figure A3: Abnormal Daily Changes in Other Meat Purchases Following Discovery of First Infected Cow



Notes: Panels display changes in log quantity sold for pork, chicken, turkey, and lamb, respectively. Each panel includes three aggregation measures: the sum of all UPCs with the same subclass, class, or meat category. Day 0 is December 23, 2003, when the first case of a mad cow outbreak in the United States is made public. Abnormal changes are net of price, as well as winter-by-store-by-aggregation level, day-number, Thanksgiving, and weekday fixed effects.

Figure A4: Gross Abnormal Daily Changes in Cattle Futures Prices (Without Adjustments for Movements in Commodity Market Index)



Notes: Panels display futures prices of Live Cattle with maturities of two, four, and six months, respectively. The left panel uses the first discovery of a mad cow case as day 0 (December 23, 2003), while the right panel uses the comments by Oprah Winfrey (April 16, 1996). Futures with a maturity of roughly two months expire before the end of the 91-day window and only a partial time series is displayed.