Livestock Mandatory Price Reporting and Effects on Lamb Price Risk

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Introduction

In 1999, Congress passed the Livestock Mandatory Reporting Act (LMR) regulating the reporting of market information specific to cattle, swine, and lambs (and their products). The LMR program was implemented in April 2001 (USDA/AMS 2004) and was reauthorized by Congress in the fall of 2006. Under LMR, meat packers with recent 5-year slaughter histories of at least 125,000 cattle, 100,000 swine, or 75,000 lambs must electronically file daily summary information to the USDA's Agricultural Marketing Service (AMS) on all transactions involving livestock purchases and meat sales. Detailed information is also to be reported by firms that import meat products and sell them into the domestic market. Overall, the LMR program is intended to provide transparency regarding pricing, marketing methods, and supply and demand conditions for livestock and livestock products (USDA/AMS 2004).

For lamb, the LMR program requires meat packers to report price information daily on domestic sales of boxed lamb cuts. Importers are required to report (to the USDA/AMS) weekly prices of imported boxed lamb cuts sold on the domestic market. These price reports must include type and quantity of sale, USDA grades, weight ranges, and delivery periods (see USDA/AMS 2004). A final rule in 2004 amended initial LMR regulations in terms of submitting information for domestic and imported boxed lamb cut sales.

Livestock producers expected improved market price performance with the LMR program, particularly in the spot or cash markets. This expectation was based on the assumption that spot markets become more competitive as captive supply (formula and forward contract) transactions become more transparent. A beef cattle study by Perry, et al. found that, for cattle of similar qualities, the LMR program resulted in fed cattle prices in the negotiated market that closely tracked fed cattle prices purchased under formula arrangements. Their results also indicate that as a result of LMR, the volume of cattle sold under formula purchases has slowed while the volume of cattle sold under negotiated purchases have increased.

Lamb LMR Effects

A study addressing the effects of LMR on the lamb sector had not been reported. However, in the analysis that follows, a statistical model is employed to estimate the effects of LMR on price risk in the lamb carcass market. Open markets for lamb are thin and prices are therefore relatively volatile. The hypothesis tested in the model is whether LMR contributes to reducing risk in lamb carcass prices due to increased market transparency. The reduction in price risk (measured by the standard deviation of carcass price) is important in reducing overall risk for lamb slaughtering and processing firms. Because lamb carcass prices are instrumental in determining lamb livestock prices, lamb finishers and lamb producers should also benefit from LMR. As well, risk reduction from LMR should contribute to reducing margin price spreads (Holt; Tomek and Robinson).

Lamb Model

A linear regression model is employed to estimate the effects of LMR regulations on lamb carcass prices. The standard deviation (or risk) of East Coast lamb carcass prices is specified as the dependent variable (variable to be explained) and is regressed on a set of independent (or explanatory) variables given by demand and supply factors in the lamb marketing channel and a set of binary variables incorporating the LMR program. Weekly data were compiled by Tom McDonnell of the American Sheep Industry Association (ASI) and used to compute annual standard deviations of lamb carcass prices. The annual data include the years 1986 through 2005.

The model of lamb price risk is based on the economic theory of input demand by marketing firms (Tomek and Robinson). Essentially, the variance in lamb carcass price is a function of changes in economic variables and mandatory price reporting variables. The equation to be estimated, using a 1986-2005 sample period, is specified as:

(1) $SL = f(\Delta QD, \Delta QI, \Delta Y, \Delta MC, \Delta P, LMR, LMRT) + \mu$,

where SL (the dependent variable) is the standard deviation of East Coast lamb carcass prices (dollars per cwt);[1] ΔQD is the change (year t minus year t-1) in domestic lamb and mutton production (billion pounds, carcass weight), ΔQI is the change in lamb and mutton imports (billion pounds, carcass weight); ΔY is change in personal consumption expenditures (billion dollars); ΔMC is the change in food marketing costs (index of 1987 = 100.0); ΔP is the change in 4-firm concentration ratio for lamb and sheep slaughtering (percent of slaughter accounted for by 4 largest lamb packers); LMR is the Livestock Mandatory Reporting Act (a binary variable with 1985 to 2000 = 0.0 and 2001 to 2005 = 1.0 for the LMR policy period); and LMRT is an interaction term between LMR and time (LMR multiplied by time, or T). The variable μ is a stochastic error term.[2] The model variables SL, Y, and MC are deflated by the Consumer Price Index (1982-84 = 100.0) to remove the effects of inflation over the 20-year sample period. Table 1 gives the descriptive statistics of the model variables in levels and in changes.[3]

Equation (1) indicates the standard deviation in lamb carcass price (or risk) depends upon changes in several economic factors. These factors include domestic production and imports of lamb and mutton (wholesale supply factors), personal consumption expenditures (retail demand factor), food marketing costs (a marketing margin shifter),

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[1] The USDA discontinued the East Coast lamb price series in 2001 with implementation of Mandatory Price Reporting. A $7.00/cwt transportation differential is added to lamb carcass price reported on a Central Basis from 2001 and beyond to continue the East Coast data set.

[2] Heteroskedasticity or non-constant variance could occur because the lamb carcass price dependent variable is measured as variance.

[3] Data sources for the lamb model are Tom McDonnell of the American Sheep Industry (SL, QD, and QI variables), Economic Report of the President (Y and Consumer Price Index variables), USDA Agricultural Outlook Series (MC variable), USDA/GIPSA (P variable), and USDA for the LMR policy variable period. Data for 2005 are based on the most recent monthly information available.

Table 1: Descriptive Statistics of Lamb Carcass Price Model, 1986-2005

	Model Variables							
Statistics	**SL**	**QD**	**QI**	**Y**	**MC**	**P**	**LMR**	**LMRT**
Mean Level	8.30	0.28	0.09	3436.03	294.62	68.60	0.25	4.50
Std. Dev. Level	2.32	0.06	0.05	571.11	13.07	4.92	0.44	8.03
Mean Change		-0.01	0.01	95.26	-2.01	0.56		
Std. Dev. Change		0.01	0.01	46.21	2.86	5.44		

Note: Symbols for model variables and their measurement units are stated in the text. Std. Dev. is the standard deviation of the model variables for levels and changes.

and lamb packer market concentration. Meat packer concentration could reflect factors of market power or cost economies in lamb slaughtering and processing. Carcass price risk is also specified as a function of the LMR program (a USDA policy factor) and interaction of LMR with time (T). The effect of the interaction variable LMRT is important to the analysis since it measures the effects on price risk over the 2001-2005 LMR period. The estimated coefficients of LMR and LMRT in the empirical model would indicate, statistically and economically, whether the standard deviation of lamb carcass price increased, decreased, or showed no change because of the LMR program.

Results

A modification of Ordinary Least Squares (OLS) was used to statistically estimate carcass price risk of equation (1). Initial OLS estimation indicated the presence of heteroscedasticity and first-order autoregression in the error term (μ). Thus, the equation was estimated using a nonlinear least squares algorithm of the EViews 5.1 software program (White-Heteroskedasticity -Consistent Estimator). The Dickey-Fuller Unit Root Test of the OLS residuals indicated that equation (1) is a cointegrated function. The Wu-Hausman test failed to reject exogeneity of the domestic and import supply variables (QD and QI). The data were transformed to double logs, whereby the estimated coefficients are interpreted as elasticities. [4]

Regression results and appropriate statistics are presented in Table 2.

Results in Table 2 indicate that the slope coefficients of several independent variables are statistically significant at the $\alpha = 0.10$ level or better. The adjusted R^2 is 0.71 and the standard error of regression is 0.16, which serve as measures of equation fit. The marketing cost variable was dropped from the analysis due to its statistical insignificance, and another interaction term (LMRP) was added due to market irregularities (discussion following).

Model results indicate that changes in consumer expenditures increase the standard deviation of lamb carcass prices. For example, a 1 percent increase in consumer expenditures increases lamb price risk by 9.1 percent. This result is consistent with the theory that changes in consumer expenditures affect the retail demand for lamb and the demand for lamb carcasses. Changes in lamb domestic production and lamb imports, however, tend to decrease the standard deviation of lamb carcass prices. For example, 1 percent increases in production and imports decrease the standard deviation of lamb price by 2.67 percent and 1.19 percent, respectively. These domestic production and import effects may reflect thin market conditions; for example, positive changes in lamb quantities can imply reduced market thinness which decreases price risk.

[4] Thus, a slope coefficient has a percentage interpretation. If we have the equation Y = 1.5X (Y and X in log form), a 1 percent increase in X increases Y by 1.5 percent (the slope coefficient)

Table 2: Regression Results of Lamb Carcass Price Model, Estimated in Double Logs

Dependent Variable	**Independent Variable**
SL =	0.26 -2.67ΔQD - 1.19ΔQI + 9.06ΔY + 0.26ΔP
	(0.89) (-2.86) (-3.10) (3.01) (0.90)
	-15.59LMR - 0.21LMRT + 0.29LMRP + 0.76SL-1
	(-1.65) (-5.78) (2.11) (6.09)
	$R^2 = 0.86$ $\bar{R}^2 = 0.71$ S.E. = 0.16

Note: The t-values are in parentheses below the estimated coefficients. Critical t-value at the $\alpha = 0.10$ significance level is 1.833. R^2 is the unadjusted R-Squared, $\bar{R}^2$ is the adjusted R-Squared, and S.E. is the Standard Error of regression.

The lamb slaughter concentration ratio (ΔP) is included in the regression equation to capture potential market power effects. Its effect is positive but not statistically significant. However, the concentration variable was retained in the analysis so that it could be interacted with the LMR (2001-2005) variable to form the LMRP variable. This variable accounts for lamb market repercussions subsequent to mandatory price reporting. Based on changes in lamb price data and on information provided in a 2001 lamb market report (McDonnell), the standard deviation of real lamb carcass price precipitously increased in 2001 (about 58 percent over 2000). Several factors accounted for this problem, but two important factors included restricted lamb price reporting (slaughter, carcass, and cut-out prices) after implementation of LMR and increased market concentration at the lamb packer and breaker levels. [5] High industry concentration (one entity controlled 65 percent of the market) prevented reporting of lamb prices from April to August of 2001. Limited carcass price reporting resumed from September to November of 2001 with a USDA agency rule change (McDonnell). Also, a major lamb packer in the early period of LMR acquired three other packers/fabricators, which substantially increased its breaking industry market share (McDonnell). These factors account for the significant positive coefficient (0.29) of the LMRP variable. [6]

The coefficients for the LMR and LMRT variables indicate negative effects on lamb price risk. For example, the implementation of mandatory price reporting in 2001 (the LMR variable) appears to have decreased the standard deviation of lamb carcass price by 15.6 percent. However, its statistical effect is relatively weak, significant at the $\alpha = 0.15$ level. The precipitous *decline* in the lamb price standard deviation from 2001 through 2005 (as indicated in Figure 1) describes the importance of LMR on a year-to-year basis. The model indicates the effect of time interacting with mandatory price reporting (coefficient of LMRT)

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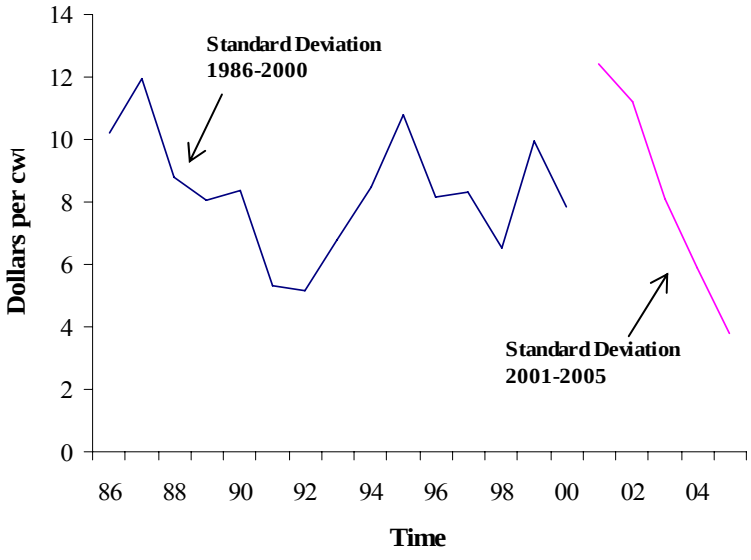
[5] Other factors were increased imports from Australia and New Zealand in 2001 (14 percent over 2000) due to exchange rates and heavy finished lambs as U.S. lamb feeders withheld marketings due to low slaughter prices.

[6] Packer concentration was also interacted with a binary variable with only 1.0 entered for the year 2001. However, the regression fit was greatly reduced, suggesting that packer concentration should be interacted with the full LMR period (the LMRP variable).

Figure 1: Standard deviations of lamb carcass prices (inflation-adjusted) for 1986-2000 and 2001-2005



reduces the standard deviation of lamb carcass price by 0.21 percent per year. In other words, implementation of the Livestock Mandatory Reporting Act in 2001 appears to have reduced lamb carcass price risk and increased stability in market price.

Livestock and meat markets are dynamic because of market rigidities that prevent instantaneous demand and supply adjustments to exogenous shocks. The source of these rigidities includes buyer-seller expectations, biological lags, institutional constraints, and technology factors. Econometric models can capture these constraints by lagging the dependent variable. In this case a one period lag (SL-1) appears to be appropriate. The lagged dependent variable is statistically significant; indicating that if the standard deviation of carcass price increased by 1 percent the previous year (t-1), then its standard deviation will increase the following year (t) by 0.76 percent. Thus, there are substantial carry-over effects of carcass price risk from one year to the next in the wholesale lamb market.

Conclusion

A nonlinear least squares regression analysis of lamb carcass price risk indicates that the Livestock Mandatory Reporting Act of 1999 and the subsequent implementation of Livestock Mandatory Price reporting in 2001 reduced, over the 2001 to 2005 period, the standard deviation of lamb carcass prices. Thus, increased market price transparency apparently reduces price risk in an industry that is characterized by thin markets.

Data trends indicate that producers may have shifted relatively more towards auction markets as a result of LMR transparency. Captive supply procurement for lambs (formula, contract, and packer ownership arrangements) averaged about 49 percent of total lamb procurement by lamb packers from 2001 through 2004 (American Sheep Industry Association). However, ASI data indicates the percentage of slaughter lambs sold under formula decreased from 53.1 percent in 2001 to 38.4 percent in 2004. The percentage of slaughter lambs sold at auctions (and others such as cooperatives) increased from 31.1 percent to 44.0 percent over this period.

Producer returns are affected by price risk. In the lamb market, such risk cannot be managed by futures hedging. Thus, since wholesale lamb prices affect the relative volatilities of prices paid for slaughter lambs and feeder lambs, producers utilizing relatively thin open markets have a vested interest in an effective LMR program.

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