

The Affect of Animal Gender on Fed Cattle Producer Marketing Behavior

By

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Abstract:

Weekly grid market share by volume for slaughter steers is compared to slaughter heifers. Summary statistics indicate average grid market share for steers (42%) is 27% higher than slaughter heifers (33%). The literature indicates that pregnancy and increased dark cutter incidence associated with heifers relative to steers creates additional financial risk when heifers are sold on a grid. Econometric analysis suggests grid market share is less sensitive to changes in market conditions for heifers relative to steers. The empirical evidence is consistent with the supposition that marketing heifers is riskier than marketing steers on a grid. Thus sellers need stronger economic incentives to market heifers on a grid relative to steers.

Introduction:

The issue of a gender effect on feeder and fat cattle production performance and prices has been a popular topic in both the animal science and agricultural economics literature. The animal science literature has investigated how gender affects animal feedlot production performance and finished carcass characteristics; i.e., average daily gain (ADG), marbling, yield grade (YG), etc., (e.g. Choat et al. 2006; Zinn et al. 2008). The “gender effect” analysis reported in the agricultural economics literature has investigated the effect of gender on price, revenue, and profit at both the feedlot and feeder stages of production (e.g. Schultz and Marsh 1985; Faminow, de Matos, and Richmond 1996). However, the effect of animal gender on producers’ marketing channel and pricing method decisions has been overlooked in the agricultural economics literature.

Fed cattle marketing-channel studies have focused on how the introduction of new alternative marketing arrangements (AMAs) for steer and heifer slaughter has affected fed cattle price, market share volume across AMAs, packers' margins, etc. (e.g., RTI International 2007; Koontz and Lawrence 2010). The growth in the use of AMAs by fed cattle producers parallels the beef industry's Value Based Marketing (VBM) initiative. The goal of the VBM initiative is to improve production efficiency and quality (e.g. Fausti et al. 1998). A key component of the VBM initiative was the introduction of grid pricing in the mid-1990s. The growth in the market share of AMA slaughter volume is positively correlated with the growth in market share of fed cattle sold on a grid pricing system.

The issue of an AMA gender affect was first discussed by Lange (2009). Lange adopted an approach developed by Fausti et al. (2008 and 2010) to estimate individual weekly AMA market share for steer slaughter volume. Lange investigated the issue of selling slaughter steers versus selling slaughter heifers on a grid. He used USDA-AMS weekly reported data for the period from April 11, 2004 to January 11, 2009. Lange reported that, on average, 41.58% of slaughter steers were sold on a grid pricing system versus 33.20% of slaughter heifers. Lange's results indicate that producers have a stronger propensity to sell their slaughter steers on a grid relative to their slaughter heifers.

The animal science literature indicates carcass quality is affected by gender. The agricultural economics literature documents that gender does affect price. However, these reported differences do not explain the magnitude of the grid market share disparity across gender reported by Lange. The question of interest addressed in this study is: Why are producers more inclined to market their slaughter heifers at an average price in the cash market relative to their slaughter steers?

Our objective is to extend Lange's data set and re-estimate AMA weekly market share for steer and heifer grid slaughter volume. A seemingly unrelated regression procedure (SUR) is employed to investigate the potential market influences that can explain this gender disparity.

Slaughter Steer and Heifer Price and Carcass Quality Differences

The animal science literature provides strong empirical evidence that steer feedlot performance in the areas of ADG, feed efficiency (FE), and mature body weight (BW), on average, is superior to heifer feedlot performance (e.g. Zinn et al. 2008). On the issue of finished carcass quality, the literature indicates that slaughter heifers have superior carcass marbling and receive, on average, a higher USDA quality grade than slaughter steers. According to Tatum, Gruber, and Schneider (2007: p. 3), the empirical evidence indicates that "Despite the fact that heifers typically produce carcasses with higher marbling scores and more desirable USDA quality grades, product tenderness usually favors steers...." However, on average slaughter heifer hot carcass weights are lower relative to slaughter steers (Choat et al. 2006).

In a study published by Certified Angus Beef™ (CAB) based on data for approximately 19.8 million carcasses (marketed from 1999 to 2005), Corah and McCully (2006) reported that the percentage of heifers and steers grading prime or choice declined from 58% to 54% and 48% to 44%, respectively. The data indicates that average heifer quality grade, for this time period, was superior for CAB program qualifying slaughter cattle.

The animal science literature has also looked at the issue of undiscovered pregnant heifers being finished and the issue of heifers having a higher propensity for being classified as a dark cutter during USDA carcass grading (Scanga et al. 1998). Both of these heifer carcass issues are financial risk factors for the producer when selling on a grid. The economic risk of pregnant slaughter heifers (Buhman, Hungerford, and Smith 2003) and the relationship between

heifer and dark cutter incidence rate (Kreikemeier and Unruh 1993) affects the live weight price differential between steers and heifers.

Schultz and Marsh (1985) discuss the perceived price differential between slaughter steers and heifers. They discuss the likely reasons for this perception: a) lighter finishing weights for heifers and b) random factors such as packer gender preferences. Schultz and Marsh (p. 85) report that they find no statistical evidence that the “finished steer minus finished heifer price differential” is present using U.S. quarterly data (Table 4: insignificant intercept coefficient). Schultz and Marsh (p. 88) also report that an increase in wholesale steer carcass price does increase the finished steer-heifer price differential. However, for the finished steer-heifer price differential they conclude that “...random factors still explain the greatest proportion of the variation in the dependent variable.”

Faminow, de Matos, and Richmond (1996) investigate if a gender bias exists when selling fed steers and heifers live weight versus their actual carcass value (the market value of cut, trim, and waste) to a packer in the Canadian market. Their empirical findings indicate that steers sold live weight were over paid their market value with respect to actual carcass value. Heifers sold live weight, however, were under paid the market value of their actual carcass value. The reported findings in the Canadian study suggest that there is a price bias when heifers are sold live weight at an average price per pen versus slaughter steers.

The Canadian study suggests the perceived negative price bias toward slaughter heifers investigated by Schultz and Marsh may have some validity even though the later study failed to find significant evidence of a price differential. The issue of an increased discount risk associated with slaughter heifers due to pregnancy or heifers having a higher incidence of being discounted as a dark cutter were not considered in the Canadian study.¹ Both of these carcass

quality issues imply additional financial risk for the packer when they purchase heifers by the pen at a live weight price. In turn, these financial risks increase the seller's propensity to market finished heifers at a live weight price by the pen.

The issue of increased uncertainty concerning heifer carcass quality relative to slaughter steer carcass quality implies heifers have a greater financial risk associated with selling on a grid. The issue of cattle carcass quality risk associated with marketing slaughter cattle was formalized in paper by Fausti and Feuz (1995). Fausti and Feuz demonstrated that packers would charge feedlots a risk premium when purchasing cattle live weight at an average price relative to purchasing them on a grid. The risk premium represents compensation to the packer for undertaking the risk of purchasing cattle without knowing the carcass quality with certainty at the time of purchase. Fausti and Feuz also argued that the existence of incomplete information about carcass quality on the part of sellers of slaughter cattle created a demand by sellers for the three live cattle marketing alternatives: live weight, dressed weight, and grid. The demand for alternative marketing alternatives is the result of risk preferences varying across sellers of slaughter cattle.

Carcass Quality and Marketing Risk

Selling cattle on a grid determines the actual market value of the animal being sold. The per head price differential, discussed in the literature, is derived by comparing the estimated grid market value of an animal to the estimated market value if the animal was marketed live weight or dressed weight. The grid pricing literature suggests that the grid price differential can be positive or negative, and depends on seasonality, carcass quality, marketing location, etc., (Fausti et al. 2010). The uncertainty associated with the sign of the grid price differential and seller risk

aversion appear to be plausible explanations for not only the existence of multiple AMAs but also why AMA market share of weekly slaughter volume fluctuates over time.

Let's assume a seller of fed cattle has a pen of finished heifers and a pen of finished steers. The seller has a choice to sell each pen live weight at an average price based on observable live animal characteristics for that pen (breed, body condition, animal temperament, uniformity, etc.). The other alternative is to sell the cattle on a grid where each animal will be evaluated to determine its exact market value based on USDA yield grade, quality grade, hot carcass weight, and the presence of any out-carcass characteristics (hard-bone, dark cutter, etc.). Fausti and Feuz (1995) demonstrated that a buyer of fed cattle (meatpacker) faced with conducting a transaction with a seller of fed cattle would view purchasing cattle at a live weight price as a risky transaction with respect to carcass quality uncertainty. Whereas, purchasing cattle on a grid would be a riskless transaction. Furthermore, Fausti and Feuz's "Theory of Factor Price Disparity" suggests that even if the meatpacking firm was risk neutral, it would still charge the seller of fed cattle a risk premium (due to carcass quality uncertainty) if it is a pen level transaction at an average price.

Assume the seller's marketing channel selection decision is influenced by their preference for risk. Let us further assume that sellers are risk averse, and are able to negotiate with packers a live weight price that reflects the sellers ex ante expectation of the average carcass quality of the cattle they are selling. If the seller decides to sell his/her cattle by the pen at a live weight price (P_L), then the price per hundred weight is known with certainty. If the seller selects to market the cattle on a grid then there is uncertainty about the final price per hundred weight. There is a positive probability (γ) that the average grid price per hundred weight will be lower than the live weight price due to unexpected negative carcass characteristics that resulted in the

levying of discounts. If this should occur, then the seller's average per head price will be P_1 . However, there is also a positive probability $(1-\gamma)$ that the average grid price per hundred weight will be higher than the live weight price due to unexpected positive carcass characteristics that resulted in the levying of unexpected premiums. In this case the seller's per head price will be P_2 , e.g., $P_2 > P_1$. The expected value of the seller's cattle marketed through a grid:

$$1. E(P_G) = \gamma P_1 + (1-\gamma)P_2.$$

Again, for simplicity, we assume the $E(P_G) = P_L$. We will assume a univariate utility function $U(P_i)$ that exhibits diminishing marginal utility with respect to price per hundred weight: $dU/dP_i > 0$, $d^2U/dP_i^2 < 0$; where $i = G$ or L . Thus the seller has a concave utility function with respect to outcomes for the two marketing alternatives. For the grid marketing alternative, the utility of expected value is:

$$2. U[E(P_G)] = U[\gamma P_1 + (1-\gamma)P_2].$$

The Expected Utility function for marketing on the grid is:

$$3. E[U(P_G)] = \gamma U(P_1) + (1-\gamma)U(P_2).$$

According to the economics of uncertainty literature, for the risk averse seller: $U[E(P_G)] > E[U(P_G)]$. Given the assumption, $E(P_G) = P_L$, the risk averse seller requires a risk premium payment to sell on a grid even when the seller's expectation is that the price per hundred weight sold live weight is equal to the grid equivalent. If the premium is not large enough to overcome the seller's aversion to risk, then the seller will market his/her cattle by the pen at an average price. Risk and risk preference provides a plausible explanation for grid market share variability.

The agricultural economics literature has investigated the transmission of grid pricing market signals for carcass quality attributes. The analysis by Johnson and Ward (2005 and 2006) on carcass quality price signals sent by grid pricing systems indicates that carcass weight

accounts for 97% of the price signal for cattle sold at an average price by the pen. For high carcass quality cattle sold on a grid, weight accounted for 79% of the market signal. For lowest carcass quality cattle in their study, 50% of the market signal was explained by carcass weight. However, for both the high quality and the low quality cattle groups, grid discounts account for 20% and 49.5% of the market signal, respectively. Their findings indicate that grid premiums explain very little of the variability in carcass value regardless of carcass quality. They report that the choice/select discount and the yield grade 4 to 5 discount send the strongest signals through the grid pricing system. Based on their empirical findings, Johnson and Ward (2006: pp. 88-89) make the following conclusion: "...under the current grid pricing structure, the weight incentive and the availability of alternative marketing channels make increasing the weight of most lower valued cattle less risky and more lucrative endeavor than attempting to improve animal quality."

Methodology and Empirical Hypothesis

Following the work of Lange (2009), we have estimated weekly grid market share for slaughter steers and for slaughter heifers (Table 1). The variability in weekly grid market shares is then investigated with respect to hypothesized market variables that have been identified as having a potential to influence seller marketing channel (AMA) selection.

We intend to investigate if the risk factors identified in the grid pricing literature can explain the variability in grid market share for slaughter steers and heifers. Given the empirical evidence presented by Johnson and Ward, we assume that estimated animal weight and grid discounts are factors sellers of fed cattle evaluate when making the decision to market live weight at an average price or sell on a grid. A system of equations, regressing weekly steer grid

market share ($stgrid_t$) and heifer grid market share ($hfgrid_t$) on explanatory variables is defined below:

$$4. \quad stgrid_t = a_0 + a_1stgrid_{t-1} + a_2stgrid_{t-3} + a_3lsteervol_t + a_4lTREVsteer_{t-4} \\ + a_5\Delta yg4dist_{t-4} + a_6\Delta seldist_{t-4} + a_7\Delta wtdist_{t-4} + a_8spring_t + a_9summer_t \\ + a_{10}fall_t + e_{1t}$$

$$5. \quad hfgrid_t = b_0 + b_1hfgrid_{t-1} + b_2hfgrid_{t-3} + b_3lheifervol_t + b_4lTREVheifer_{t-4} \\ + b_5\Delta yg4dist_{t-4} + b_6\Delta seldist_{t-4} + b_7\Delta wtdist_{t-4} + b_8spring_t + b_9summer_t \\ + b_{10}fall_t + e_{2t}$$

This is Zeller's (1962) seemingly unrelated regression (SUR) model, and is estimated by generalized least square (GLS). The SUR model can take the contemporaneous correlation between e_{1t} and e_{2t} into account, and uses that cross-regression correlation to obtain more efficient estimates of the coefficients. Intuitively e_{1t} and e_{2t} are correlated because there are some common omitted factors that affect both $stgrid_t$ and $hfgrid_t$. The SUR model can be statistically justified by a nonzero correlation between the residuals of the two regressions.

The explanatory variables selected are: lagged grid market share, quarterly seasonal dummy variables, choice/select discount ($seldist_t$), the yield grade 4-5 discount ($yg4dist_t$), the heavy weight discount ($wtdist_t > 1000$ lbs.), weekly steer and weekly heifer slaughter volume (e.g. Vol_t), and the weekly average live weight per head price for steers and heifers (e.g. $TREV$). Weekly steer and heifer volume are assumed to have an inverse relationship with grid market share due to influences of the cattle cycle, and inconsistent production by smaller feedlots. The issue of steer and heifer weight is accounted for by calculating the average market value per head (live weight price * live animal weight). It is assumed, based on the Johnson and Ward papers, as average weekly live weight per head total revenue increases, the incentive to market on a grid declines, due to carcass quality uncertainty.

Another advantage of SUR model is that it allows for testing cross-regression restrictions. For example, one interesting hypothesis is $H_0: a_1 = b_1$; that is, the first lags of the dependent variables in the two regressions have the same coefficients. This approach is useful for comparing the short run dynamics. Notice that we use differenced variables, such as $\Delta y_{4dist_{t-4}}$, in the regressions whenever the ADF test indicates non-stationarity. The specification of the lag structure is guided by (i) the autocorrelation function (ACF), (ii) partial autocorrelation function (PACF) and (iii) the assumption that the grid versus average price marketing decision is made thirty days prior to expected delivery.² We also calculated the pseudo R-square for the SUR model that basically measures the gain in the goodness-of-fit relative to the restricted SUR model that uses just intercept terms (see page 8.7.1 of Cameron and Trivedi (2005) for more discussion about the pseudo R-square).

Data

The sources of the data used in this study are the USDA-AMS weekly reports (2004-2010); series LM_CT154 and LM_CT151. The LM_CT154 (National Weekly Direct Slaughter Cattle) covers slaughtered cattle that were purchased using a negotiated price. Conversely, series LM_CT151 (National Daily Direct Slaughter Cattle – Formulated and Forward Contract Purchases – Domestic) reports the breakdown of non-negotiated purchases, both formulated and forward contract purchases. These reports include slaughter volume, dressing percentage, weight range, price range, and weighted average price. Data on grid premiums and discounts was collected from USDA-AMS weekly reports: National Carcass Premiums and Discounts for Slaughter Steers and Heifers: NW_LS195.

Empirical Results

Table 1 provides the weekly averages for marketing channel (AMA) shares. Consistent with the findings reported by Lange (2009), the data shows a definite propensity for heifers to be sold at an average price relative to steers. The magnitude of the market share differential suggests that the animal science and agricultural economics literature are correct in their view that sellers of finished heifers have a greater concern over the carcass quality of heifers relative to steers.

The SUR regression results are presented in Table 2. The regression diagnostics indicate that regression residuals (e_{1t} and e_{2t}) are highly correlated ($\rho=0.55$) and provides strong support for the use of the SUR method. McFadden's R-squared ($R^2=0.45$) was estimated as a measure of global fit, and it suggests the model explains about 70% of the variability in grid market share.³

Table 1. Grid Market Share, Averages for April 11, 2004 - May 2, 2010

Description	Steers	Heifers	Steers & Heifers
Negotiated Live & Dressed Wt. Cash Market Share	0.46	0.55	0.49
Negotiated Grid Net Cash Market Share	0.08	0.06	0.09
Cash Market Share	0.54	0.61	0.58
Forward Contract Market Share	0.06	0.08	0.07
Formula Pricing Net Market Share	0.40	0.31	0.36
Formula Pricing Grid Market Share	0.35	0.27	0.31
Forward Contract and Formula Market Share	0.46	0.39	0.42
All Grid Slaughter, Cash & Contract	0.42	0.33	0.39

As discussed above, we also conducted Chi Square tests across steer and heifer regression coefficients. The lagged dependent variable coefficients indicate a positive persistence in grid marketing. If grid marketing by producers is robust then there is persistence for it to remain robust. If grid marketing by producers is weak then there is persistence for it to remain weak. This persistence in marketing behavior is stronger for steers than heifers. This is indicated by a more robust lag 3 dependent variable for steers relative to heifers. The Chi Sq. test ($p < 0.05$) indicates that past steer grid market share has a stronger influence on current steer grid market share relative to the heifer SUR estimates.

There does appear to be a seasonal pattern to both steer and heifer grid market share. SUR estimates indicate a higher grid market share in the summer and fall for steers but only in the summer for heifers. The Chi Sq. test ($p < 0.01$) indicates that the seasonal steer grid market share pattern is different from heifers in the fall.

Table 2: Estimates from Seemingly Unrelated Regressions.

Dependent Variable: Stgrid_t				
Mean of Dependent Var.		0.4238		
Standard Error of Dependent Var.		0.0520		
Standard Error of Estimate		0.0387		
Sum of Squared Residuals		0.4662		
Durbin Watson Statistic		2.1089		
Independent Variables:		Coefficient	Std. Error	T-Stat.
1. constant		3.3548	0.3527	9.5123
2. stgrid _{t-1}		0.1787	0.0414	4.3120
3. stgrid _{t-3}		0.2845	0.0418	6.8028
4. lsteerVol _t		-0.2044	0.0173	-11.7868
5. lTREVsteer _{t-4}		-0.0906	0.0365	-2.4820
6. Δyg4dist _{t-4}		-0.0014	0.0075	-0.1868
7. Δseldist _{t-4}		-0.0023	0.0023	-0.9901
8. Δwtdist _{t-4}		-0.0039	0.0027	-1.4081
9. spring _t		0.0019	0.0065	0.2975
10. summer _t		0.0386	0.0075	5.1429
11. fall _t		0.0308	0.0066	4.6366

(Table 2 continued.)

Table 2: Estimates from Seemingly Unrelated Regressions (continued.)

Dependent Variable: hfgrid _t			
Mean of Dependent Var.	0.3311		
Standard Error of Dependent Var.	0.0507		
Standard Error of Estimate	0.0387		
Sum of Squared Residuals	0.4677		
Durbin Watson Statistic	1.9552		
Independent Variables:	Coefficient	Std. Error	T-Stat.
12. constant	2.5463	0.3207	7.9399
13. hfgrid _{t-1}	0.1986	0.0419	4.7408
14. hfgrid _{t-3}	0.1865	0.0419	4.4539
15. lhieferVol _t	-0.1531	0.0149	-10.2932
16. ITREVheifer _{t-4}	-0.0796	0.0362	-2.1997
17. Δyg4dist _{t-4}	-0.0019	0.0074	-0.2612
18. Δseldist _{t-4}	-0.0026	0.0023	-1.1540
19. Δwtdist _{t-4}	0.0015	0.0027	0.5425
20. spring _t	0.0011	0.0063	0.1751
21. summer _t	0.0346	0.0065	5.3277
22. fall _t	0.0083	0.0064	1.2986

SUR Global Fit: McFadden's Pseudo R² = 0.4519

Steer and heifer slaughter volume were included in the model to determine if increased supply of fed cattle to the market influenced producer decisions to market on a grid or by the pen. The SUR estimates indicate that increased slaughter volume has negative effect on both steer and heifer grid market share. Furthermore, the chi sq. test ($p < 0.01$) indicates that producers decisions to market steers on a grid are more sensitive to fluctuations in steer slaughter volume than their decisions to market heifers on a grid. This may indicate that during periods of increased slaughter volume: a) the marginal increase in volume is coming from a segment of the feedlot industry that is more risk averse, or b) the marginal volume increase contains fed cattle entering the market with a greater level of carcass quality uncertainty.

The estimated coefficients for both the steer and heifer per-head live weight market value ($P_L * \text{Live-weight}$) are negative and significant at less than 0.03. This result supports our

supposition that sellers of fed steers and heifers do switch marketing channels as market conditions change. Producers selling cattle live weight increases as the market value of weight increases. This is not surprising given the findings reported by Johnson and Ward. As average weight increases, sellers may view the risk of marketing on a grid as increasing given the bias toward discounts reported in the literature (e.g. Fausti et al 1998, Anderson and Zeuli 2001, Fausti and Qasmi 2002, Johnson and Ward 2005 and 2006).

An interesting result is the failure of any of the grid discount variables to explain the variability in grid market share. The implication of this failure could be due to the marginal marketing decision i.e., the seller's decision to market live versus grid is made by deciding if the grid incentive structure is great enough to take on the financial risk of carcass quality uncertainty versus the financial certainty of adding additional pounds.

Summary and Discussion

The results presented indicate that heifer grid market share is significantly lower than steer grid market share. The SUR coefficient estimates for the lagged dependent variables indicate a persistence to maintain positive or negative trends in grid market share for steers relative to heifers.

The SUR results, based on Chi Sq. tests, also indicate that steer grid market share has greater sensitivity to changes in market conditions relative heifer grid market share. The sensitivity of steer grid market share to seasonality and slaughter volume fluctuations is greater relative to heifer grid market share. The implication of heifer grid market share being less sensitive to changes in market conditions than steer grid market share is consistent with the supposition that marketing heifers on a grid is riskier than marketing steers on a grid.

Footnotes:

1. The animal science literature has numerous articles on the tendency of slaughter heifers to have a higher percentage of dark cutter discounts than slaughter steers (Scanga et al. 1998). The National Cattlemen's Association funded a study on the factors affecting slaughter heifer quality (Tatum, Gruber, and Schneider 2007) that examines factors that influence the heifer carcass dark cutter incidence and the effect on carcass value. The 1991 National Beef Quality Audit found that approximately 2.7% of slaughter heifers were pregnant (Lorenzen et al. 1993).

2. Grid marketing volume is approximately 80% formula sells. This implies that at least a 30 day delivery contract has been agreed upon by the buyer and seller. It is at this point (30 days prior to delivery) that the feedlot has made the final decision to sell their cattle on a grid. At the time of this decision, sellers are assumed to evaluate market conditions (prices) and animal finishing performance and use this information to arrive at the decision to market on a grid. To include this information we have included live weight average total revenue (weekly national average: live weight price times average live weight at slaughter) lagged four weeks to coincide with the 30 day delivery window. Thus the 4 week lag is consistent with producer marketing decisions because most cattle marketed on a grid (our dependent variable) are sold on contract. A contract is defined as a commitment to sell at least 30 days prior to slaughter. Selling by the pen is the marketing alternative for marketing on the grid. Thus, when the total revenue per head at the pen level of increases the marginal net benefit of putting on extra weight and selling by the pen will outweigh the marginal net benefit of selling fed cattle on a grid at a lighter weight. We are assuming that total live weight revenue contains the information of the cost of putting on extra pounds of gain given that the live weight component contains the market information of

marginal benefit of addition weight vs. the marginal cost of putting on the additional weight. The same logic is used to include grid premiums and discounts as explanatory variables. Higher premiums increase the incentive to market on a grid, higher discounts reduce the incentive.

3. Veall and Zimmermann (1994: Table 2) estimated the approximate value of equivalent OLS R^2 associated with McFadden's Pseudo R-squared. They report the results from small sample (less than 200 obs.) simulations for estimating the OLS R^2 equivalent for the McFadden Pseudo R^2 . They estimate that for a McFadden $R^2 = 0.45$, the OLS R^2 equivalent has lower bound of 0.673 (McFadden $R^2 = 0.40$) and an upper bound of 0.78 (McFadden $R^2 = 0.50$). A simple approximation of an OLS $R^2 = 0.72$ is our McFadden equivalent. Our SUR model explains about 72% of the variability in steer and heifer grid market share.

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