An Empirical Analysis of Recent Changes in US Beef Marketing Margins

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Abstract

An Augmented Relative Price Spread (ARPS) model is employed to explain recent changes in real US beef wholesale-retail (WR) and hence farm-retail (FR) marketing margins. It is found that the surge in retail market concentration in 1999 most likely increased retail market oligopsony power relative to wholesale oligopoly power, ultimately changing real US WR beef marketing margins. The finding that higher oligopsony retail market power relative to oligopoly wholesale market power in the US beef industry was most likely responsible for the changes in US WR marketing margins in 1999 is important because it provides an economic justification for policy makers to regulate anticompetitive conduct by beef retailers.

1 Introduction

The rise of supermarkets in the late twentieth century produced changes in the structure and organization of many agricultural commodity markets in the US, Australia, the UK and the developing world ((Cotterrill, 2006) and (Trail, 2006)). While some cost savings were realized from increasing retail market concentration, concerns remain about inadvertent negative consequences of the rise of supermarkets. An example of retail markets where negative effects of increasing concentration is of particular importance is the US retail beef market where vigorous mergers and acquisitions activity by Ahold, Safeway, Albertsons, Kroger and Wal-Mart in 1999 resulted in a highly consolidated retail beef sector after 1999 (Marsh and Brester, 2004). Concurrent with the rapid increase in retail market concentration in 1999, real US WR beef marketing margins increased unexpectedly in 1999 suggesting that changes in the margins may have been driven by events in the retail beef sector.

High retail beef market concentration may lead to increased oligopsony market power for beef retailers compared to oligopoly market power of wholesalers enabling them to manipulate wholesale beef prices. Since beef wholesalers will likely pass on depressed beef prices to farmers as lower farm prices, farmers and wholesalers have positive incentives to demand antitrust regulation of beef retailers provided it can be established that the later practices anticompetitive conduct. This paper attempts to find out if the sharp rise in beef retail market concentration in 1999 resulted in the exercise of higher retail relative to wholesale market power and further if this rise in relative retail market power significantly changed real US WR beef margins [1]

[1] Although marketing margins and price spreads do not mean the same thing, the two series move together

2 Related Literature

The earliest method for identifying market power is credited to the Structure Conduct Performance (SCP) approach pioneered by (Bain, 1951) and relies on the relation between profits and markets concentration to identify market power [2] The more modern NEIO approach employs the price-cost margin (PCM) model and criticizes the SCP for having suspect econometric foundation. However the NEIO has itself been been criticized for not performing any better than the SCP [3] The theoretical dependence of marketing margins on different determinants particularly market power using NEIO type models is laid out in (Wohlgenant, 2001) drawing heavily on (Appelbaum, 1982). Identification is established separately by Lau (1982) and (Bresnahan, 1989).

Two NEIO-based procedures have been used to investigate the effects of market power on WR margins. Marsh and Brester examine the effects of retail market concentration, retail demand, farm input supply and marketing costs in the beef and pork markets simultaneously using only WR specifications. In contrast, Capps et all, link behavior in FW and WR for a specific commodity and allow for the exercise of market power to emerge interactively in either of the decomposed margins. This is particularly relevant in the beef market as research has demonstrated the presence of market power at the wholesale level (i.e. the packers) which has resulted in lower producer prices. Failure to decompose margin behavior may make it difficult to identify the exercise of

and for this paper we assume they mean the same thing. The beef marketing margin is the difference in the value of the animal product at two different stages of the beef supply chain. By contrast the price spread is the difference between the buying price and selling price of the animal product.

[2]See (Choudhury, 2005) for a summary and synthesis of this literature.

[3]Digal and Ahmadi-Esfahani (2002) contrast the strengths and weaknesses of the NEIO model.

market power at the retail level.

We use the Capps et all model and not the Marsh and Brester model because it is particularly relevant, flexible and is easy to modify and operationalize. Capps et all use marketing costs, concentration, demand, and price data to determine the most important factors affecting lamb margins. They conclude that packer concentration and marketing costs positively impact margins. We modify the Capps et all model in different ways to reflect more accurately the current US beef industry. The details are in the theory section. Finally, since few analysis of US WR margins using post 1998 data exist, this research will fill that void in the literature.

3 Theory Model and Methods

We develop the model used for our research in two stages. In stage 1, we describe the base model, and, in stage 2, we modify the model to test for a possible structural break in 1999 induced by changes in the retail beef market.

3.1 Stage 1: The Base Model and Determinants of the Marketing Margins

Following Wholgenant (2001), the development of the base model begins by assuming profit-maximizing firms provide marketing services until the marginal value of the services is identical to marginal costs (1),

(1)

$$M = MC(Q, C)$$

where M is the marketing margin P_F - P_R, Q is the quantity of beef processed, C is a vector of marketing inputs, and MC is the marginal cost of marketing services. Equation (1) can be rearranged to provide a relative price spread model (2),

(2)

$$M = P_R * MC(Q, C/P_R) = P_F - P_R$$

where P_R and P_F are beef prices at retail and at the farm expressed in retail weight equivalents and measured in cents per pound. In linear form, (2) can be expressed as (3),

$$Mt = \beta_1 P_{Rt} + \beta_2 P_{Rt} Q_t + \beta_3 IC_t + e_t$$

where Q_t is per capita quantity of beef produced, IC_t is an index of marketing costs, and e_t is a random error term. To investigate margin behavior at retail, it is useful to decompose the margin equation into farm-wholesale and wholesale-retail margins which leads directly to the augmented relative price spread (ARPS) framework (Capps, et al.). Here, we further modify the ARPS model by including the price of substitute pork, a measure of labor productivity, and four-firm concentration ratios in linear and non-linear form. Researchers have shown that it is important to include the price of a substitute in commodity models, and the use of a productivity measure should make it possible to identify the changes in margins associated with changes in processing and marketing technology (Marsh and Brewster). Further, Digal and Esfahani argue that the relationship between performance and market power may be more accurately represented in a non-linear fashion. Finally, we allow for possible changes in the level of the margin after 1999, by including dummy variables (D_i) in each equation. The dummy if significant will signal a change in the underlying data generating process of the marketing margins Equations (4) and (5) provide the decomposed FW and WR specifications used in the analysis,

(4) $M_{FWt} = \lambda_1 P_{Wt} + \lambda_2 CONS_t + \lambda_3 (P_{Wt} * CONS_t) + \lambda_4 ICW_t + \lambda_5 (TOP_4 W)_t + \lambda_6 LPRODW_t + D_i + \lambda_7 SQTOP_4 R_t + \lambda_8 SW_t + \upsilon_{1t}$

(5) $M_{WRt} = \mathrm{a}_1 P_{Rt} + a_2 CONS_t + a_3 (P_{Rt} * CONS_t)_t + a_4 ICR_t + a_5 (TOP4R)_t + a_6 LPRODR_t + D_i + a_7 SQTOP_4 W_t + a_8 SR_t + \upsilon_{2t}$

Where for (4) and (5), (M_{jkt}) is the quarterly j to k beef marketing margin in cent per lb retail weight equivalent, and j, k represent farm, wholesale or retail. Furthermore CONS is quarterly consumption of beef per capita, ICW and ICR represent indices of wholesale and retail marketing cost and are measured by wholesale and retail labor costs respectively. $(TOP_4 R)$ and $(TOP_4 W)$ are the four firm concentration ratios in the beef packing and retail grocery industry respectively. LPRODW and LPRODR measure labor productivity at wholesale and retail respectively. SW and SR are the real prices of wholesale beef and retail beef substitute pork respectively. Table E in the Appendix contains the theoretically consistent predictions about the signs of the relation between the explanatory variables and the FW and WR margins respectively. The variables are expected to have similar effects on FW and WR beef marketing margins. Below we only provide explanations of the predict of the signs of the determinants of the WR margin as we focus mainly on the WR margin because it makes up 80 percent of the FR margin.

3.2 Effect of Retail concentration a_5 on WR Margin

A surge in retail grocery market concentration in the US may increase, or decrease WR margins. Therefore the sign of the coefficient a_5 in (5) is theoretically indeterminate ex ante but is determined by the underlying econometrics. For the specific case of the US beef sector, it has been found that increasing retail concentration increases WR margins. Hall, Schmitz, and Cothern (1979), Wohlgenant and Mullen (1987) and Marsh and Brester (2004) all analyzed US beef marketing margins and the effect of increasing retail market concentration on margins at different times using different ranges of data. They all conclude that increasing retail market concentration increases US beef marketing margins. A positive and significant relation is therefore expected between the TOP_4R variable and WR margins, so a_5 in (5) is expected to be positive.

3.3 Effect of increasing retail price a_1 on the WR margin

All else equal, an increase in retail price will increase WR margins. Hall, Schimtz and Cotthern (1979), Wohlgenant and Mullen (1987) and Marsh and Brester (2004) analyzed US beef marketing margins at different times using different ranges of data. They all conclude that retail price increases usually widen WR margins.

3.4 Effect of productivity at retail a_6 on the WR margin

Increasing (decreasing) productivity at retail will result in decreased (increased) WR margin. The data however clearly shows a positive trend in labor productivity since 1999 (see fig 3) so we surmise that the coefficient (a_6) that captures the relationship between retail productivity and the WR margin will be negative.

3.5 Effect of retail marketing service costs a_4 on the WR margin

When input cost of providing retail market services increase, the WR increase (Marsh and Brester 2004). For example, if the demand for boneless beef and delicatessens increase relative to the demand for ordinary plain beef, the cost of marketing services or the wage increases and the WR margin will increase. The reverse is true when consumer-tailored retail beef demand decreases (Hahn, 2004). From graph fig 3 in the appendix, marketing service is trending up throughout the range of estimation. The econometric evidence also favors a positive relationship between retail marketing and the WR marketing margin. Hall Lana, Schmitz Andrew, and James Cothern, (1979), Wohlgenant and Mullen (1987), and Marsh and Brester 2004) all found a positive relationship between retail marketing costs and the WR margin. Consequently, we expect the coefficient a_4 in (5) to be positive and significant.

4 Data

Table A in the Appendix contains the definitions of the main variables used, the symbol used to represent the variables, the unit of measurement as well as the mean and standard deviations of the variables. All price-related variables in this table are real, deflated by the US CPI. Nominal data for the three beef margins M_{FW}, M_{WR} and M_{FR} as well as prices at the farm (P_R), wholesale (P_W), retail (P_R) and prices of substitutes at wholesale and retail (SW and SR) were all obtained from the Economics Research Service (ERS) of the USDA. The historical margin and price data are posted on the ERS website in monthly frequency [4] SAS was used to convert the data to quarterly frequency. The quarterly prices are thus simple averages of the monthly prices and the monthly prices are simple average prices for the particular months. Note that while Capps et all use de-seasonalized price and margin data, we do not. Capps, Byrne and Gary Williams (1995) argued use de-seasonalized data because they are interested in inter-year as opposed to intra-year trends in the margins. We do not de-seasonalize the data preferring to let the seasonality in a particular series explain the seasonality in other series. Tables B in the Appendix contains summary statistics for the nominal price data. As expected the nominal retail price is approximately equal to the sum of nominal wholesale and farm prices. Table C displays CPI deflated retail, wholesale and farm prices as well as real FW, WR and FR margins. As expected, the real FR is approximately equal to the sum of the real FW and WR margins. Tables D and E on the other hand contain correlation matrices of the independent variables in equations (4) and (5) respectively. A look at these correlation matrices does not give much cause to worry unduly about multicollinearity since none of the correlations are equal to 1. To estimate the effect of increasing consumption on WR margins quarterly data on US consumption of beef per capita was also obtained from the ERS. BLS's aver-

[4] Although there are many different significant players along the vertical beef supply chain we assume for simplicity that there are only three main players farmers, wholesale beef packers and retailers so the only relevant prices are the farm price, the wholesale price and the retail price. Note also that the farm price is essentially the average slaughter price of beef, the wholesale price is the average beef packer price and the retail price is essentially the grocery store price of beef. Nominal prices at wholesale retail and farm were all converted into retail equivalent weight (c/lb) using conversion factors: 1.14lbs of wholesale beef per pound of retail beef and 2.4lbs of live choice steer per lb of retail beef.

age hourly wage at wholesale is used to measure marketing costs at wholesale after deflating with US CPI. Similarly BLS's seasonally adjusted employment cost index for retail grocery stores is used to measure retail marketing costs after deflating it with the CPI. We ignore other variable costs at wholesale and retail such as energy costs because it constitute a smaller portion of total costs and is assumed to be proportional to output (Antle, 2000). Next, we utilize the BLS index of retail labor productivity for grocery stores to capture the contribution of retail productivity to WR margins. Data for the four firm concentration ratios (CR_4) at retail was obtained from the different annual versions (1995-2004) of (Lazich, 2006)'s Market Power Reporter references at the end of this paper. Since the retail concentration data was only available annually, a short program was written using time series software called the Forecasting, Analysis and Modeling Environment (FAME) to convert the annual data to quarterly frequency using Cubic-Spline-Interpolation. Packer Concentration data was obtained from the current and previous issues of Packers and Stockyards Statistical Report. Retail market concentration obtained from the ERS was also compared to the FAME generated data but differences were minor.

5 Estimation Procedure

Recall that OLS regression using non-stationary data yields spurious results (Granger and Newbold, 1974). To ensure that all explanatory variables were stationary, unit root tests of stationarity were performed for all the independent variables in (4) and (5) using the Augmented Dickey Fuller (ADF) testing procedure in STATA. The AKAIKE criterion was then employed to select the appropriate number of lags. In other words models with no constant and no trends (NCNT) were compared to models with no constant but with a trend (NCT). The NCT models were analyzed first. We checked to see if the trend was significant or not in the NCT model. If the trend was significant, NCT was the right model. The AKAIKE criterion was then used to select the optimal lag length. If the trend was not significant then the NCNT model was preferred to the NCT model [5] Before including variables and interactions of variables to perform tests of structural break we verify that equation (5) essentially captures the trends WR marketing margins by estimating (5) by OLS regression. Technically (4) and (5) could be correctly estimated equation by equation using OLS assuming that the assumption concerning the error terms are satisfied and that OLS is indeed BLUE. We only report test results from the WR equation since this is our focus but carry out identical tests on the FW margins. To obtain a handle on just how biased or inefficient initial OLS equations of the WR retail margins is, we subjected it to a battery of tests. First to ensure the absence of serial correlation, correlograms of the error term were generated and analyzed (chart 1 in Appendix). The Breusch and Pagan (1994) LM test was also used to test for AR (p) serial correlation. The alternate Durbin Watson test for serial correlation is not applicable in this case because the margins are estimated without a

[5] In the event that all the independent variables of the WR margin were non-stationary but the error is stationary the margin equation is co-integrated. Recall also that in the case of more than two variables in a cointegration relationship the coefficients will not display asymptotic t-distributions except if the right hand side variables are independent and there exists a single co-integrating vector ((Enders, 1994). p. 380): otherwise F-tests are invalid. In other words the possibility of the existence of multiple cointegration relationships requires that the set of independent variables of each margin relationship must be necessarily independent.

constant term (Draper and Smith, 1981). The Breusch and Pagan (1994) LM test for heteroskedasticy was also applied. Finally a test of functional form misspecification, specifically a test for omitted variables was performed. The OLS estimations of the WR margin are heteroskedastic but not autocorrelated. The OLS estimates were therefore corrected for heteroskedasicty by using White's heteroskedastic robust estimator.

As correctly identified by Capps, Oral, Byrne Patrick and Gary Williams (1995), non-zero cross equation correlations are possible between the error terms in equation (4) and (5). If such cross correlation do exist then Seemingly Unrelated Regression (SURE) provides a more precise or efficient estimate compared to OLS (Wooldridge, 2003). However, if the retail price in (5) is endogenous in the WR marketing margin, 3SLS is preferred to 2SLS. We use Hausman's (1974) test to test for endogeneity of P_R in the WR marketing margin equation given by (5) (see Tale K.1). The result verified that the null hypothesis of strict exogeneity of the independent variables must be be rejected. Consequently estimation of (4) and (5) is by three stage least squares (3SLS).

6 Stage 2: Testing for Structural Break

Using our modified version of the Caps et all ARPS model, we test for structural break tests based on the hypothesis that unexpected increase in retail concentration resulted in the exercise of higher oligopsony power relative to oligopoly power to such an extent that a significant change occurred in WR margins in 1999. Positive results from our structural break test will confirm our hypothesis that the possible structural break in 1999 was indeed due to the unexpected surge in retail concentration in 1999. Specifically, we hypothesize that the unexpected increase in retail market concentration in 1999 which was caused by the emergence of Wal-Mart as the retail industry leader in 1999 might have caused a fundamental change in the retail beef sector. We follow Capps, Oral, Byrne Patrick and Gary Williams (1995) and include TOP_4RD as a slope shifter for the WR margin. TOP_4RD = (CR_4 at retail)*D where D = 0 before 1999 and D = 1 after 1999. We argue that the rapid emergence of Wal-Mart as an industry leader increased CR_4 at retail as Wal-Mart increased its own Market share from virtually zero before 1999 to almost 10 percent by 1999 and to 20 percent by 2004 Lazich (2004). This potentially fundamentally changed the retail beef environment. We perform this test using both the OLS and the 3SLS estimators. We had to define a corresponding slope shifter for the FW margin for the 3SLS estimators. TOP_4WD is a slope shifter for the WR margin. TOP_4WD = (CR_4 at wholesale)*D where D = 0 before 1999 and D = 1 after 1999. A significant coefficient of this slope-shifter interaction dummy variable is evidence of a fundamental change in the data generating process of the WR margins caused by the change in the retail market sector.

7 Results

We first present the results of the robust OLS version of Capps, Byrnes, and Williams (1995), model executed using our data with the only modification being to add the dummy for 1999 in order to determine if the model captures the underlying characteristics of the real WR beef marketing margin. From Table I, most variables have the expected signs but not all variable are significant at 5 percent significance level. In particular, the dummy for 1999 and the retail market concentration variable are positive and significant at 5 percent significance level suggesting that model is at least capturing the underlying WR relationship. The positive and significant dummy for 1999 suggests that the data generating process (DGP) of the WR margin changed in 1999. By contrast, marketing costs and beef consumption are not significantly related to the WR margins at 5 percent significance. However, since the R-square for the regression is reasonably high (0.69), as a set, the explanatory variable explain a lot of the variation in the WR margins. The results of the OLS of our modified version of Capps's ARPS model (corrected for heretoskedasticity) is displayed in Table J. The retail market concentration parameter and the dummy for 1999 are again positive and significant which is as we expect from the reasons given under the discussion of expected signs. Marsh and Brester, Wolhlgenant and Mullen (1987) and Hall et all (1979) also find that market concentration is positively related to WR beef marketing margins using different ranges of data. The R-square for the regression is again reasonably high; about 0.7 so the set of explanatory variables cannot explain only 30 percent of the variation in the WR margin. Paradoxically the productivity variable is positive but we expect it to be negative given that the retail productivity has been increasing since 1999. Increasing retail productivity should logically increase the input cost of preparing retail beef thereby decreasing the retail price without necessarily decreasing the wholesale price. It follows therefore that increasing retail productivity should decrease not increase WR margins. Although Marsh and Brester (2004) also conclude that retail productivity is positively and significantly related to WR margins, they conclude that productivity is positively related to WR margins because productivity was declining over the range of their estimation. For the reason that the sign of the productivity result is not consistent with theoretical prediction the main theoretically reasonable explanation for the positive surge in marketing margins remain the surge in market concentration. The fact that retail market concentration is positive and significant provides the preliminary answer to our first research question: what are the important factors affecting margins? A reasonable preliminary answer is precisely retail market power emanating from increase retail concentration. Re-estimating the model after eliminating outliers and using SRCONS instead of PRCONS to achieve identification where SRCONS is the interaction of the consumption and retail pork price variable (not reported) does not change the results significantly because the retail market concentration remains positive and significant at 5 percent confidence level. Unlike the conclusions from Capps Byrnes and Williams and Marsh and Brester's models, Table K.1 confirms that the Hausman endogeneiy test to determine the endogeneity of retail price in the WR margin rejects the null null of exogeneity of retail price. We there correctly estimate the system by 3SLS instead of ITSURE. From Table K.2 which contains the 3SLS results, focusing on the WR margin coefficients in the lower half of the table we see that the retail market concentration coefficient is positive and significant at 5 percent significance level as expected and in conformity with the OLS results. However although the retail price and marketing costs variables have the expected sign they are not significant at 5 percent significance level. The structural break dummy is also positive and significant. It seems plausible to argue therefore that an increase in market concentration was the key determinant of marketing margins especially given that a positive coefficient on the productivity variable will narrow not widen margins. Using the conjectural variations argument due to Appelbaum (1982), an increase in market concentration typically increases market power. We argue that the unexpected increase in retail market concentration which increased retail oligopsony power relative to wholesale oligopoly power is the most likely reason why WR margins changed in 1999. We concede that the literature on beef marketing margins using pre-1998 data ascribes a minor role to market power as a determinant of WR margin. We however argue that that our finding of a larger role for retail market power using our more recent data set that includes 1998 while at variance with the previous finding necessarily has to be different because of the increasing importance of retail market power more recently. The formal tests of structural lends more support to our conjectures: From the results of the Wal-Mart inspired slope shifter structural break test in Table M using 3SLS regression, it is clear that the slope shifter variable is significant at 5 percent. This confirms our hypothesis that the changes in the WR margins is inspired by a change in retail market concentration. On calculating elasticity of transmissions from wholesale to retail and from retail to the farm following exactly the formula provided by Capps et all (1995), we obtain values of 0.7 for the former which indicates presence of market power and 1.0 for the later calculations which suggests the absence of market power.

8 Conclusions and Challenges for Future Research

Although labor productivity at retail, marketing costs and retail prices all changed in the range of data analysis the variation in these determinants of marketing margins do not explain the changes in WR margins in 1999. This is because labor productivity increased not decreased during the period and should therefore decrease not increase margins. The price and marketing variables were not significantly related to the real WR margins at 5 percent significance so they did not change margins much. A theoretically reasonable explanation for the increase in marketing margins in 1999 is provided by the increase in retail oligposony market power emanating form increased retail market concentration that occurred around the same same time. The OLS and 3SLS versions of the modified ARPS both support this result. Further evidence is provided by the Wal-mart inspired test of structural break. Finally recall that the elasticity of transmission from retail to wholesale and from wholesale to the farm gives us an indication of the sensitivity of the farm price to changes in the wholesale price and the sensitivity of the wholesale price to the retail price. The value of 0.7 translates into exercise of retail market power because in the absence of market power the elasticity of transmission is close to 1.0 one as recorded for the farm-wholesale transmission elasticity. Despite the evidence of exercise of retail power, caution should be exercised in the use of the research results to guide policy decisions because some determinants of marketing were not included in this research the most important of which is risk. As Azzam (1997) has outlined, when risk is included in the analysis of margins the results often changes. However since the variance of the retail price before and after 1999 appear to be similar we expect risk to have a limited role in explaining WR margins. The contribution to market power due to changing variety, time and quality were also not considered in depth. (Demsetz, 1973) argues that increasing retail market concentration reduces cost as well as increasing market concentration so the two effects must be appropriately decomposed. Further research needs to address these issues. Recall also that only domestically produced beef was used in this analysis and beef consumed at fastfood outlets was ignored; it might be instructive to see what effect importation and exportation of beef and beef consumed at fastfood outlets have on US beef marketing margins. A final but very pertinent challenge for future research is the collection of quality national retail market concentration data at a high frequency since the result of this kind of research hinges critically on minimizing errors in the collection of the data.

References

ANTLE, J. M. (2000): "No Such Thing as a Free Safe Lunch: The Cost of Food Safety Regulation in the Meat Industry," *American Journal of Agricultural Economics*, 82(2), 310–22.

APPELBAUM, E. (1982): "The Estimation of the Degree of Oligopoly Power," *Journal of Econometrics*, 19(2-3), 287–299.

AZZAM, A. M. (1997): "Measuring Market Power and Cost-Efficiency Effects of Industrial Concentration," *Journal of Industrial Economics*, 45(4), 377–86.

BAIN, J. (1951): "Relation of Profit Rate to Industry Concentration American Manufacturing, 1936-1940," *The Quarterly Journal of Economics*, 65, 293–324.

BRESNAHAN, T. F. (1989): "Empirical Studies of Industries with Market Power," *Handbook of Industrial Organization*, 2, 1011–1057.

CAPPS, O., P. BYRNES, AND G. WILLIAMS (1995): "Analysis of Marketing Margins in the U.S. Lamb Industry," *Agricultural and Resource Economics Review*, 24(2), 232–240.

CHOUDHURY, S. (2005): "Measuring Market Power in Beef And Pork Markets," *Purdue Department of Agricultural Economics PhD Dissertation*.

COTTERRILL, R. (2006): "Antitrust Analysis of Super Markets," *The Australian Journal of Agricultural and Resource Economics*, 50(1), 17–32.

DEMSETZ, H. (1973): "Industry Structure, Market Rivalry and Public Policy," *Journal of Law and Economics*, 16, 1–9.

DIGAL, L. N., AND F. Z. AHMADI-ESFAHANI (2002): "Market power analysis in the retail food industry: a survey of methods," *The Australian Journal of Agricultural and Resource Economics*, 46(4), 559–584.

DRAPER, N. R., AND H. SMITH (1981): "Applied Regression Analysis," 2.

ENDERS, W. (1994): "Applied Econometric Time Series," *John Wiley and Sons*.

GRANGER, C., AND P. NEWBOLD (1974): "Spurious regressions in econometrics," *Journal of Econometrics*, 2, 111120.

HAHN, W. (2004): "Beef and Pork Values and Price Spreads Explained," *Electronic Outlook Report of The Economic Research Service, USDA*, LDP-M(118).

HALL, L., A. SCHMITZ, AND J. COTHERN (1979): "Beef Wholesale-Retail Maarketing Margin and Concentration," *Economica*, 46, 295–300.

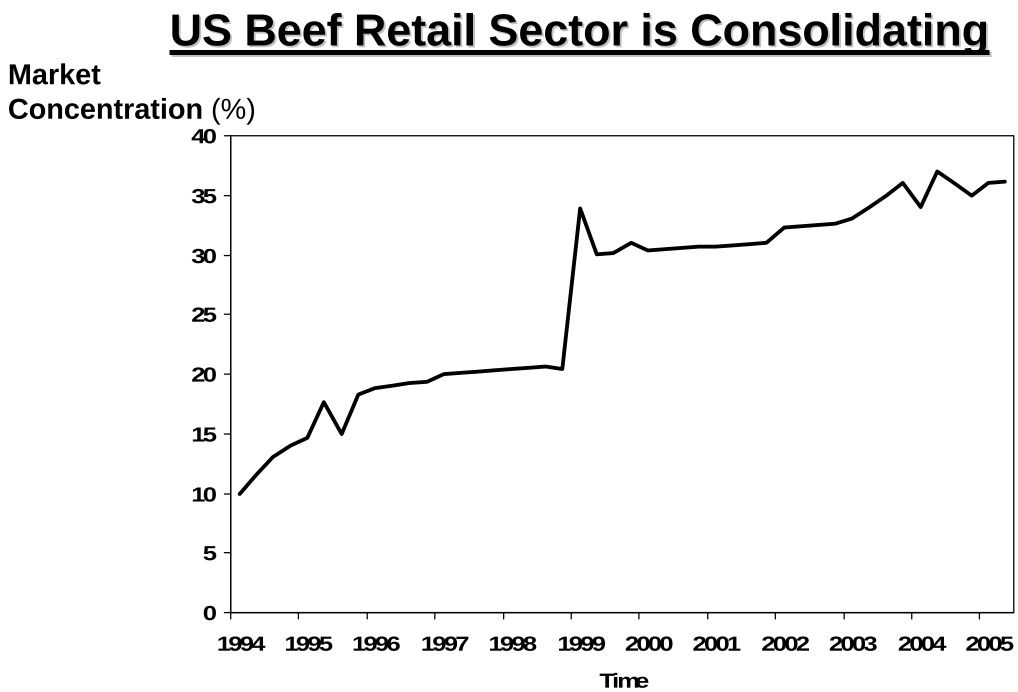
LAZICH, R. S. (2006): "Market Share Reporter:Annual Compilation of the Reported Market Share Data on Companies,Products and Services," *Thomas Dale*, Different Isses.

MARSH, J., AND G. BRESTER (2004): "Wholesale -Retail Margin behavior in Pork and Beef," *Journal of Agricultural and Resource Economics*, 29, 45–64.

TRAIL, B. (2006): "The Rapid Rise of Supermarkets," *A Review of Economics and Statistics*, 24(2), 163–174.

WOHLGENANT, M. (2001): "Marketing Margins, Empirical Analysis," *Bruce Gardner and Gordon Rausser, ed Handbook of Agricultural Economics*, 1, 934–970.

WOHLGENANT, M., AND J. MULLEN (1987): "Modeling the Farm-Retail Price Spread for Beef," *Western Journal of Agricultural Economics*, 12(2), 115–125.

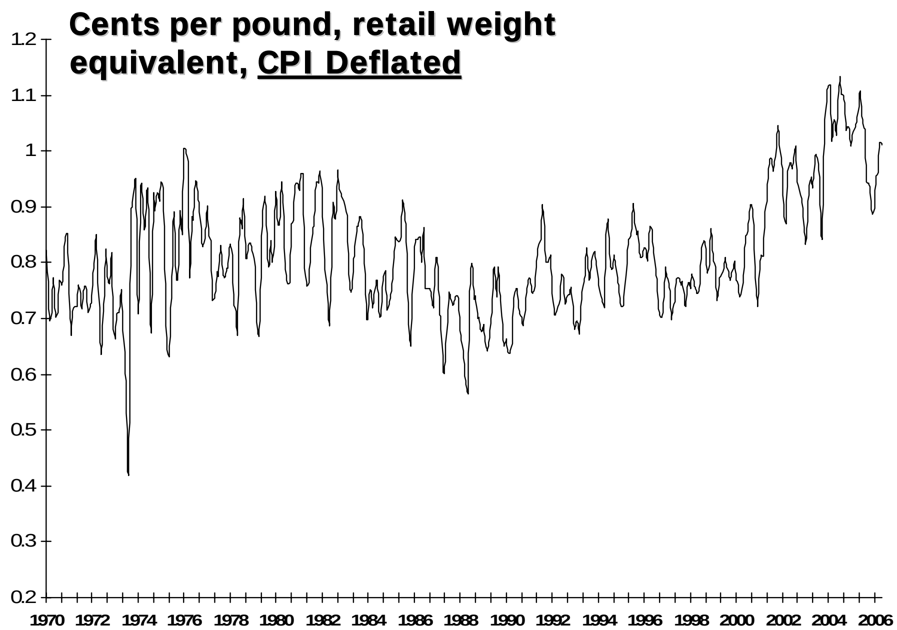


Sources: **Market Share Reporter and USDA**

labelbpr:FIG1

beginfigure[ht]

Retail-Farm Price Spread For Beef, All Data



Source: ERS

labelbpr:FIG2

Narrow Range of Labor Cost Increase, Improving Retail Productivity

Source: ERS OF USDA

labelbpr:FIG3

Table A: Variable Definition and Summary Statistics

SYMBOL	Variable Description	Mean
M_{FW}	Farm-Wholesale Margin, c/lb Deflated	0.18
		(0.04)
M_{WR}	Wholesale-Retail Margin, c/lb, Deflated	0.8
		(0.08)
P_R	Retail Price, c/lb, Deflated	1.87
		(0.15)
P_W	Wholesale Price, c/lb, Deflated	1.07
		(0.09)
P_F	Farm price, c/lb, Deflated	0.8
		(0.08)
CONS	Consumption of Beef Per Capita	16.62
		(0.08)
ICW	Index of Wholesale Cost, Deflated, $	0.09
		(0.003)
ICR	Index of Retail Cost, Deflated, $	0.5
		(0.014)
TOP_4R	Top 4 concentration ratio for Groceries, %	24.4
		(9.65)
TOP_4W	Top4 Packer Concentration Ratio, %	68.6
		(2.52)
PRODW	Productivity at wholesale, output/hr	109.3
		(20.56)
PRODR	Productivity at retail, output/hr	103.9
		(4.6)
YEAR	Measure of technology	23.5
SW	Price of Substitute Pork at Wholesale, c/lb, Deflated	0.66
		(0.01)
SR	Price of Substitute Pork at Retail, c/lb, Deflated	1.47
		(3.2)

Table B: Descriptive Statistics of Nominal Beef Prices

Variable	Mean c/lb	Std Dev	Volatility	N
Farm Price	152.73	21.85	0.143063	46
Wholesale Price	182.9	27.22	0.15	46
Retail Price	321.49	49.44	0.15	46

labelbpr:FIG5

Table C: Descriptive Statistics of Real Beef Prices and Margins

Variable	Mean c/lb	Std Dev	Volatility	N
Farm Price	0.8	0.08	0.1	46
Wholesale Price	1.07	0.09	0.08	46
Retail Price	1.87	0.15	0.08	46
Farm-Wholesale Margin	0.18	0.04	0.22	46
Wholesale-Retail margin	0.8	0.08	0.1	46

Table D: Correlation Matrix for Independent Variables of the Farm-Wholesale Margin

	P_W	TOP_4W	ICW	SW	$SQTOP_4W$	CONS	P_WCONS
P_W	1						
TOP_4W	0.137566	1					
ICW	0.177859	-0.075335	1				
SW	0.041928	0.131623	-0.6389	1			
$SQTOP_4W$	0.151876	*0.998318*	-0.0622	0.1204	1		
CONS	0.293255	0.234776	0.60049	-0.203	0.24490732	1	
P_WCONS	*0.915942*	0.204982	0.39593	-0.0538	0.22088345	0.6513	1

Table E: Correlation Matrix for Independent Variables of the Wholesale-Retail Margin

	P_R	ICR	TOP_4R	SR	CONS	PRCONS
PR	1					
ICR	0.276279	1				
TOP_4R	-0.341237	-0.839248	1			
SR	-0.097763	0.389003	-0.150553	1		
CONS	0.349963	0.599573	-0.618572	0.181419	1	
P_RCONS	0.913055	0.46925	-0.520817	0.007138	0.700593	1

labelbpr:FIG6

Table E: Expected sign of Coefficient in the margin equations

Farm-Wholesale Margin (M_{FW})	Coefficient Symbol	Expected Sign
P_W	λ_1	Positive
CONS	λ_2	Negative
P_WCONS	λ_3	Ambigous
ICW	λ_4	Positive
TOP_4W	λ_5	Positive
LPRODW	λ_6	Ambigous
SW	λ_7	Ambigous
$SQTOP_4W$	λ_8	Negative
Wholesale-Retail Margin (M_{WR})		
P_R	a_1	Positive
CONS	a_2	Negative
P_RCONS	a_3	Ambigous
ICR	a_4	Positive
TOP_4R	a_5	Positive
LPRODR	a_6	Ambigous
SR	a_7	Positive
$SQTOP_4R$	a_8	Negative

labelbpr:FIG7

TABLE G: Stationarity Tests of All Key Variables in the FW and WR Margins

Variable Definition	# of lags using AKAIKE criterion	Trend is significant	5% critical Value= - 1.950	Ho: Series is Non-Sationary
MFW	2	NO	-0.095	ACCEPT
MWR	1	NO	-0.49	ACCEPT
ERROR(MFW)	3	NO	-2.1	REJECT
ERROR(MWR)	4	NO	-2	REJECT
P_R	2	NO	-1.6	ACCEPT
P_W	1	NO	-2.28	REJECT
P_F	4	NO	-1.08	ACCEPT
CONS	8	NO	-1.359	ACCEPT
ICW	2	NO	-1.02	ACCEPT
ICR	2	NO	-0.98	ACCEPT
TOP_4R	3	NO	-0.925	ACCEPT
TOP_4W	4	NO	-1.2	ACCEPT
PRODW	3	NO	-1.502	ACCEPT
PRODR	2	NO	-0.45	ACCEPT
YEAR	1	NO	-0.2	ACCEPT
SW	2	NO	-0.97	ACEPT
SR	2	NO	-1.01	ACCEPT

labelbpr:FIG8

Fcritical = 3.0 and Fstatistic = [8, 46 - (2*8)] = F [8, 20] = [3.00]

Chart 1 AC Plot of WR Margin Error from OLS

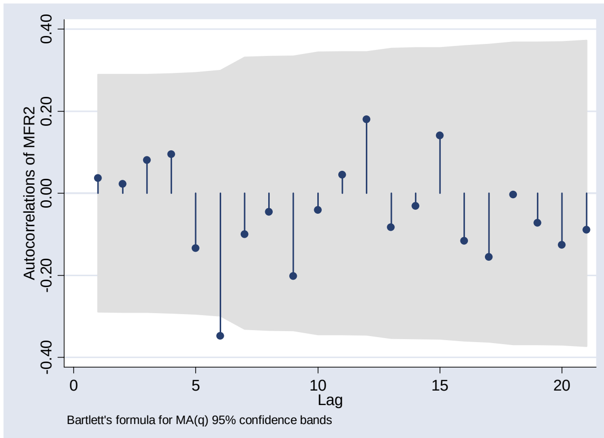


Table H: Battery of Test for the WR Margin (OLS)

Table H.1 Breusch-Pagan / Cook-Weisberg test for heteroskedasticity

Ho: Constant variance

Variables: fitted values of WR

Chi-Sq(1) = 3.94

Prob > Chi-Sq = 0.0473

Conclusion: Reject Ho so model is heteroskedastic

Table H.2 Breusch-Godfrey LM test for autocorrelation

Lags(p)	Chi-Sq	DF	Pob Chi-sq
1	0.072	1	0.788
2	0.096	2	0.95
3	0.395	3	0.94
4	0.92	4	0.92
5	2.4	5	0.8

Ho: no serial correlation

Conclusion: Accept Ho so model is not serially correlated

Table H.3 Ramsey RESET test using powers of the fitted values of WR

Ho: model has no omitted variables

F(3, 36) = 0.43

Prob > F = 0.7318.

Conclusion: Accept Ho: model is well specified

labelbpr:FIG9

TABLE I: Heteroskedasticity consistent OLS regression results for the WR US beef marketing margins, using the Capps Byrnes and Williams (1995) model

	M_{WR}
P_R	1.274
	(0.83)
TOP_4R	0.005
	(3.47)**
ICR	0.936
	(0.59)
CONS	0
	(0.49)
PRCONS	0
	-0.51
D	0.18
	(2.64)*
Observations	46
R-squared	0.69
Robust t statistics	in parenthesis
* significant at 5%	** significant at 1%

TABLE J: Heteroskedasticity consistent OLS for WR beef marketing margins, *my model*

	M_{WR}
P_R	1.136
	(0.74)
TOP_4R	0.001
	(3.4)*
ICR	0.945
	(0.65)
SQTOP4R	0
	(0.28)
SR	-0.061
	(0.4)
PRCONS	0
	(0.62)
D	0.144
	(0.55)
PRODR	0.01
	(2.1)*
Observations	46
R-squared	0.73
Robust t statistics	in parenthesis
* significant at 5%	** significant at 1%

labelbpr:FIG10

TABLE K.1: Endogeneity test

Tests of endogeneity of: P_R	
Ho: Regressor is exogenous	
Wu-Hausman F test:	P-value = 0.00114
Durbin-Wu-Hausman chi-sq test:	P-value = 0.00048

Conclusion: Reject Ho. Conclude Price is endogenous in the WR equation

TABLE K.2: Regression results for 3SLS regression using *my model*

	(1)	(2)
	M_{FW}	M_{WR}
P_W	-0.096	
	(0.91)	
SW	-0.112	
	(1.94)	
ICW	-1.122	
	(0.39)	
TOP_4W	0.004	
	(1.61)	
$SQTOP_4W$	0	
	(1.64)	
PWCONS	0	
	(2.31)*	
D	0.036	0.315
	(2.20)*	(1.28)
PRODW	0	
	(1.84)	
P_R		3.863
		(1.46)
SR		-0.027
		(0.16)
ICR		1.058
		(0.81)
TOP_4R		0.028
		(2.12)*
$SQTOP_4R$		0
		-0.94
PRCONS		0.001
		(1.38)
CONS		0.001
		(1.39)
PRODR		0.007
		(1.3)
Observations	46	46

* Significant at 5%; ** significant at 1%. Endogenous variables: P_R and P_W

labelbpr:FIG11

TABLE M: Structural break test using the slope shifter argument

	(1)	(2)
	M_{WR}	M_{FW}
TOP_4R	0	
	(1.82)	
$SQTOP_4R$	0	
	(2.1)*	
ICR	0.079	
	(0.63)	
SR	-0.006	
	(0.39)	
CONS	0	0
	(67.61)**	(2.85)**
P_RCONS	0	
	(105.11)**	
TOP 4 RD	-0.002	
	(2.24)*	
D	0.061	0.012
	(1.66)	-0.45
PW		(3.004)
		(2.89)**
TOP_4W		0.008
		(2.84)**
$SQTOP_4W$		0
		(2.83)**
ICW		4.415
		(1.49)
SW		-0.157
		(2.95)**
PWCONS		0
		(3.04)**
TOP 4 WD		0.001
		-1.82
Observations	46	46

Absolute value of z statistics in parentheses
Significant at 5%; ** significant at 1%

labelbpr:FIG13