

The Effects of Meat Exports and imports on Wholesale Primal Prices

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Trade liberalization has increased livestock sector interest regarding the impact of exports and imports on domestic meat prices. The focus of this analysis was to determine the impact on wholesale prices of various cuts of beef and pork from changes in U.S. meat exports and imports. The results of this analysis found that U.S. beef and pork exports and imports from different locations impacted cut prices differently.

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Trade liberalization has increased livestock sector interest regarding the impact of exports and imports on domestic meat prices. Meat imports decrease farm prices through increased supply, and meat exports increase farm prices through increased demand. Meat quality, defined here by the type of various cut of beef and pork is often overlooked when studying price effects of exports and imports. For a given quantity, the price effect from exporting/importing high-quality (i.e., high valued) cuts or products is greater than the price effect from exporting/importing low-quality cuts or products. Therefore, exports and imports may affect different valued primal meat prices differently and thus have different impacts on farm prices. Research on quality of meat exports and imports is needed to determine on-farm price impacts and to provide insight into international allocation of check-off dollars. The focus of this analysis is to determine the impact on wholesale prices of various cuts of beef and pork from changes in U.S. meat exports and imports.

Figures 1 and 2 graphically depict trends in U.S. beef and pork exports and imports from 1988 through 1997. There have been considerable changes in the levels of exports and imports of these commodities over the past decade. The U.S. has shifted from a net importer of beef and pork to recently a net exporter of each. The types of cuts being exported tend to be different than those imported, therefore, the marginal meat price impact of exports likely differs from that of imports.

This analysis adds to the breadth of previous research by investigating the effects of meat exports and imports on various cuts of beef and pork. Previous analyses have been limited to beef (e.g., Freebairn and Rausser; Hoffland, Hayenga, and Hayes; Marsh; Ward). Additionally, these studies are either outdated and used aggregated data (Freebairn and Rausser; Ward) or are limited to one export market for multiple cuts (Hoffland, Hayenga, and Hayes) or live animals (Marsh). There

is a need to update the literature, expand the data to include additional import and export markets, and empirically test import and export effects on alternative meat types.

Allocation of check-off dollars in the livestock industry is of particular interest. Expanding export markets (from 1985 to 1997 beef and pork exports increased 466% and 641%) provide opportunities for check-off allocation to promote international meat sales. However, questions arise as to which countries or regions to direct check-off dollars. That is, large exports of low-value meats may have less of an impact on producer prices than small exports of high-value meats. One of the objectives of this analysis is to provide insights as to where check-off dollars might provide the highest return when targeted in international markets.

The price impact of meat and live animal exports and imports is of great interest to the livestock industry and policy makers. Empirical research has not evaluated the effect of exports and imports by meat cut and for different meat types, but has focused primarily on imports of specific meat types at the aggregate level or specific cuts for a single export market. This analysis determines the price impact of domestic meat exports and imports for various cuts of beef and pork.

Empirical Model

The impact of changes in exports and imports on primal prices is important for making policy recommendations regarding export/import restrictions and expansion and for determination of check-off dollar allocation abroad. To determine the impact on wholesale primal prices for beef and pork a demand model was constructed for specific primal cuts within each meat type. The empirical model to be estimated is:

$$(1) \quad P_{jit} = \alpha_{ji} + \beta_{ji1} PPC_{jt} + \beta_{ji2} MC_t + \beta_{ji3} NAFTA_t + \beta_{ji3+r} \sum_{r=1}^R I_{jtr} + \beta_{ji3+R+s} \sum_{s=1}^S X_{jts} + \epsilon_{jit}.$$

Where subscript j represents meat type, subscript i represents cut, subscript t represents week, subscript r represents import country, and subscript s represents export country. The dependent variable (P_{jit}) is the wholesale price of cut j of type of meat i at time t . Numerous wholesale cut prices for beef and pork were available; however, for this analysis only a subset of these cuts were evaluated for beef and pork. The beef cuts analyzed were Rib Roll (112A); Boneless Chuck (113A); Armbone Chuck (126); Round (168); and Bottom Round (170). The pork cuts analyzed were fresh loin; Sliced Bacon; Spareribs; Boston Butts; and Sausage.

The first term (α_{ji}) represents the intercept term which varies by meat type and cut within the meat type. The next term (PPC_{ji}) is per capita monthly production of beef or pork. Monthly quantities marketed by cut are not available. Capps et al. proportioned quantities for individual beef cuts as percentages of carcass. However, their technique assumed constant proportions over time, and therefore monthly production of beef and pork is essentially equivalent to their specifications. Own parameter estimates are expected to be inversely related to price to conform to downward sloping demand curves.

An index of marketing costs for meat (MC_i) was included in the model to capture the effect on prices from changes in the costs of wholesale marketing services. Capps et al. found an increase in marketing costs to sometimes increase wholesale beef cut prices. However, in a derived demand with inelastic supply, in the short run, an increase in marginal costs would impact farm price and leave wholesale prices unchanged. Therefore, the expected sign on this variable is unknown. A dichotomous dummy variable was included to model the effect of the North American Free Trade Agreement (NAFTA). The NAFTA dummy variable equals *zero* prior to January, 1994, and *one*

after. The effect of NAFTA ($NAFTA_i$) is expected to vary by cut, with no *a priori* sign on a specific cut.

The quantity of imports (I_{jir}) and exports (X_{jis}) are included in the model to capture quality of quantities transported into and out of the U.S. by import and export country.¹ Only those countries having continuous trade with the U.S. during the period evaluated in this study were included in the model. Those countries evaluated here are: Canada and Japan for pork import; Japan, Canada, and Mexico for pork exports; Australia, New Zealand, and Canada for beef imports; and Japan and Mexico for beef exports. There is no *a priori* expected impact of exports and imports on individual cut prices. However, U.S. exports of a particular cut to a specific country would have a positive impact on domestic wholesale prices, and U.S. imports of a particular cut from a specific country would have a negative impact on domestic wholesale prices. Specifically, the own-price effect on the dominant export/import cut would be larger than the cross-price effects. That is, if Canada primarily imported Ground Chuck from the U.S., then total exports to Canada would have the largest positive impact on the domestic wholesale price of Ground Chuck. Alternatively, if Canada primarily exported Ground Chuck to the U.S., then imports from Canada would have the largest negative impact on the domestic wholesale price of Ground Chuck.

Exports and imports of beef and pork were expressed as the ratio of exports or imports in a particular country to total exports or imports less the level of exports or imports to that country. This was done to express the level of exports or imports on a relative basis and not an absolute basis.

¹An other category was created for beef and pork exports and imports for all countries not included here; however, it was not possible to estimate equation 1 with these data due to the inability to determine instrumental variables for the endogenous system to be estimated here. This will be discussed further in the results section.

Data

Summary statistics of selected variables are listed in table 1. This analysis used monthly data for the period April, 1988 through December, 1997. Nominal prices of wholesale cuts of beef are weekly U.S. aggregate prices and were obtained from weekly publications of the *Livestock, Meat, and Wool Weekly Summary and Statistics* (USDA). Various cut prices were occasionally missing.² These prices were estimated by employing step-wise regression of the price series containing missing values as a function of prices of all other cuts of meat from the same species included in the data set to determine the price series which had the largest correlation with the regressor. The regression with highest *R-squared* was used to estimate predicted prices for missing prices. Nominal prices of wholesale cuts of pork are weekly U.S. aggregate prices and were obtained from the USDA (Duewer). Weekly wholesale cut prices for beef and pork were aggregated to monthly averages, and prices were deflated by the monthly Producer Price Index for wholesale food and feed goods (1997=100).

Per capita production of beef and pork was calculated by dividing monthly pounds of production by the resident population. Weekly production data for beef and pork was available from the *Livestock, Meat, and Wool Weekly Summary Statistics* (USDA). Weekly production data for beef and pork were aggregated to monthly data, and monthly total exports of either beef or pork were subtracted from the respective production data series. The resident population is monthly (U.S. Department of the Census).

²For each of the beef cut price series, except Armbone Chuck, less than 5% of the observations were missing (512 total observations). For Armbone Chuck, 17% of the observations were missing.

The index of marketing costs was calculated as the simple average of the index of meat packing employees average hourly wage, the producer price index for energy, the index of transportation employees average hourly wage, and the producer price index of diesel fuel (U.S. Department of Labor). This index was deflated by the CPI (1997=100).

Domestic exports and imports of beef and pork meat are monthly values. These data were obtained from the *Livestock, Dairy, and Poultry Situation and Outlook* (USDA). As shown in table 1 considerable variability exists in exports and imports across countries. For pork, Canada was the largest exporting nation to the U.S. Japan was the largest importing nation of pork from the U.S. For Beef, Australia was the largest exporting nation to the U.S. with 71,590 lbs. of beef exported monthly. Japan imported nearly 65,000 lbs of beef monthly. The data described above was used in the estimation of separate demand models for each cut by meat type described in equation 1.

Results

A concern in estimations like these is that the regressor and exports and imports may be determined simultaneously. Therefore, equation 1 was estimated using Two-Stage Least Squares (2SLS). Instruments chosen to be correlated with exports and imports and not with prices were exchange rates (Shagam), lagged domestic production, seasonality, and domestic prices of cattle or hogs.

Estimated coefficients using equation 1 for beef and pork are reported in tables 2 and 3, respectively. Models were estimated in double-log form, so estimated coefficients refer to flexibilities. The demand models estimated here explained from 8% to 64% of the variation in wholesale cut price. The factors affecting price variation in beef wholesale prices will be described first, followed by a discussion of factors affecting pork wholesale prices.

For beef, the own-quantity flexibility of per capita consumption was negative and significant in each of the models, except for Rib Roll. All flexibility estimates were less than 1.0 (absolute value), with the exception of Boston Butts, indicating inflexible or elastic demand curves. Marketing costs tended to not be significant in explaining variation in wholesale prices. This is not consistent with Capps et al. who found marketing costs to help explain the variation in wholesale beef cut prices.

The coefficient on imports of beef into the U.S. was generally of the expected sign, except for imports from Australia (which were essentially zero). Imports of beef from New Zealand seem to have the largest impact on wholesale Rib Roll and Boneless Chuck beef cut prices. For instance, a 1% increase in imports from New Zealand relative to total imports would decrease the wholesale price of Rib Roll by 0.16%. This is equivalent to a decrease in price of \$0.626/cwt for Rib Roll. For Boneless Chuck, a 1% increase in imports from New Zealand relative to total imports would decrease the wholesale price of Boneless Chuck by \$0.084/cwt (or \$0.0084/lb). Canada exports of beef to the U.S. appear to represent cuts of middle value from the Top and Bottom Round.

Domestic exports of beef to Japan and Mexico had minimal impacts on wholesale cut price. As expected, the high valued cut of Rib Roll realized an increase in price of 0.34% from a 1% increase in exports to Japan relative to total exports. This increase would impact the price of Rib Roll by almost \$1.30/cwt.

The variable for NAFTA was not statistically significant from zero for any of the beef cuts. This is not surprising in that little change in the trade pattern of beef took place with the inception of NAFTA. Marsh found similar results for the impact on feeder and live cattle price from exports and imports from Canada and Mexico prior to and after NAFTA.

For pork, all own-quantity flexibilities were of the expected sign and only one was not statistically different from zero. The own-quantity flexibility for Boston Butts was greater than one. Marketing costs only had a statistically significant impact on Sliced Bacon for the pork prices models.

Imports of pork from different locations were generally statistically significant and of the right sign. Apparently, imports from Canada and Denmark have a considerable impact on domestic wholesale pork prices. For instance, a 1% increase in Canadian exports to the U.S. relative to all other imports to the U.S. decreased price by 0.58% or \$0.78/cwt. For pork exports, exports to Canada impacted all but one of the wholesale pork prices evaluated here. Exports to Japan of high valued cuts (i.e., Spare Ribs) impacted the domestic price.

It was determined that the two highest valued cuts evaluated here (Bacon and Ribs) increased in price as a result of NAFTA. This is surprising in that the terms of trade differed little prior to and after NAFTA. These values may have increased in response the strengthening Mexican economy.

Conclusions

This study empirically investigated the impacts of exports and imports on wholesale prices of primal cuts for beef and pork. The objective of this study was to determine the quality of meats being imported into and exported out of the U.S. Results indicated that different qualities of meats are being exported and imported domestically. The results of this analysis found that U.S. beef and pork exports and imports from different locations impacted cut prices differently. For the case of beef, exports did not generally effect domestic prices, while imports had a negative impact on certain cut prices. For the case of pork, exports to Canada increased certain cut prices, and imports from Canada and Denmark decreased a majority of the cut prices studied here.

Figure 1. Monthly Domestic Exports and Imports of Beef (1988-1997)

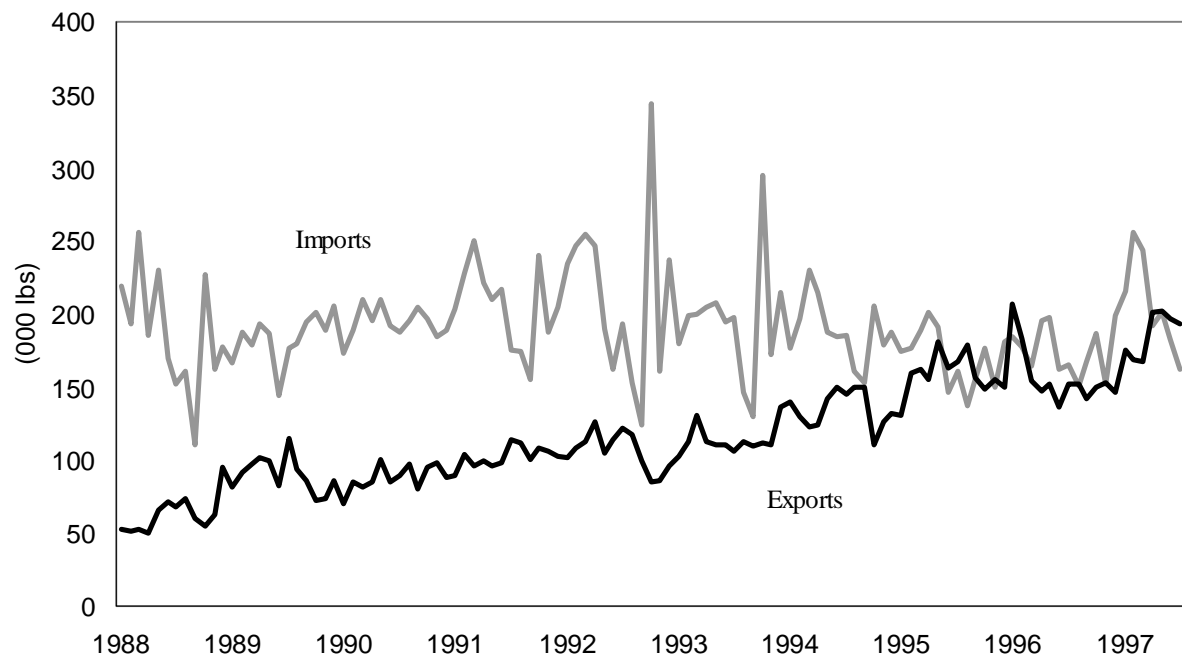


Figure 2. Monthly Domestic Exports and Imports of Pork (1988-1997).

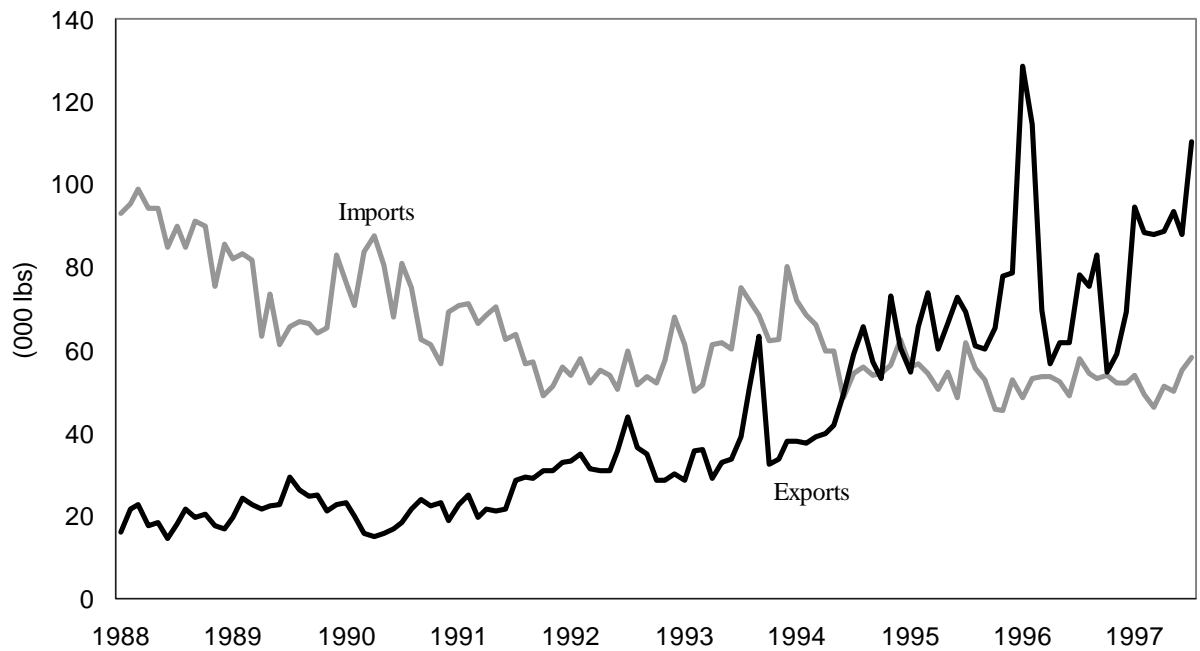


Table 1. Summary Statistics of Variables Employed in the Estimation of Equation 1.

Variable	Average	S.D.	Minimum	Maximum
Beef				
Prices (\$/cwt, 1997 dollars)				
Rib roll	385.41	49.13	50.25	508.75
Boneless chuck	93.53	11.51	65.11	114.28
Armbone	107.03	13.49	73.68	133.45
Round	146.66	19.98	107.88	178.03
Top round	152.02	18.27	115.74	187.65
Bottom round	129.71	19.07	88.38	165.96
Prod. (00000 lb)	447.16	27.40	390.67	506.62
Imports (000 lb)				
Australia	71.59	27.28	23.14	215.42
New Zealand	49.09	20.76	1.05	96.87
Canada	31.42	13.89	9.75	65.99
Exports (000 lb)				
Japan	64.23	18.68	34.73	121.05
Canada	19.14	7.29	2.93	37.27
Pork				
Prices (\$/cwt, 1997 dollars)				
Loin	107.90	11.83	78.37	144.14
Bacon	135.67	21.89	107.40	195.33
Spareribs	110.26	15.13	71.35	144.10
Boston Butts	69.67	12.54	38.37	105.05
Sausage	57.24	14.82	30.02	99.35
Prod. (00000 lb)	311.69	23.90	247.61	372.92
Imports (000 lb)				
Canada	35.84	4.40	26.00	50.81
Denmark	17.18	5.91	6.80	38.06
Exports (000 lb)				
Japan	21.08	12.95	7.62	84.60
Canada	3.87	2.95	0.57	12.40
Mexico	6.62	3.12	1.43	16.45

Table 2. 2SLS Regression Results for Wholesale Beef Cut Price.^a

	Rib Roll	Boneless Chuck	Armbone	Bottom Round	Top Round
Per capita beef prod.	0.31 (0.65)	-0.93** (3.10)	-0.93** (3.27)	-0.88** (3.13)	-0.41** (2.26)
Marketing costs	0.33 (0.51)	-0.11 (0.28)	-0.13 (0.33)	0.15 (0.41)	-0.07 (0.27)
Imports					
Australia	-0.09 (0.57)	0.10 (1.04)	0.07 (0.74)	0.02 (0.19)	0.01 (0.27)
New Zealand	-0.16* (1.69)	-0.09* (1.47)	-0.07 (1.21)	-0.08* (1.48)	-0.03 (0.76)
Canada	-0.01 (0.54)	-0.07 (0.57)	-0.09 (0.83)	-0.22* (1.97)	-0.15** (2.11)
Exports					
Japan	0.34* (1.67)	0.02 (0.15)	0.02 (0.17)	-0.01 (0.11)	0.06 (0.81)
Mexico	0.33 (1.77)	0.11 (0.98)	0.11 (1.07)	0.42 (0.38)	0.14* (1.93)
NAFTA	0.08 (0.70)	-0.02 (0.22)	-0.04 (0.53)	0.01 (0.12)	-0.03 (0.58)
Constant	3.81 (1.16)	6.94** (3.39)	7.11** (3.66)	5.65** (2.92)	6.08** (4.92)
<i>R-squared</i>	0.08	0.37	0.44	0.47	0.64

^a One and two stars represent coefficients statistically different from zero at the 0.15 and 0.05 level of significance, respectively.

^b Values in parentheses are *t*-statistics.

Table 3. 2SLS Regression Results for Wholesale Pork Cut Price.^a

	Fresh Loin	Sliced Bacon	Spare Ribs	Boston Butts	Sausage
Per capita pork prod.	-0.66** (2.62) ^b	-0.29 (1.22)	-0.81** (3.10)	-1.23** (3.16)	-0.78* (1.77)
Marketing costs	-0.34 (0.67)	1.23** (2.52)	0.62 (1.17)	0.39 (0.49)	0.90 (0.99)
Imports					
Canada	0.05 (0.41)	-0.51** (3.99)	-0.24* (1.75)	-0.31* (1.51)	-1.19** (4.98)
Denmark	-0.15 (1.04)	-0.58** (4.09)	-0.32** (2.08)	-0.56** (2.44)	-1.30** (4.95)
Exports					
Japan	0.07 (1.09)	-0.01 (0.06)	0.18** (2.55)	0.13 (1.20)	-0.04 (0.31)
Canada	0.25** (2.80)	0.18** (2.11)	0.08 (0.87)	0.31** (2.27)	0.52** (3.30)
Mexico	0.05 (1.05)	-0.02 (0.42)	-0.01 (0.10)	0.11 (1.29)	0.04 (0.44)
NAFTA	0.01 (0.02)	0.13** (2.84)	0.84* (1.62)	-0.01 (0.17)	-0.03 (0.33)
Constant	7.84** (3.16)	-0.30 (0.13)	3.10 (1.21)	4.93 (1.29)	1.59 (0.37)
<i>R-squared</i>	0.19	0.44	0.32	0.27	0.45

^a One and two stars represent coefficients statistically different from zero at the 0.15 and 0.05 level of significance, respectively.

^b Values in parentheses are *t*-statistics.

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