STATE-LEVEL ANALYSIS OF NATIONAL BEEF POLICY: THE USE OF STATE ECONOMETRIC MODELS

Roland K. Roberts and William J. Martin

Abstract

Interest has grown in analyzing the impact of national imports of foreign beef on state agricultural sectors. In this study, an interfaced Hawaiian-national model is simulated for a change in national beef imports. Hawaiian and national impacts demonstrate wide variation in both sign and magnitude. Usefulness of state models is emphasized for situations where state impacts of national policies are of interest.

Key words: beef imports, policy, econometric model, state-national interface.

Although many econometric models have been developed to assess the impact of changes in beef imports on the United States beef industry (Arzac and Wilkinson; Bain; Crom; Freebairn and Rausser; Martin and Heady; Reeves; Yanagida and Conway), little emphasis has been placed on regional or state impacts. Interest has grown in regional effects as evidenced by a statement in the Meat Imports Act of 1979 calling for a study of such impacts (Pub. L. 96-177). Interest has also grown in developing general state econometric models (Knapp et al.). For a state agricultural model to be useful for a wide range of policy analyses, it should be able to indicate state-level impacts of changes in both state and national policy (Colyer and Irwin).

The Virginia beef and pork model presented by Baum et al. is capable of such analyses. The authors emphasize a methodology for transferring information from national models to state models, and study the impact of a change in national beef imports on the Virginia beef and pork sectors. However, no comparison is made with the impacts at the national level. Without such comparisons, the need for state agricultural econometric models to analyze state impacts of national policies is not demonstrated. When state economies in general, and more specifically state beef sectors, closely follow their counterparts at the national level, state impacts could be approximated from impacts estimated by a national model.

Although the methodology proposed by Baum et al. for transferring information from national models to state models is innovative, comparisons between state and national impacts might have more fully justified their modeling effort and made the impact results more useful. On the one hand, if a proposed change in national policy was demonstrated to favorably or adversely affect the Virginia beef industry, relative to the aggregate United States beef industry, Virginia beef producers and representatives in Congress could use the model's results to lobby for or against the proposed change. Alternatively, if Virginia impacts were shown to closely follow impacts from the national model, the Virginia model's importance in analyzing the effects of national policies would be reduced.

The objective of this paper is to emphasize the need for state models when the impacts of national policies on state agricultural sectors are of interest. The importance of state models is demonstrated by interfacing a Hawaiian beef model (Roberts et al.) with a national beef model (Martin and Heady) and comparing the Hawaiian and United States impacts of a change in the level of foreign beef imported into the United States.

Although this application is specific to Hawaii, the results would be of interest to a large number of modelers involved in econometric analysis of national policy at the state level. No state has a beef industry identical to that of Hawaii or any other state. Thus, the impacts of a change in national policy might be expected to affect each state differently. Yet, the assumptions used to facilitate model interfacing apply to most states. By showing that there are wide variations in impacts at state and national levels in the case of Hawaii, the importance of the Hawaiian model is demonstrated and others

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might be encouraged to develop state beef models to analyze the effects of changes in national policy.

The United States and Hawaiian models are briefly described in the following sections. To conserve space, emphasis is placed on model interfacing. Detailed descriptions of the models can be found in Martin and Heady and Roberts et al. Impacts of a reduction in U.S. imports of foreign beef are estimated by simulating the interfaced model. State and national impacts are compared and conclusions are drawn.

THE UNITED STATES MODEL

The national model is a 55-equation quarterly econometric model of the United States livestock-feed subsector. It is used to generate national level beef and corn prices, which then determine Hawaiian prices via price transmission equations. The model covers production and inventory relations for beef, pork and broilers, the marketing and consumer demand for various kinds of meats, and a simple model of corn production and marketing. Total beef production is disaggregated by class of animal and method of finishing; i.e., into grain-fed steers and heifers, grass-fed steers and heifers, cows, and bulls. Because of a strong interest in assessing the effects of beef imports, total beef consumption is divided into table and processing quality groups as suggested by Ryan and the level of beef imports is viewed as a predetermined variable. Changes in beef imports are assumed to affect only the supply of processing quality beef, leaving the supply of table quality beef unchanged. Interaction between processing and table quality beef occurs as consumers substitute one for the other in response to changes in relative prices.

The model was formulated based on the structure of the system under study, economic theory, and previous empirical results. Equations were linearly specified and arranged in a block-recursive form. Equations of the simultaneous block were estimated by truncated two-stage least squares. The set of variables used in the first stage contained a set of key variables used for all equations, plus any other predetermined variables occurring in the equation. This approach ensured consistency of the instrumental variable estimators. Parameter estimates were verified for correspondence with economic theory and previous empirical results. Equations were estimated using quarterly data for 1962 through 1979.

THE HAWAIIAN MODEL

The Hawaiian model is a 26-equation econometric model of Hawaiian beef production and price formulation. It is similar to the national model in that beef production is disaggregated by animal class and finishing method. This greatly expands the state-national comparison capabilities beyond the Baum et al. model, which only included beef equations for cow inventory, beef cattle slaughter, calf inventory, and calf slaughter.

The beef industry in Hawaii is heavily influenced by the aggregate U.S. beef industry and the two have several similarities, but the Hawaiian beef industry is not a microcosm of the aggregate. As with the beef industries of many states such as Virginia, there are several characteristics that lead to differences in model specification. First, in Hawaiian ranchers typically retain ownership of their animals until they are sold after slaughter. Therefore, contrary to Mainland pricing practices, ranchers are paid on a carcass weight basis rather than a liveweight basis. Prices for carcasses with yellow fat are typically discounted. Thus, in Hawaii, ranchers receive clearer market signals to indicate changes in the relative profitability of grain-fed versus grass-fed steer and heifer beef production.

Second, there are no formal feeder cattle markets in Hawaii as there are on the Mainland. Ranchers generally base their breeding herd inventory decisions on the carcass weight steer and heifer prices rather than feeder calf prices. Also, the cow price appears to be less important in influencing breeding herd size than in the United States as a whole (Roberts et al.).

Third, Martin and Heady estimates an equation for placements on feed. Because of incomplete data, the Hawaiian model uses inventories of steers and heifers to link the calf crop with final beef production. This makes it difficult to divorce the decisions of how many animals to place on feed and at what weight to slaughter them once they are placed. This should not complicate the comparing of ultimate beef production from the two models.

Fourth, on average for the 1976-80 period, Hawaii imported 48 and 18 percent of the beef consumed in the State from the Mainland United States[1] (mostly choice beef) and from foreign sources (non-fed beef from Australia and New Zealand), respectively. However, quantities imported were small compared to total U.S. beef production and total imports of foreign beef into the United States (Schermerhorn et al.).

[1] The quantity imported from the Mainland United States is a rough estimate based on a regression equation estimated by the Hawaii Agricultural Reporting Service, using annual data for 1950 through 1970. Because of gross inaccuracies in reporting, accurate records of beef imported from the Mainland are not available after 1970.

Therefore, theory would suggest that wholesale beef prices in Hawaii are exogenously determined by U.S. Mainland prices, Australian, and New Zealand prices and transportation costs. Within a period of a few days, wholesale prices of comparable beef might diverge to an extent greater than the cost of transportation, but such differences should not persist over more extended periods such as a quarter or a year.

Finally, Hawaiian ranchers respond to changes in the prices they receive, but, since Hawaii is a net importer of beef, changes in Hawaiian beef prices are determined by changes in the supply and demand for beef on the U.S. Mainland or in Australia and New Zealand (holding transportation and handling costs constant).[2] Shifts in the demand for beef in Hawaii only serve to change the quantity of beef supplied from outside sources and have little impact on the price ranchers receive for their beef (a horizontal supply curve). Consequently, the demand side of the Hawaiian beef market has no appreciable influence on the quantity of beef produced in Hawaii. For that reason, and because accurate data on the quantity of beef supplied from the United States Mainland are not available, the model concentrates solely on the production of beef in Hawaii as influenced by exogenously determined prices.

Figure 1 provides a summary of the theoretical relationship between choice beef production in Hawaii, imports of choice beef from the Mainland, Mainland-to-Hawaii transportation costs, and wholesale prices of choice beef.[3] Demand and supply on the Mainland are represented by D and S, which determine the Mainland choice beef price (P_0) at their intersection. The wholesale price of choice beef in Hawaii (P_1) is equal to P_0 plus transportation costs (T). P_1 represents the demand curve for locally produced choice beef. It also represents the supply curve for choice beef in Hawaii (Hawaii-produced choice beef plus Mainland imports). The quantity produced locally (q_1) is determined by the intersection of the Hawaiian choice beef supply function (S_H) and P_1. If D_{H1} represents the demand for choice beef in Hawaii, q_2 is the quantity consumed in Hawaii, and $q_2 - q_1$ represents the quantity supplied from the Mainland to fill the gap between local production

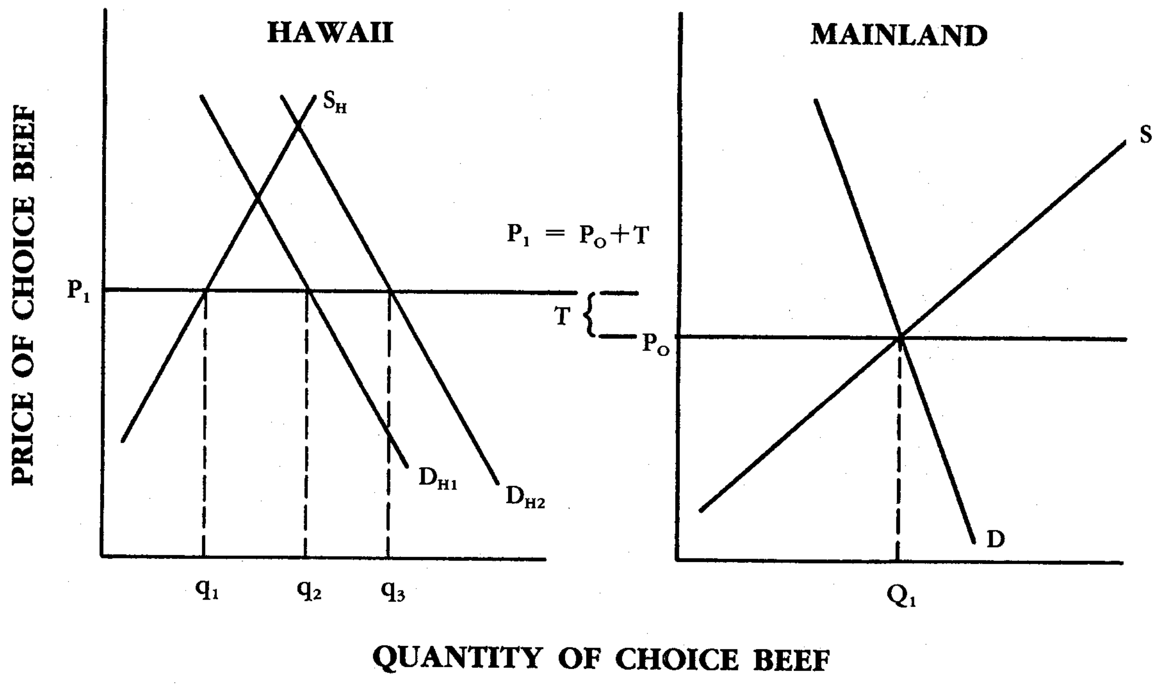

Figure 1. The Relationship of the Hawaiian Choice Beef Market to the Mainland United States Choice Beef Market.

[2] When discussing prices ranchers receive, handling costs that enter the farm-to-wholesale price margin for carcasses must also be considered.

[3] The graphical presentation which follows holds for all states, whether net importers or exporters to other states. Because there are no barriers to trade among states, the process of arbitrage should lead to beef and feed prices being about equal across states, except for transportation cost differentials. Baum et al. recognized this in the case of beef and pork in Virginia.

and choice beef consumption at price P_1. Now, if the demand for choice beef in Hawaii shifted to D_{H2}, the quantity consumed in Hawaii would easily adjust to q_3 as imports from the Mainland increase by $q_3 - q_2$. The Hawaiian price is not affected because the increase in Hawaiian importation of Mainland beef is insignificant in relation to production on the Mainland (Q_1) and because imports adjust to fill the gap within a period of a few days.[4]

A similar graphical exercise could be presented for grass-fed steer and heifer beef and cull beef, with prices being determined exogenously by Australian and New Zealand prices and transportation costs. It is important to note, however, that Australian and New Zealand beef prices are dominated by United States prices. The United States is the world's leading producer and importer of beef, absorbing one-third of the world beef trade. Evidence suggests *"that the United States is a leader in price making and inventory adjustment in the major beef exporting countries"* (Simpson, 1981, pp. 1 and 9-10). Consequently, Hawaiian prices of lower quality beef are dominated by Mainland prices via the Australian and New Zealand markets. This eliminates the need for the added modeling complexity of using Australian and New Zealand prices to determine Hawaiian cow and grass-fed beef prices.

Exogenously determined prices greatly simplify estimation procedures. The matrix of endogenous variable coefficients is triangular and it is assumed that the industry can be represented by a recursive model structure (Johnston, p. 369). Therefore, ordinary least squares, and Cochrane-Orcutt and Grid Search autoregression procedures were used to estimate the structural equations of the model (White), using quarterly and annual data for 1970 through 1980. Where lagged dependent variables were present with autocorrelation, a Grid Search technique was used to verify that the Cochrane-Orcutt procedure converged to a consistent estimator at the global maximum of the likelihood function. The Grid Search procedure was accurate to the nearest one-hundredth, still leaving a slight margin of error (Betancourt and Kelejian, p. 1,076). For those equations estimated as distributed lags, partial adjustment was assumed (Nerlove). Estimated variances for autoregressive equations that included lagged dependent variables were calculated using Dhrymes' Theorem 7.1 (Dhrymes, pp. 199-201).

MODEL INTERFACING - PRICE TRANSMISSION

Based on the model formulated in Figure 1, four equations were specified to reflect quarterly beef and feed price transmission from the Mainland United States to Hawaii. They included as explanatory variables current and lagged Los Angeles prices, ocean freight rates from Los Angeles to Honolulu, and seasonal dummy variables. Lag structures were not specified *a priori*. Therefore, in equations where lags in price transmission were hypothesized, the number of lags was determined by including successively longer lags until the coefficient of the final lag became negative or negligible relative to its standard error. Seasonal effects were retained only where significant. The equations were estimated by ordinary least squares and Cochrane-Orcutt autogressive methods with quarterly data for 1970 through 1980.

The final price transmission equations are presented in Table 1, equations 1-4. The R^2's are all greater than 0.97, suggesting that the explanatory variables provide a good fit (Kmenta, p. 234).

Ocean freight rates are used in equations 1-4 because time series on total transportation costs for beef and feed from Los Angeles to Honolulu are not available. Although ocean freight costs represent a significant portion of total transportation costs, other logistics costs such as wharfage fees, land transportation costs for hauling to and from docks, and storage, can account for a large portion, perhaps as much as one-half of the total cost (Garrod). Ocean freight rates can be viewed as proxies for total transportation costs because all transportation costs, whether for land or sea transportation, are highly correlated with energy and labor costs.

The freight rate variables are all highly significant, with coefficients ranging from 2.26 in the Honolulu choice beef price, equation 1, to 2.56 in determining the price of grass-fed beef, equation 3. These coefficients appear high at first glance, but are acceptable if one accounts for non-ocean transportation costs. If the transportation cost variables in equations 1-4 were total transportation costs rather than ocean freight rates, the expected size of the coefficients would be about 1.0. Two conditions increase the expected size of the coefficients. First, if ocean freight costs were half of total transportation costs and other logistics costs

[4] This statement holds under any situation likely to prevail in Hawaii in the foreseeable future. Hawaii has been a net importer of beef from the United States Mainland and from foreign sources since before 1954 (University of Hawaii, Cooperative Extension Service). However, it should be pointed out that if D_H and S_H were to intersect below P_1, changes in the demand for choice beef in Hawaii would then influence the Hawaiian choice beef price and, hence, local production decisions.

were highly correlated with ocean freight rates, an increase in ocean freight rates by $1.00 would be accompanied by an increase in total transportation costs of $2.00. Hence, the price of beef or feed in Hawaii would increase by about $2.00. Second, the ocean freight rates used in this analysis are calculated assuming that containers are full, which is not always true. Less than full containers are charged at a higher rate. Therefore, the actual rates are probably higher than the rates used, further increasing the expected size of coefficients.

Equation 1 most closely fits the Mainland price plus transportation cost model because of local pricing mechanisms. Once a week the major Hawaiian slaughterhouses call slaughterhouses in Los Angeles for price quotations. Hawaiian grain-fed steer and heifer prices are based on those quotations plus a markup for transportation costs.

Transmission of cow prices from the Mainland to Hawaii is more complicated than for choice beef. Pricing methods are not as well defined, and because Hawaii imports large quantities of cow beef from Australia and New Zealand, price transmission from the Mainland is indirect via the Australian and New Zealand markets. Lagged Los Angeles cow prices are included in equation 2 to capture price transmission delays caused by the great distances involved and the time required for changes in the United States cow price to work through the Australian and New Zealand markets to Hawaii.

The determination of the grass-fed steer and heifer beef price in Hawaii is complicated by several factors. First, there is no wholesale grass-fed steer and heifer beef price in Hawaii or on the Mainland. Second, a dressed weight price received by farmers is recorded in Hawaii but not on the Mainland. Third, as with cow beef, the Hawaiian price is determined by the Mainland market via the Australian and New Zealand markets. Because Hawaiian produced grass-fed beef competes with both cow and grass-fed steer and heifer beef imported from Australia and New Zealand, it is hypothesized that Mainland steer and cow prices are both highly influential in determining the Hawaiian grass-fed steer and heifer beef price. In equation 3, current and lagged Los Angeles utility cow prices and current and lagged differences between the Los Angeles choice steer price and the utility cow price are used to represent the influence of the Mainland beef market on the Hawaiian grass-fed steer and heifer price.

The Hawaiian cattle feed price paid by farmers is directly determined by Mainland prices. Most of the feed used is manufactured in Hawaii from feed stuffs imported from the Mainland. Relatively little manufactured feed is received from the Mainland for use by cattle. Again, pricing methods are not well defined, therefore, current and lagged Los Angeles wholesale corn prices are used in equation 4 to capture delays in price transmission from the Mainland to Hawaii and from one level in the marketing chain to another.

Two additional equations are required to complete the linkage of the Hawaiian model with the national model. The national model estimates retail table quality and processing quality beef prices, while the Hawaiian model uses wholesale prices as determined by Los Angeles wholesale choice steer and utility cow prices. Thus, equations 5 and 6, Table 1, are estimated to link national retail prices to Los Angeles wholesale prices. Equation 5 estimates the Los Angeles wholesale choice steer price (LAGFBPR) as a function of the U.S. retail choice beef price (USRCBPR), the choice beef carcass byproduct allowance (USCBPA), the average hourly earnings of retail growers (USAHERG), and a time trend (T). The U.S. retail choice beef price is a weighted average of the processing and table quality beef prices obtained from the national model, with weights of 0.232 for processing quality beef and 0.768 for table quality beef. These weights represent the proportions of these cuts in a typical grain-fed carcass (Ryan).

In equation 6, the Los Angeles wholesale utility cow price (LACPR) is estimated as a function of the United States retail hamburger (processing quality beef) price (USRGBPR). Specification of equations 5 and 6 incorporates the assumption that Los Angeles wholesale choice steer and utility cow prices are highly correlated with United States average wholesale choice steer and utility cow prices. This specification reduces the number of equations necessary for model interfacing from eight to six. The estimated coefficients of equations 5 and 6 conform with *a priori* expectations and the R^2's suggest a good fit.

The procedure used to link the models is to first simulate the national model under alternative assumptions about beef imports to obtain impacts on national retail choice beef and hamburger prices, and on the national average corn price received by farmers. Equations 1—6 are then used to transmit the national price impacts to Hawaii. Finally, the Hawaiian model is simulated to determine the impacts on production as ranchers respond to changes in local prices.

BEEF IMPORT SIMULATIONS

The interfaced model was simulated dynamically over the 1972 through 1980 period under two sets of assumptions regarding the level of beef imports. The first simulation was a base simulation in which historical levels of United

TABLE 1. ESTIMATED EQUATIONS FOR TRANSMITTING LOS ANGELES WHOLESALE BEEF PRICES TO HONOLULU AND FOR LINKING NATIONAL RETAIL BEEF PRICES TO LOS ANGELES WHOLESALE BEEF PRICES[a]

Explanatory variable[b]	Dependent variable[b] and equation number					
	HGFBPR 1	HCPR 2	HNFBPR 3	CFPR 4	LAGFBPR 5	LACPR 6
Intercept	−7.09 (−5.08)[c]	−14.50 (−3.76)	6.61 (−1.89)	0.32 (1.46)	−1.54 (−0.53)	1.37 (0.25)
LAGFBPR	0.98 (40.05)					
LACPR		0.24 (3.62)	0.33 (5.77)			
LACPR(−1)[d]		0.42 (5.45)	0.31 (4.97)			
LACPR(−2)		0.17 (2.28)				
LACPR(−3)		0.13 (1.85)				
LAGFBPR−LACPR			0.31 (4.22)			
LAGFBPR(−1)−LACPR(−1)			0.24 (1.90)			
LACORNPR				0.09 (1.31)		
LACORNPR(−1)				0.30 (3.17)		
LACORNPR(−2)				0.19 (2.80)		
TRANB	2.26 (6.42)	2.35 (2.69)	2.56 (2.87)			
TRANC				2.42 (12.89)		
D1			1.67 (2.35)			
D2			1.15 (1.70)			
D3			−0.07 (−0.13)			
USRCBPR					0.45 (10.27)	
USRGBPR						0.64 (11.37)
USCBPA					8.37 (3.18)	
USAHERG					−0.79 (−2.20)	
T					−0.26 (−2.90)	
$\hat{P}$		0.45 (3.37)	0.53 (4.17) (1.73)		0.25 (1.73)	0.68 (6.22)
DW[e]	1.79	1.17	1.22	1.47	1.32	0.98
R^2	0.997	0.987	0.991	0.973	0.992	0.953

[a] Sources of data: Hawaii Agricultural Reporting Service; Hawaii Market News Service; California Federal-State Market News Service; and Matson Navigation Company.

[b] Variable definitions in alphabetical order: CFPR is the cattle feed price paid by Hawaiian ranchers ($/100 lb.); D1, D2, and D3 are quarterly dummy variables for the first, second, and third quarters, respectively; HCPR is the Honolulu cow price (wholesale, all carcasses, utility, $/100 lb.); HGFBPR is the Honolulu grain-fed beef price (wholesale, 500-900-lb. carcasses, choice feedlot steers and heifers, $/100 lb.); HNFBPR is the Hawaiian grass-fed beef price (dressed weight, all steer and heifer carcasses, state average, $/100 lb.); LACORNPR is the Los Angeles corn price (wholesale, $/100 lb.); LACPR is the Los Angeles cow price (wholesale, 350-700-lb. carcasses, utility, $/100 lb.); LAGFBPR is the Los Angeles grain-fed beef price (wholesale, 600-700-lb. carcasses, choice steers, $/100 lb.); T is a time trend equal to 1 in 1970I to 44 in 1980IV; TRANB is the cost of transporting beef from Los Angeles to Honolulu ($/100 lb.); TRANC is the cost of transporting animal feeds from Los Angeles to Honolulu ($/100 lb.); USAHERG is the U.S. average hourly earnings of retail grocers ($/hr.); USCBPA is the U.S. carcass by-product allowance for choice beef (¢/lb.); USRCBPR is the U.S. retail choice beef price (¢/lb.), and; USRGBPR is the U.S. retail ground beef price (¢/lb.).

[c] Numbers in parentheses below coefficients are t statistics (asymptotic for Equations 2, 3, 5, and 6).

[d] Numbers in parentheses following variable names indicate lags.

[e] Calculated from the ordinary least squares residuals.

States imports of foreign beef were assumed to prevail. The second simulation assumed that beef imports were 50 percent below historical levels. A 50 percent reduction was assumed because relatively small impacts were anticipated. All other exogenous variables were unchanged from one simulation to the other. Results of the deterministic simulations can be interpreted as likely or expected outcomes, given the assumptions of each simulation and the estimated parameters of the model equations.

Impacts on National Retail Beef Prices

National retail prices obtained from the base simulation and impacts on those prices of a 50 percent reduction in imports appear in Table

TABLE 2. PREDICTED IMPACTS ON U.S. RETAIL BEEF PRICES OF A 50 PERCENT REDUCTION FROM HISTORICAL LEVELS OF BEEF IMPORTED INTO THE UNITED STATES, 1972-80

Year	Processing quality		Table quality		Choice	
	Historical imports assummed to prevail (base)	Imports[a] reduced 50 percent from base	Historical imports assumed to prevail (base)	Imports[a] reduced 50 percent from base	Historical imports assumed to prevail (base)	Imports[a] reduced 50 percent from base
	Price (¢/lb.)	Price change (Percent)	Price (¢/lb.)	Price change (Percent)	Price (¢/lb.)	Price change (Percent)
1972	69.6	5.7	128.0	−1.1	114.5	−0.2
1973	84.8	5.2	152.7	−1.8	136.9	−0.7
1974	83.8	6.5	165.5	−1.6	146.5	−0.5
1975	85.8	9.6	169.3	−0.4	149.9	0.9
1976	85.8	12.9	160.2	0.6	142.9	2.3
1977	99.5	12.1	183.5	1.3	164.0	2.8
1978	121.8	11.6	222.9	1.1	199.4	2.6
1979	147.6	10.6	269.8	0.6	241.4	2.0
1980	157.9	10.5	303.5	1.1	269.7	2.3
Average	104.1	9.7	195.0	0.3	173.9	1.6

[a]Results for the 50 percent reduction in imports are expressed as percentage deviations from the base simulation, with negative signs indicating decreases.

2. They are converted to annual averages to conserve space. As expected, the processing quality beef price increases in all years, with the largest percentage impact of 12.9 percent occurring in 1976. Processing beef prices increase as the supply of processing quality beef decreases with the reduction in beef imports. The impacts on the United States retail table quality beef price are slight and average only 0.3 percent over the 1972-80 period, as compared to 9.7 percent for processing beef prices. In addition, impacts on national table beef prices are mixed. Reduced imports do not immediately reduce the supply of table beef as in the case of processing beef. In fact, higher cow prices result in a slight increase in table beef production. A similar result was found by Freebairn and Rausser (p. 686). This effect arises because the opportunity cost of holding a cow in the herd increases. When beef imports are reduced, the price of cow beef increases and producers desire to hold a smaller cow herd. In the first few years, while producers make this inventory adjustment, there are more heifers available for placement on feed. Therefore, between 1972 and 1975 the table beef price actually falls as the supply of table beef increases slightly. At the same time, higher processing quality beef prices result in an increase in table beef demand. Thus, in the later years, the price impacts are positive because the positive influence of increased demand outweighs the negative influence of increased supply. The impact on the choice beef price is simply a weighted average of the processing and table beef price impacts. As expected, the impacts of reduced beef imports are substantially higher for lower quality beef prices than for choice beef prices.

Hawaiian Versus National Impacts

Table 3 contains annual average impacts of a 50 percent reduction in beef imports on beef production in the United States and in Hawaii. The impacts on Hawaiian beef prices are also presented. Impacts of a beef import reduction on the Honolulu cow price follow a slightly different pattern and are somewhat lower in magnitude than the impacts on the United States price of processing quality beef, Table 2. At the

TABLE 3. PREDICTED IMPACTS OF A 50 PERCENT REDUCTION IN BEEF IMPORTS FROM HISTORICAL LEVELS ON HONOLULU BEEF PRICES, HAWAIIAN BEEF PRODUCTION, AND UNITED STATES BEEF PRODUCTION, 1972-80[a]

Year	Honolulu beef prices			Grain-fed beef production		Grass-fed beef production		Cow and bull beef production		Total beef production	
	Cows	Grain-fed steers and heifers	Grass-fed[b] steers and heifers	United States	Hawaii	United States	Hawaii	United States	Hawaii	United States	Hawaii
	(Percent deviation from base)										
1972	3.7	−0.2	0.7	1.1	−0.2	2.5	0.0	10.8	0.9	2.9	0.1
1973	4.9	−0.6	0.5	1.9	−1.2	0.5	2.3	11.5	−0.1	3.5	−0.4
1974	5.5	−0.4	0.8	2.2	−0.9	−1.5	6.5	6.4	0.1	2.5	0.3
1975	7.8	0.7	2.0	1.7	−0.6	−1.9	4.1	3.4	0.5	1.6	0.4
1976	10.8	1.9	3.5	1.4	−0.6	−3.8	2.3	3.3	0.4	1.2	0.1
1977	11.1	2.4	3.7	1.0	−0.7	−4.9	1.8	2.4	0.1	0.6	−0.1
1978	10.5	2.2	3.6	1.1	−0.6	−6.7	1.8	4.2	0.1	1.0	0.0
1979	9.9	1.7	3.2	1.6	−0.5	−10.3	2.0	5.8	−0.5	1.4	0.0
1980	9.1	1.9	3.1	1.0	−0.2	−7.5	3.1	3.4	−0.9	0.7	0.4
Average	8.1	1.1	2.3	1.4	−0.6	−3.7	2.7	5.3	0.1	1.7	0.1

[a]Results are expressed as percentage deviations from base simulation results, where the base simulation assumes that historical imports prevail. Negative signs indicate reductions from base simulation results and positive signs indicate increases.
[b]State average price for grass-fed steers and heifers.

national level, the impacts reach a peak in 1976. In contrast, the impact on the Honolulu cow price is largest in 1977, demonstrating a slight lag in price transmission. The average impact is 8.1 percent for the Hawaiian cow price, as compared to 9.7 percent for the U.S. processing quality beef price.

Impacts on the Honolulu wholesale and U.S. retail choice carcass prices are similar in their pattern, both reaching a peak in 1977. Again the magnitude is lower in Hawaii, averaging 1.1 compared to 1.6 percent for the United States as a whole.

Although no comparison for the Hawaiian grass-fed steer and heifer price is possible, one relationship is worthy of mention. The impacts on the Hawaiian grass-fed steer and heifer price are closer in magnitude to the impacts on the Honolulu choice beef price than on the Honolulu utility cow price. This suggests that grass-fed steer and heifer beef is more of a substitute for higher quality beef than for cow beef in Hawaii.

The impacts on Hawaiian grain-fed and grass-fed steer and heifer beef production are opposite in sign to the national impacts. In both models, reduced imports affect the composition of steer and heifer beef production in two ways. First, feeder calf availability increases, causing placements on feed to increase. This in turn results in a shift toward more grain-fed and less grass-fed beef. Second, the price of non-fed beef increases relative to the price of grain-fed beef,[5] dampening the tendency to increase placements on feed. In Hawaii, the change in relative prices appears to be more influential than increased feeder availability. Therefore, grass-fed steer and heifer beef production increases while grain-fed beef production declines slightly. For the entire United States, the change in relative prices is evidently less influential. Therefore, grass-fed beef production declines while grain-fed beef production increases.

The difference in impacts probably occurs because of differences in the cattle markets represented by the two models. On the Mainland, slaughter cattle are generally sold on a liveweight basis, making it difficult to establish separate prices for grass-fed and grain-fed beef. Cattle producers would not be expected to respond readily to changes in the relative scarcity of grass-fed versus grain-fed beef. In contrast, ranchers typically sell their slaughter cattle on a carcass weight basis in Hawaii, and carcass prices are discounted up to 20 cents per pound if the fat color is yellow. Hawaiian ranchers receive clear market signals and are responsive to changes in relative grain-fed and grass-fed beef prices.

The average impact on cow and bull beef production is only 0.1 percent for Hawaii, while for the nation it averages 5.3 percent higher than under the assumption of historical beef imports. Historically in Hawaii, cow and bull beef production has been more stable than for the nation as a whole. Over the 1972-80 period, the range in cow and bull beef production was only 13.2 percent of the low for the period as compared to 55.4 percent for the entire United States. The relative stability of cow beef production and these simulation results suggest that prices are less influential in Hawaii than in the entire United States in determining cow and bull slaughter.

Finally, relative to the 50 percent reduction in imports, the impacts on production are slight for both the United States and Hawaii. The impacts on total beef production are negligible for Hawaii and average only 1.7 percent for the entire United States. Although the impacts are small, results suggest that aggregate beef production in Hawaii is less responsive to changes in beef imports than in the nation as a whole. This occurs mainly because cow beef production is less responsive to changes in prices.

CONCLUSIONS

Concern over the impact of national beef policy at the state level prompted development of an econometric model of the Hawaiian beef production sector. The objective of this paper was to demonstrate that state econometric models of beef sectors can be useful to policymakers and others. Large variations in state and national impacts obtained from an interfaced Hawaiian-national model emphasize the need for a separate model to analyze policy impacts at the state level. Reviewing the results from the national beef model would not be sufficient to determine the impact of national beef policy on Hawaii. The discrepancies in impacts are mostly a result of underlying structural differences in the sectors represented by the two models. Because differences in state and national impacts exist, usefulness of the model is enhanced. Policymakers could use the interfaced model to determine the benefits or costs to the Hawaiian beef industry, relative to the aggregate United States beef industry, of proposed changes in national beef import legislation. As beef policy legislation is proposed in Congress, results from simulations such as these could be used by Hawaiian beef producers and

[5] In the national model, utility cow and feeder steer prices are included in the grass-fed steer and heifer beef production equation to represent the relative profitability of grass versus grain feeding. As expected, the utility cow price enters with a positive sign and the feeder steer price enters with a negative sign.

representatives in Congress in their lobbying efforts. Also, if policy changes were instituted, state planners and beef producers could use such information to formulate plans for reaction to the changes.

Although the results presented are specific to Hawaii, they demonstrate the need for state models to analyze the impact of national policy. Each state has a beef industry with special characteristics that differentiate it from other states and from the nation as a whole. The more a state beef industry diverges from its national counterpart, the more useful would be the state econometric model. Other econometric modelers might be encouraged by the demonstrated divergence between Hawaiian and United States impacts to develop models of other state agricultural sectors for analyzing state impacts of national policy.

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