The Effects of Alternative Beef Import Quota Regimes on the Beef Industries of the Aggregate United States and Hawaii

Roland K. Roberts and William J. Martin

The effects of the 1964 and 1979 beef import laws on the beef industries of the aggregate United States and Hawaii are simulated for 1972–81 by linking Hawaii and national econometric models. Although impacts are slight for both models, Hawaii beef prices and production appear to be less affected by changes in beef import rules.

The impact of foreign beef imports has been an issue of concern to agricultural policymakers and beef producers in the United States since the early 1960s. Several econometric models have been developed to analyze the impact of changes in beef import policy at the national level [e.g., Arzac and Wilkinson; Folwell and Shapouri; Freebairn and Rausser; Martin; Yanagida and Conway]. The impact of a national policy measure may vary widely across states, and representatives of some states are concerned about the regional impact of national beef import policies [Pub. L. 96–177]. Baum *et al.* address this issue by linking a Virginia beef and pork econometric model with a national model to study the effects of changes in U.S. beef imports on the Virginia beef and pork sectors. Unfortunately, no comparison is made with relative impacts at the national level. In Hawaii, the impact of beef import policy is of particular interest since some have argued [University of Hawaii Cooperative Extension Service, p. 9; University of Hawaii College of Tropical Agriculture and Human Resources, p. 30] that the impact of imports on cow prices is greater in Hawaii than in other states. The objective of this paper is to study and compare the impacts of various beef import rules on aggregate United States and Hawaii beef prices and production by linking a Hawaii model [Roberts *et al.*] with a national model [Martin].

The National Model

The national model is a 55-equation quarterly econometric model of the U.S. livestock–feed subsector. It is used to generate national level beef and corn prices, which then determine Hawaii 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

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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. Details for the national model are given by Martin and Heady.

The Hawaii Model

The Hawaii model is a 26-equation econometric model of Hawaii 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 facilitates comparison of simulated impacts between models.

As with the beef industries of many states, there are several characteristics that lead to differences in model specification. Although the national model is an aggregate of all 50 states, it is dominated by the U.S. Mainland. Hawaii beef production averaged only about 0.14 percent of total U.S. beef production in 1982 and 1983 [U.S. Department of Agriculture, December 1984, pp. 29, 31]. Therefore, when discussing differences between the Hawaii and national models, differences in the Hawaii and U.S. Mainland beef markets are stressed.

Five major characteristics distinguish the Hawaii model from the national model. First, in Hawaii, ranchers typically retain ownership of their animals until they are sold after slaughter. Therefore, contrary to U.S. Mainland pricing practices, ranchers are paid on a carcass weight basis rather than a live-weight 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 U.S. Mainland. Ranchers generally base their breeding herd inventory decisions on 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 estimate an equation for placements on feed. Because of incomplete data, the Hawaii 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 U.S. Mainland[1] (mostly choice beef) and from foreign sources (nonfed 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.*]. Therefore, theory would suggest that wholesale beef prices in Hawaii are exogenously determined by U.S. Mainland prices, Australia and New Zealand prices,

[1] The quantity imported from the U.S. Mainland is a rough approximation 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 U.S. Mainland are not available after 1970.

and transportation costs. Similarly, Hawaii ships from the U.S. Mainland virtually all feed grains used by the state's livestock sector, resulting in Hawaii feed prices being determined by U.S. Mainland feed prices and transportation costs. Within a period of a few days, prices of comparable beef and feeds 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, Hawaii ranchers respond to changes in prices they receive, but, since Hawaii is a net importer of beef, changes in Hawaii beef prices are determined by changes in supply and demand for beef on the U.S. Mainland or in Australia and New Zealand (holding transportation and handling costs constant). 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 Hawaii beef market has no appreciable influence on the quantity of beef produced in Hawaii. For this reason, and because accurate data on the quantity of beef supplied from the U.S. Mainland are not available, the model concentrates solely on the production of beef in Hawaii as influenced by exogenously determined prices.

Model Linkage

Given the smallness of the Hawaii choice beef market relative to that of the U.S. Mainland and the high volume of shipments to Hawaii relative to Hawaii production, a strong relationship between choice beef prices in Hawaii, choice beef prices on the U.S. Mainland and transportation costs is safely hypothesized.[2] Similar relationships between cow and grass-fed beef prices on the U.S. Mainland and those in Hawaii are not as straightforward. It is important to realize that Australia and New Zealand beef prices are dominated by U.S. beef 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 beef prices in major beef exporting countries are heavily influenced by the U.S. beef market [Simpson and Farris, pp. 179–183]. For Australia and New Zealand, this is further supported by the fact that they respectively shipped 53 and 67 percent of their total exported beef[3] to the United States during 1979–81 [Food and Agriculture Organization of the United Nations; U.S. Bureau of the Census]. Consequently, Hawaii prices of lower quality beef are dominated by U.S. Mainland prices via the Australia and New Zealand markets. This eliminates the need for the added modeling complexity of using Australia and New Zealand prices to determine Hawaii cow and grass-fed beef prices.

Based on the hypothesis that Hawaii beef prices are determined by U.S. Mainland beef prices and transportation costs, Equations 1–4 were estimated to reflect beef and feed price transmissions from the U.S. Mainland to Hawaii. They were estimated by ordinary least squares and Cochrane–Orcutt autoregressive methods with quarterly data for 1970 through 1980.

$$\begin{aligned} HCBP = {} & -7.09 + 0.98LACBP + 2.26TB, \\ & (-5.08)\ (40.05)\qquad (6.42) \\ & DW = 1.79,\quad R^2 = 0.997 \end{aligned} \tag{1}$$

$$\begin{aligned} HCP = {} & -14.50 + 0.24LACP \\ & (-3.76)\ (3.62) \\ & + 0.42LACP(-1) \\ & \ (5.45) \\ & + 0.17LACP(-2) + 0.13LACP(-3) \\ & \ (2.28)\qquad\qquad (1.85) \\ & + 2.35TB,\ \hat{\rho} = 0.45, \\ & \ (2.69)\qquad (3.37) \end{aligned}$$

[2] A similar discussion of the national and Hawaii models is found in Roberts and Martin where a graphical presentation of the theoretical linkages between Hawaii and U.S. Mainland choice beef prices is also presented.

[3] Includes fresh, chilled, and frozen beef and veal, with and without bone.

$$DW = 1.17, \quad R^2 = 0.987 \tag{2}$$

$$\begin{aligned} HGBP = {} & -6.61 + 0.33LACP + 0.31LACP(-1) \\ & (-1.89) \quad (5.77) \qquad (4.97) \\ & + 0.31(LACBP - LACP) \\ & \quad (4.22) \\ & + 0.24(LACBP(-1) - LACP(-1)) \\ & \quad (1.90) \\ & + 2.56TB + 1.67D1 \\ & \quad (2.87) \qquad (2.35) \\ & + 1.15D2 - 0.07D3, \ \hat{\rho} = 0.53, \\ & \quad (1.70) \quad (-0.13) \qquad (4.17) \end{aligned}$$

$$DW = 1.22, \quad R^2 = 0.991 \tag{3}$$

$$\begin{aligned} HFP = {} & 0.32 + 0.09LACRP \\ & (1.46) \quad (1.21 \\ & + 0.30LACRP(-1) \\ & \quad (3.17) \\ & + 0.19LACRP(-2) + 2.42TC, \\ & \quad (2.80) \qquad\qquad (12.89) \end{aligned}$$

$$DW = 1.47, \quad R^2 = 0.973 \tag{4}$$

where HCBP is the Honolulu choice beef price; LACBP is the Los Angeles choice steer price; TB[4] is the Los Angeles-to-Honolulu ocean freight rate for beef; HCP is the Honolulu utility cow price; LACP is the Los Angeles utility cow price; HGBP is the Hawaii grass-fed steer and heifer beef price; D1, D2, and D3 are quarterly dummy variables; HFP is the Hawaii feed price; LACRP is the Los Angeles wholesale corn price; and TC is the Los Angeles-to-Honolulu ocean freight rate for corn. All prices are in dollars per hundredweight. Numbers in parentheses below coefficients are t statistic (Equations 1 and 4) or asymptotic t statistics (Equations 2 and 3) and numbers in parentheses following variable names indicate lags. Dubin–Watson statistics are calculated from the ordinary least squares residuals and, for Equations 2 and 3, R^2 is presented only as a measure of goodness-of-fit.

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.

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

Transmission of cow prices from the U.S. 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 U.S. Mainland is indirect via the Australia 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 U.S. cow price to work through the Australia 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 U.S. Mainland. Second, a dressed weight price received by farmers is recorded in Hawaii but not on the U.S. Mainland. Third, as with cow beef, the Hawaii price is determined by the U.S. Mainland market via the Australia and New Zealand markets. Because Hawaii-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 U.S. Mainland steer and cow prices are both highly influential in determining the Hawaii grass-fed steer and heifer beef

[4] Estimated coefficients for TB and TC, as detailed by Roberts and Martin (p. 66), are larger than 1.0 because ocean freight rates are less than half of total logistic costs, although the two series are highly correlated.

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 U.S. Mainland beef market on the Hawaii grass-fed steer and heifer price.

The Hawaii cattle feed price paid by farmers is directly determined by U.S. Mainland prices. Most of the feed used is manufactured in Hawaii from feed stuffs imported from the U.S. Mainland. Relatively little manufactured feed is received from the U.S. 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 U.S. Mainland to Hawaii and from one level in the marketing chain to another.

Two additional equations are required to complete linkage of the Hawaii model with the national model. The national model estimates retail table quality and processing quality beef prices, while the Hawaii model uses wholesale prices as determined by Los Angeles wholesale choice steer and utility cow prices. Thus, Equations 5 and 6 are estimated to link national retail prices to Los Angeles wholesale prices.

$$\begin{aligned} \text{LACBP} = &-1.54 + 0.45\text{USRCBP} \\ &(0.53)\ (10.27) \\ &+ 8.37\text{USCBPA} - 0.79\text{USAHERG} \\ &(3.18)\qquad\quad (-2.20) \\ &- 0.26\text{T},\ \hat{\rho} = 0.25, \\ &\qquad\quad (1.71) \\ &\text{DW} = 1.32,\quad R^2 = 0.992 \end{aligned} \tag{5}$$

$$\begin{aligned} \text{LACP} = &\ 1.37 + 0.64\text{USHP},\ \hat{\rho} = 0.68, \\ &(0.25)\ (11.37)\qquad (6.22) \\ &\text{DW} = 0.98,\quad R^2 = 0.953 \end{aligned} \tag{6}$$

where USRCBP is the U.S. retail choice beef price (¢/lb.), USCBPA is the U.S. carcass by-product allowance (¢/lb.), USAHERG is the U.S. average hourly earnings of retail grocers ($/hr.), T is a time trend equal to 1 in 1970(I) to 44 in 1980(IV), USHP is the U.S. retail price of hamburger (¢/lb.), and other variables are as previously defined. In Equation 5, USRCBP 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].

Specification of Equations 5 and 6 incorporates the assumption that Los Angeles wholesale choice steer and utility cow prices are highly correlated with U.S. 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^2s suggest a reasonable 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 Hawaii model is simulated to determine the impacts on production as ranchers respond to changes in local prices.

Beef Import Rule Simulations

The interfaced model is simulated dynamically over the 1972(I) to 1981(IV) period under three sets of assumptions about the level of beef imports: 1) historical values, 2) the 1964 Law rule, and 3) the 1979 Law rule. In the first simulation, imports are exogenous to the model, taking on their actual historical values. The first simulation is used as a base by which other simulations are compared. Imports in the second and third simulations are set by the model at 110 percent of the import quota

(the "trigger" level of imports). Import quotas are endogenously determined by the 1964 and 1979 Law rules as described below in Equations 7 and 8. These calculations assume that the United States negotiates voluntary restraint agreements with major beef exporting countries at the "trigger" level, that the U.S. President does not intervene to change the quota, and that the level of imports does not fall below the maximum allowable by the quota. A major difference between the three simulations is that imports in the second and third simulations follow their respective formulas without deviation, while the first includes actual imports as they deviate from what the formulas would have required.

Allowable beef imports under the 1964 Act are determined by an adjusted base quota, calculated on an annual basis [Sheales and Weeks, p. 63]. The adjusted base quota under the 1964 Act is calculated as:

$$ABQ = BQM(MP3/BP) \quad (7)$$

where ABQ is the adjusted base quota (product weight); BQM is the base quota at 725.4 million pounds; MP3 is a three-year moving average of U.S. meat production, using a forecast for the quota year and observed production in the previous two years; and BP is base average production during 1959–63 [Simpson, 1981, p. 10].[5]

The 1964 Act provided that imports could not exceed a "trigger" level given by 110 percent of the adjusted base quota without Presidential approval. The historical quantity was usually controlled by voluntary restraint agreements negotiated with exporting countries up to the "trigger" level. Under the 1964 Act, the President had considerable discretion to suspend or increase the import quota. In 1972, 1973, 1975, 1978, and 1979, this discretion was used to increase the quantity of meat imported into the United States substantially above the "trigger" level.

The Meat Import Act of 1979 modified the 1964 Law primarily by the introduction of a "countercyclical" quota formula [Simpson, 1981, p. 17] given by:

$$Q = BQM(MP3/RBP)(CB5/CB2) \quad (8)$$

where Q is the annual import quota (product weight); BQM is average annual imports for 1968–77 (product weight); MP3 is a three-year moving average (forecast of the quota year plus the two preceding years) of domestic commercial production (carcass weight) of beef, veal, mutton, and goat, less the carcass weight equivalent of live cattle imports; RBP is a 10-year average of base-period domestic production for 1968–77, calculated using the same product definitions as for MP3 (constant at 22,526.7 million pounds carcass weight);[6] CB5 is a five-year moving average (forecast of the quota year plus the four preceding years) of domestic per capita cow beef supply; and CB2 is a two-year moving average of domestic per capita cow beef supply (the quota year forecast plus the preceding year).

In addition to the formula in (8), the 1979 Act provided a guaranteed minimum level of access to imports of 1,250 million pounds product weight [Conable]. The 1979 Act also prevented the U.S. President from increasing the level of imports when the countercyclical factor (CB5/CB2) was less than unity, except for national security reasons or in the event of a major market disruption.

The national model is augmented by the quota formulas, using fourth-order autoregressive models (in the first differences) to generate forecasts of production vari-

[5] Only beef production is considered in this analysis since beef generally makes up over 95 percent of total U.S. production of quota meats [Simpson, 1981, p. 11] and because only beef production is included in the national model.

[6] Again, only beef production is considered in the analysis because of the minor nature of the other components, and their absence from the model.

TABLE 1. Historical Imports and Imports Generated Under Alternative Quota Rules, Million Pounds Carcass Weight.

Year	Historical Imports[a]	1964 Law Imports[b]	1979 Law Imports[b]
1972	1,960.0	1,748.7	1,937.4
1973	1,990.0	1,789.2	1,866.6
1974	1,615.0	1,764.1	2,004.8
1975	1,758.0	1,762.5	1,866.6
1976	2,073.0	1,922.1	1,869.4
1977	1,939.0	2,042.6	1,922.7
1978	2,297.0	2,027.3	2,199.3
1979	2,405.0	1,926.3	2,545.8
1980	2,064.0	1,772.8	2,606.2
1981	1,743.0	1,683.2	2,010.9
Mean	1,984.4	1,843.7	2,082.9
SD[c]	244.4	125.4	278.5
C.V. (%)[d]	12.3	6.8	13.4

[a] Actual historical imports. Source: U.S. Department of Agriculture, November 1984, p. 38.
[b] Imports generated by the model after augmenting by the 1964 and 1979 import quota formulas.
[c] Standard deviation.
[d] Coefficient of variation.

ables. Moving averages required by the formulas are constructed from these forecasts plus estimates of production variables made by the model in previous periods. This approach makes the import quota formulas endogenous to the system and accounts for the effects of changes in import levels on production and, hence, on subsequent import levels. Earlier studies [e.g., Simpson, 1982] neglected feedback from this source. Product-weight quota estimates given by the formulas are made consistent with quantities from the Hawaii and national models by converting to carcass weight using a factor of 1.37.[7] Quantities are further increased to the "trigger" level with a factor of 1.1 to represent the binding level of imports set by the 1964 and 1979 Laws. Finally, seasonal adjustment factors (SAS) are used to distribute annual imports among quarters.

Simulation Results for National Imports and Prices

The estimated quarterly levels of beef imports are converted to annual totals and reported in Table 1. On average, historical imports were seven percent higher than those estimated by the 1964 Law rule. This difference reflects the use of Presidential discretion to increase the level of imports above the "trigger" level.

Results indicate that the formula under the 1979 Law would have been noticeably less restrictive, during the simulation period, than the 1964 Law formula and would have allowed average imports to be five percent above the historical average.[8] However, in years such as 1972 and 1973, when imports were allowed by Presidential discretion to rise substantially above the 1964 Law import "trigger," the 1979 Law would have resulted in substantial reductions in import levels. Furthermore, in some years in which allowable imports were relatively large under the 1979 Law, actual imports fell below allowable levels and would not have been affected by the import levels set by the 1979 Law rule.

The simulated level of imports under the 1979 Law is much more variable than under the 1964 Law and slightly more variable than historical imports. For the annual data presented in Table 1, the coefficient of variation is 6.8 percent for the 1964 Law, 12.3 percent for actual imports and 13.4 percent for the 1979 Law.

The minimum access level provided in the 1979 Act would have been important during the simulation period. In 1973, the minimum resulted in a very slight increase in imports above the level calculated by the 1979 Law rule without the minimum restriction. In 1975 and 1976, it resulted in increases of 7.5 percent and 13.8 percent, respectively.

The slightly higher level of imports al-

[7] This factor is a 1974–83 average of the ratio of carcass weight to product weight beef and veal imports [U.S. Department of Agriculture, December 1984, p. 159].

[8] The extent of this increase is somewhat higher than expected and reflects the fact that the "countercyclical" factor [Simpson, 1982, pp. 243–44] was, on average, 1.04 during the sample period.

TABLE 2. Predicted Annual Prices of U.S. Beef and Cattle Under Various Import Regimes.

Year	Ground Beef (Retail)			Choice Beef (Retail)			Utility Cows (Omaha)			Choice Steers (Omaha)		
	Historical Imports (Base)	1964[a] Law	1979[a] Law	Historical Imports (Base)	1964[a] Law	1979[a] Law	Historical Imports (Base)	1964[a] Law	1979[a] Law	Historical Imports (Base)	1964[a] Law	1979[a] Law
	(¢/lb.)	Percent		(¢/lb.)	Percent		(¢/lb.)	Percent		(¢/lb.)	Percent	
1972	69.60	1.44	0.43	114.90	0.09	0.15	21.80	2.75	0.46	33.40	0.00	0.30
1973	84.70	1.30	0.83	137.10	−0.15	0.00	30.00	2.33	1.33	41.60	−0.24	−0.24
1974	83.80	−0.72	−2.39	146.60	−0.34	−0.34	28.50	−1.75	−5.61	43.30	−0.46	−0.23
1975	85.80	0.35	−0.93	149.90	0.33	0.27	38.00	0.71	−2.14	42.40	0.71	0.47
1976	85.70	1.75	1.28	142.80	0.35	0.00	25.80	4.26	3.10	39.00	0.51	0.00
1977	99.50	−0.40	−0.30	163.80	0.43	−0.06	32.90	−0.30	−0.30	46.30	0.65	0.00
1978	121.80	1.81	0.33	199.30	0.35	−0.10	45.70	3.72	0.66	58.90	0.34	−0.17
1979	147.60	2.78	−0.81	241.40	−0.21	−0.41	58.00	5.52	−1.55	74.30	−0.27	−0.54
1980	157.90	2.15	−3.10	269.70	0.26	0.19	65.70	4.57	−5.78	81.40	0.49	0.37
1981	162.50	1.29	−1.79	279.10	0.29	0.18	67.50	2.52	−3.26	82.70	0.24	0.12
Mean	109.90	1.37	−0.91	184.46	0.16	−0.05	40.39	2.72	−1.98	54.32	0.18	0.00
C.V. (%)[b]	31.57	2.09	−2.79	32.10	0.12	0.12	43.17	2.41	−4.03	34.25	0.12	0.18

[a] Simulation results and coefficients of variation are expressed as percentage deviations from the base.
[b] Coefficient of variation for the base and percentage deviations from the base for the 1964 and 1979 Laws.

lowed under the 1979 Law can be expected to lead to slightly lower beef prices. Whether the more variable level of imports under this law leads to more, or less, price variability depends upon whether the fluctuations in imports accentuate or counteract variations in domestic supplies. Examination of the price data presented in Table 2 suggests that differences between import regimes would have only a slight effect on the stability of beef prices. At the retail level, the price of choice beef is not noticeably affected by use of the 1979 Law rule, and the price of ground beef decreases by less than one percent. Use of the 1979 Law appears to reduce variability of ground beef prices, but only by a small amount, with the coefficient of variation falling from 31.6 percent under historical imports to 30.7 percent under 1979 Law imports. At the farm level, there appears to be little impact on the price of choice steers but a slightly greater effect on the price of cows. Over the simulation period, the average simulated price of cows is predicted to be two percent lower under the 1979 Law than under historical imports. The 1979 Law rule also forecasts slightly lower variability in cow prices, with the coefficient of variation falling from 43.2 percent to 41.4 percent. By contrast, use of the 1964 Law formula results in slightly less stable cow prices than under historical imports.

Hawaii Versus National Impacts

Table 3 gives simulated impacts of the quota regimes on Los Angeles and Honolulu wholesale prices. Impacts of the 1964 and 1979 Law rules on Los Angeles prices are only slightly lower in magnitude and follow similar patterns to national retail price impacts (Table 2). As expected from construction of Equations 1 and 5, Honolulu wholesale choice steer and heifer price impacts follow the pattern of impacts on the national retail and Los Angeles wholesale choice beef prices and are similar in average magnitude to the Los Angeles impacts. Impacts on the Honolulu wholesale utility cow price are slightly lower than Los Angeles impacts, and their pattern deviates somewhat from the national and Los Angeles impacts. This divergence in pattern reflects lags in the price transmission process resulting from the great distances involved and the indirect influence of the U.S. Mainland price via the returns available to Australia and New Zealand suppliers. It appears from this analysis that changes in beef imports have a slightly smaller impact on the Honolulu wholesale cow price than on the Los Angeles wholesale cow price.

As with national retail beef prices, variation in Honolulu and Los Angeles wholesale prices changes only slightly among simulations. The coefficient of variation for choice beef prices in Los Angeles and Honolulu remains virtually unchanged at about 29.2 percent, while utility cow prices become more variable under the 1964 Law but more stable under the 1979 Law. The coefficient of variation increases by 1.93 percent for the Honolulu utility cow price under the 1964 Law compared to a 2.24 percent increase for the Los Angeles utility cow price. Under the 1979 Law, coefficients of variation decrease by 2.79 percent and 2.16 percent for Los Angeles and Honolulu cow prices, respectively. Thus, not only are average impacts on cow prices smaller in Honolulu than Los Angeles, but changes in price variation also are smaller. This happens because changes in the U.S. cow price are transmitted gradually to Hawaii over a period of four quarters, while they are transmitted immediately to California. If Hawaii imported cow beef from the U.S. Mainland rather than from Australia and New Zealand, price transmission would be almost instantaneous, and cow price impacts would be similar for Los Angeles and Honolulu, as they are for choice beef.

The national and Hawaii impacts on beef production are presented in Tables 4

TABLE 3. Predicted Impacts of Beef Import Rules on Los Angeles and Honolulu Wholesale Beef Prices.

	Historical Imports (Base)				1964 Law Imports				1979 Law Imports			
	Utility Cow		Choice Beef		Utility Cow		Choice Beef		Utility Cow		Choice Beef	
Year	Los Angeles	Honolulu	Los Angeles	Honolulu	Los Angeles	Honolulu	Los Angeles	Honolulu	Los Angeles	Honolulu	Los Angeles	Honolulu
	¢/lb.				Percentage Deviation from the Base							
1972	46.80	43.70	57.80	63.70	1.20	0.62	0.09	0.08	0.15	−0.11	0.14	0.13
1973	56.10	53.00	69.50	76.50	1.02	0.92	−0.12	−0.11	0.58	0.36	−0.02	0.02
1974	55.30	57.20	72.20	80.90	−0.71	0.23	−0.29	−0.25	−2.42	−0.93	−0.28	−0.24
1975	56.50	57.60	73.70	82.80	0.40	−0.12	0.32	0.28	−0.89	−1.45	0.23	0.20
1976	56.40	58.70	66.60	76.20	1.73	1.40	0.36	0.31	1.32	0.78	0.02	0.02
1977	65.20	63.90	76.90	86.70	−0.20	0.03	0.38	0.33	−0.09	−0.01	−0.06	−0.05
1978	79.60	77.60	94.40	104.70	1.80	1.01	0.30	0.27	0.36	0.05	−0.12	−0.11
1979	96.20	95.00	116.40	128.20	2.75	2.69	−0.17	−0.15	−0.81	−0.02	−0.36	−0.32
1980	102.90	107.30	123.80	137.40	2.13	1.61	0.25	0.22	−3.10	−2.59	0.19	0.17
1981	105.90	114.60	126.70	144.20	1.28	1.56	0.27	0.23	−1.80	−1.65	0.19	0.16
Mean	72.09	72.86	87.80	98.13	1.29	1.09	0.14	0.15	−0.87	−0.83	−0.01	−0.01
C.V. (%)[a]	30.82	33.76	29.20	29.24	2.24	1.93	0.14	0.07	−2.79	−2.16	0.07	−0.03

[a] Coefficient of variation for the base and percentage deviations from the base for the 1964 and 1979 Laws.

TABLE 4. Predicted Impacts of Beef Import Rules on U.S. Beef Production (Carcass Weight).[a]

Year	Historial Imports (Base)				1964 Law Imports				1979 Law Imports			
	UFSHBS	UNFSHBS	UCBBS	UTBS	UFSHBS	UNFSHBS	UCBBS	UTBS	UFSHBS	UNFSHBS	UCBBS	UTBS
	1,000,000 lbs.				Percentage Deviation from the Base							
1972	16,270.40	1,807.90	3,852.80	21,931.20	0.08	0.91	2.36	0.55	−0.15	0.46	0.29	−0.02
1973	16,607.60	1,223.80	3,706.80	21,538.20	0.37	0.21	2.36	0.70	0.13	0.53	1.45	0.38
1974	15,404.70	2,077.00	4,145.60	21,627.40	0.34	−1.37	−1.57	−0.19	−0.06	−1.49	−3.59	−0.87
1975	14,888.90	3,213.60	5,775.80	23,878.30	−0.28	0.21	−0.36	−0.23	−0.61	0.76	−0.67	−0.44
1976	16,725.80	3,161.40	5,744.10	25,631.30	0.18	−0.72	0.50	0.14	0.25	−0.05	1.33	0.46
1977	16,635.10	2,936.30	5,337.80	24,909.10	−0.30	−0.50	−1.07	−0.49	0.01	0.15	0.32	0.09
1978	16,799.10	2,076.70	4,387.00	23,262.80	0.09	0.35	1.83	0.44	0.13	0.74	1.02	0.35
1979	16,125.90	1,482.80	3,473.70	21,082.30	1.13	−1.83	4.55	1.49	0.34	−1.45	−1.42	−0.07
1980	14,798.50	1,719.90	3,745.10	20,263.50	0.30	0.04	2.23	0.64	−1.24	1.00	−5.01	−1.75
1981	14,841.00	2,243.70	4,428.00	21,512.80	0.28	−1.55	−0.32	0.04	−0.74	0.28	−1.81	−0.85
Mean	15,909.70	2,194.32	4,459.67	22,563.69	0.22	−0.43	0.83	0.28	−0.17	0.13	−0.68	−0.24
C.V. (%)[b]	5.27	31.78	19.31	7.82	0.19	0.13	−5.96	−4.09	7.97	0.50	4.82	5.75

[a] Variable definitions: UFSHBS is U.S. grain-fed steer and heifer beef production; UNFSHBS is U.S. grass-fed steer and heifer beef production; UCBBS is U.S. cow plus bull beef production; and UTBS is U.S. total beef production.

[b] Coefficient of variation for the base and percentage deviations from the base for the 1964 and 1979 Laws.

TABLE 5. Predicted Impacts of Beef Import Rules on Hawaii Beef Production (Carcass Weight).[a]

Year	Historical Imports (Base)				1964 Law Imports				1979 Law Imports			
	HFSHBS	HNFSHBS	HCBBS	HTBS	HFSHBS	HNFSHBS	HCBBS	HTBS	HFSHBS	HNFSHBS	HCBBS	HTBS
	1,000 lbs.				Percentage Deviation from the Base							
1972	19,419.90	5,363.80	7,101.50	31,885.20	−0.01	0.00	0.20	0.04	0.04	0.01	0.03	0.03
1973	20,534.00	4,859.10	7,159.00	32,552.40	−0.29	0.34	−0.09	−0.15	−0.10	−0.13	0.01	−0.08
1974	19,142.60	3,646.40	6,319.10	29,108.10	−0.18	1.24	−0.26	−0.02	−0.09	0.34	−0.44	−0.01
1975	17,598.40	4,729.00	6,866.70	29,194.10	0.19	0.62	0.18	0.26	0.37	−0.05	0.20	0.26
1976	20,605.70	5,419.80	6,528.10	32,553.60	−0.04	−0.28	0.22	−0.03	−0.01	−0.73	0.29	−0.07
1977	20,255.40	5,497.70	6,799.60	32,552.70	−0.02	0.04	−0.21	−0.05	−0.08	0.10	−0.16	−0.07
1978	19,031.60	5,012.30	6,850.00	30,893.90	0.02	−0.41	0.23	0.00	−0.06	0.20	0.04	0.01
1979	18,237.60	6,595.20	6,620.90	31,453.60	−0.40	0.03	0.04	−0.22	−0.19	0.20	−0.27	−0.12
1980	14,807.60	6,692.90	6,355.70	27,856.10	−0.27	1.44	−0.23	0.15	0.45	0.37	−0.37	0.25
1981	14,210.30	7,599.70	6,416.00	28,226.00	−0.22	1.00	−0.16	0.16	0.61	−1.10	0.39	0.04
Mean	18,384.31	5,541.59	6,701.66	30,627.87	−0.11	0.04	−0.01	0.01	0.06	−0.12	−0.02	0.01
C.V. (%)[b]	12.29	20.49	4.48	6.09	0.18	1.02	2.23	−1.12	−1.16	−1.12	1.79	−0.87

[a] Variable definitions: HFSHBS is Hawaii grain-fed steer and heifer beef production; HNFSHBS is Hawaii grass-fed steer and heifer beef production; HCBBS is Hawaii cow plus bull beef production; and HTBS is Hawaii total beef production.

[b] Coefficient of variation for the base and percentage deviations from the base for the 1964 and 1979 Laws.

and 5. The 1964 and 1979 Law rules have little effect on beef production in either the United States as a whole or in Hawaii. Average impacts are small compared to the seven percent average decline in beef imports under the 1964 Law and the five percent average increase under the 1979 Law. Nevertheless, it appears that beef production in Hawaii is affected less by changes in national beef import policy than is beef production in the nation as a whole. The average impacts on total beef production (HTBS) in Hawaii are negligible for both the 1964 and 1979 Law rules, while for the United States, they average only slightly larger in absolute value at 0.28 percent and −0.24 percent, respectively. The difference occurs because cow and bull beef production is less responsive to price changes in Hawaii than at the national level.

The impacts on Hawaii grain-fed and grass-fed steer and heifer beef production for most years are opposite in sign to the national impacts. In both models, reduced imports affect the composition of steer and heifer beef production by increasing the availability of feeder cattle for feedlot production. However, at the same time, grass-fed beef prices increase relative to grain-fed beef prices, increasing the incentive to place more animals on pasture. Because of differences in market structure described earlier, beef producers in Hawaii respond more readily to changes in relative prices than to increased feeder availability, while the opposite is true on the U.S. Mainland.

Somewhat surprisingly, results suggest that the 1979 Law formula increases variability in both imports and national cow and bull beef production, and that cow prices are less variable because variation in imports and production counteract each other when combined to form supply. The opposite is true under the 1964 Law rule. In Hawaii, however, changes in variability of beef production are mixed and do not follow the same pattern as at the national level. The coefficients of variation for cow and bull beef production increase above base values for both the 1964 and 1979 Law rules, while they decrease for total beef production in both cases.

Conclusions

This study examined changes between alternative beef imports quota regimes and their effects on the aggregate U.S. and Hawaii beef industries. Over the 1972–81 period, simulated national import levels determined by the 1979 Law formula were found to be higher than actual historical levels, while simulation of the 1964 Law rule resulted in lower imports. Variability in simulated imports was also much higher under the 1979 Law rule than under the 1964 Law rule.

Prices responded only slightly to changes in import rules, decreasing under the 1979 Law and increasing under the 1964 Law. Cow price impacts were smaller for Honolulu than for Los Angeles, and the pattern of impacts was different. Changes in cow price variability were also smaller for Honolulu than for Los Angeles. Differences in the magnitude of impacts and variation in cow prices can be attributed to lags in the cow price transmission process from the U.S. Mainland via Australia and New Zealand markets.

Impacts on production were slight for the United States as a whole but were even smaller when Hawaii was considered alone, suggesting that beef production in Hawaii is less affected by changes in beef import policy than is national beef production. The smaller effect on production for Hawaii stems from differences in supply response and from slightly smaller simulated price impacts. Total beef production in Hawaii is less responsive mainly because cow and bull beef production is unresponsive to changes in the cow price. Also, price signals are diluted because formal feeder and slaughter cattle

markets do not exist as they do on the U.S. Mainland.

The approach taken in this paper can be used when there is interest in evaluating the effects on only one of many "small" markets of policies developed for uniform application over a larger dominant market area. As an example, this study investigated the effects on the Hawaii beef industry of changes in nonport-specific restrictions on U.S. beef import. The impacts on beef production in Hawaii were evaluated without regard to the impacts on beef production in Florida, California, or any other individual state. The criterion for model interfacing is that prices in one market area be dominated by those in the larger region. Otherwise, a simultaneous determination of prices and production would be more appropriate. This approach can also be directly applied to many small developing countries that rely on a larger developed nation for trade in a particular commodity.

Another interesting implication from this modeling effort is that in some cases other "large" countries can be ignored, allowing a reduction in model complexity. Cow prices in Hawaii are dominated by Australia and New Zealand prices, but U.S. Mainland prices dominate Australia and New Zealand prices. Therefore, models for Australia and New Zealand are unnecessary unless impacts are of interest there.

Simulation results presented in this paper demonstrate that in at least one case, state and national impacts of a national policy measure can differ. Given these results, other econometric modelers of agricultural sectors might find interfacing state and national models useful for impact analysis. Results could be used by farmers and policymakers as they attempt to understand the effects of alternative policy actions. If a given policy measure were found to be beneficial (detrimental) to a particular state's agricultural sector, relative to the agricultural sectors of other states or the nation as a whole, model results could be used in efforts to support (defeat) that policy measure. The Hawaii beef industry has traditionally supported a port-specific import quota, believing that it was hurt, relative to beef industries of other states, by nonport-specific import restrictions. Results presented in this paper, which show the Hawaii beef industry being affected less than the aggregate U.S. beef industry, might be useful in directing attention away from the belief that beef imports are the major reason for Hawaii cow prices being lower than U.S. Mainland cow prices. This Hawaii beef example emphasizes the importance of analyzing national policy impacts at the state level wherever there is interest in state level response.

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