ANALYZING THE ECONOMIC IMPACT OF NATIONAL BEEF IMPORT LEVEL CHANGES ON THE VIRGINIA BEEF AND PORK SECTORS

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Dynamic, recursive simulation models for the national livestock-feed sector have been designed by agricultural economists for the specific purpose of making long-run projections and evaluating alternative agriculture policies (Reynolds et al.; Yanagida and Conway). While these models are useful for describing the workings of the national grain and livestock sectors, they are incomplete for policy evaluation purposes at a subnational or state level (Knapp et al.; Maki et al.). In these situations, unless state or regional production and marketing patterns are represented as a constant percentage of the national model solution values, the impact of changes in a state's crop or livestock production relative to other states and alternative policy decisions cannot be considered (Ratajczak). Consequently, a state model must be able to reflect the impact of national and international policies and events to be effective and functional (Colyer and Irwin).

The Meat Import Act of 1964 established a quota on the amount of beef and veal that enters the United States at 725.4 million pounds (Crom et al.). This quantity is adjusted annually to account for changes in domestic beef production. The quota was suspended in 1978 under discretionary authority, and an additional 200 million pounds of beef were allowed to enter the United States. The revision of the 1964 Act to allow additional imported quantities of beef and veal, in addition to the 1.18 billion pound level in 1980, will affect prices and incomes of producers in the United States livestock sector.

Thus, the primary objectives of this research are to formulate and estimate a prototype econometric model representing the slaughter and inventory structure of the Virginia beef and pork livestock industry, to develop a methodological technique for linking or transmitting information between a national model and a state model, and to estimate the economic effects of a hypothetical increase in national beef import levels on the Virginia beef and pork sectors (Freebairn and Rauser; Safyurtlu). The data base utilized to estimate the econometric model was developed from statistical information contained in USDA publications and the Virginia Crop Reporting Service.

VIRGINIA BEEF SECTOR

Conceptually, a complete econometric model of the Virginia beef sector would have three sets of equations (Crom; Folwell and Shapouri; Reutlinger). A set of equations would correspond to each of the beef cow, steer, heifer and calf subsectors. Each subsector would contain five equations estimating inventory, slaughter, liveweight, price, and income; however, data limitations reduced the amount of possible disaggregation in this investigation. Four annual behavioral relationships were actually estimated: beef cow inventory, beef cattle slaughter, calf inventory, and calf slaughter. In functional form, the equations are

(1) BCI = F(BCI1, CORPH3, CUPO3)
(2) BCS = F(BCI, PV, BCS1)
(3) VI = F(PV1, CORPH1, VI1)
(4) VS = F(V1, DC1, PV)

where

BCI = January 1 inventory of beef cows and heifers that have calved, and steers over 500 pounds in Virginia (1,000 head)
CORPH1 = National harvest year corn price per bushel received by farmers, lagged 1 year ($/bu.)
CUPO3 = Omaha utility cow price lagged 3 years ($/cwt.)
BCI1 = BCI lagged 1 year; BCI(t−1)
BCS = Beef cattle slaughter, Virginia (1,000 head)
PV = Average national price received by farmers for calves ($/cwt.)
PV1 = PV lagged 1 year; PV(t−1)
BCS1 = BCS lagged 1 year; PV(t−1)
VI = January 1 inventory of beef and dairy calves in Virginia under 500 pounds (1,000 head)

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VI1 = VI lagged 1 year; VI(t−1)
VS = calf slaughter, Virginia (1,000 head)
DCI = January 1 inventory of dairy cows and heifers which have calved, Virginia (1,000 head).

The coefficients and related statistics for these equations were estimated using annual data from 1955 to 1979 and are presented in Table 1. The residuals of the beef sector equations were assumed to be independent because the correlation coefficients were insignificant (Table 2). Therefore, each equation was estimated with an ordinary least squares method (Wold). Consequently, the assumption of a diagonal covariance matrix, and the use of actual values of endogenous variables serving as predetermined variables in subsequent equations appeared to be justified.

The beef cow inventory equation estimates the impact of various factors on the primary actor in the Virginia beef industry, the cow-calf operator. The lagged beef cow inventory (BCI1) is utilized as a proxy variable for past investment and the plant capacity of the beef cow herd (Nerlove). The three-year lagged corn price was based on the biological lag time involved in beef production. Prior economic reasoning indicated that a negative coefficient should be expected with the lagged corn price (CORPH3), and positive coefficients should be expected with utility cow price (CUPO3) and plant capacity (BCI1).

TABLE 1. Virginia Beef Sector Equations[a]

Independent Variables	Regression Equations: Beef Cow Inventory	Beef Cattle Slaughter	Calf Inventory	Calf Slaughter
Intercept	54.08 (1.65)	108.72 (3.58)	4.11 (.27)	100.80 (1.02)
BCI1	0.10 (9.66)			
CORPH3	-81.63 (-4.03)			
CUPO3	6.48 (2.17)			
BCI		0.12 (3.38)		
BCS1		0.39 (3.11)		
PV		-2.84 (5.31)		-4.49 (-6.89)
PV1			2.29 (3.19)	
CORPH1			14.42 (1.18)	
VI1			0.72 (7.75)	
VI				0.33 (2.00)
DCI				0.35 (2.52)
S.E.	36.50	19.10	21.64	22.83
R^2	0.96	0.72	0.95	0.88

[a] Student t-values are given in parentheses.

TABLE 2. Correlation Matrix of Estimated Residuals from the Beef Sector Equations

Variable	BCI	BSC	VI	VS
BCI	1.000	-0.178	0.334	0.018
BCS		1.000	0.111	0.201
VI			1.000	0.009
VS				1.000

The current inventories of beef cows, heifers, and steers were included in the beef cow slaughter equation specification because they are the sources for slaughter beef animals. The lagged values of BCS act as a proxy for the existing plant capacity. A negative coefficient was expected for the price of calves (PV). A positive coefficient was expected for the beef cattle inventory (BCI) and existing plant capacity (BCS1).

The calf inventory equation was estimated, assuming that a livestock producer with the resources to produce calves must make a production decision based on the expected price of calves (PV) and their feed costs (CORPH). A positive coefficient was expected for the lagged price of calves (PVI), and existing plant capacity (VI1) of the producer. A negative coefficient for the input price (CORPH1) indicated that Virginia producers are sensitive to change in corn prices and respond by decreasing inventory. An explanation for the coefficient of feed cost having a positive sign is that live animals are often considered simultaneously as capital goods and consumption goods (Reutlinger).

The decision to sell calves as feeders, keep heifers as replacements to expand production, or sell them for slaughter is affected primarily by the relative price of calves to feeder and slaughter cattle. The current inventories of calves (VI) and dairy cows (DCI) are included in the calf slaughter equation because they are sources of slaughter calves. The coefficients of DCI and VI were not expected to exceed unity, and both coefficients were expected to be positive. A negative coefficient was expected for the price of calves. This indicated that a rise in current price of calves likely resulted in an increase of Virginia calf movements to Midwest feedlots and a decrease in the number otherwise available for slaughter.

VIRGINIA PORK SECTOR

A complete econometric model of the Virginia pork sector would have two sets of equations

(Colyer and Irwin; Crom). The sets of equations would correspond to cull sows and mature gilts, and to the barrows and gilts subsectors, respectively. Each subsector would contain five equations estimating inventory, slaughter, liveweight, price, and income. The pork sector differs from the beef sector in that data on January 1 inventories are not reported for breeding stock, therefore each equation was estimated with biannual data.

Hog production in Virginia can be measured by sow farrowings, market hog inventory, and slaughter. This investigation was concerned only with estimating the inventory and slaughter model for the Virginia hog sector because of data limitations. Thus, the economic model representing the structure of Virginia's pork sector included three equations, sows farrowings, market hog inventory, and hog slaughter:

(5) SF = f(SEMI, PBHI, PBHI1, PCR1)
(6) MHI = f(SEMI, SF, PBR, PCR, BGP1, MHI1)
(7) HS = f(PCR1, BGP, BGP1, PBHI2)

where

SF = sows farrowing from December to May and June to November, Virginia (1,000 head)
SEMI = zero-one semi-annual dummy variables; December, 1966 to June, 1967 = 0
PBHI = breeding herd, inventory, June 1 and December 1, Virginia (1,000 head)
PBHI1 = PBHI lagged 6 months; PBHI(t−1)
PBHI2 = PBHI lagged 12 months; PBHI(t−2)
PCR = average semi-annual price of corn received by farmers from January to June, and July to December, U.S. ($/cwt.)
PCR1 = PCR lagged 6 months; PCR(t−1)
MHI = market hog inventory at June 1 and December 1, Virginia (1,000 head)
PBR = (BHI−SF), Virginia (1,000 head)
BGP = seven market barrows and gilts price, U.S. ($/cwt.)
BGP1 = BPG lagged 6 months; BGP(t−1)
MHI1 = MHI lagged 6 months; MHI(t−1)
HS = hog slaughter from January-June and July-December, Virginia (1,000 head).

The coefficients and related statistics were estimated for these equations using biannual data from 1967 to 1978 and are presented in Table 3. As with the beef sector equations, the residual errors from the pork sector equations were assumed to be independent because the correlation coefficients were insignificant (see Table 4), and each equation was estimated with ordinary least squares.

TABLE 3. Virginia Pork Sector Equations[a]

Independent Variables	Regression Equations Statistics: Sow Farrowings	Market Hog Inventory	Hog Slaughter
Intercept	9.95 (1.26)	101.70 (1.57)	1134.75 (4.62)
SEMI	5.82 (2.93)	49.46 (3.16)	
PBHI	0.44 (5.78)		
PBHI1	0.10 (1.40)		
PCR1	-1.65 (-2.83)		52.25 (2.52)
SF		3.30 (3.89)	
PBR		-0.10 (-1.32)	
PCR		-10.91 (-2.20)	
BGP1		1.30 (2.47)	-4.16 (-1.17)
MHI1		0.45 (4.32)	
BGP			-6.28 (-2.04)
PBHI2			3.73 (2.61)
MHI			0.47 (1.31)
S.E.	3.36	18.43	70.34
R^2	0.72	0.88	0.72

[a] Student t-values are given in parentheses.

The major source of variation in pork production results from changes in sow farrowings. Fall prices of hogs and corn affect the number of farrowings in the following spring. Breeding herd inventory in the previous and current period is the primary explanatory variable in the sow farrowings equation. In Virginia, sow farrowings from June to December account for little more than half of the total annual farrowings. Thus, the intercept shifter SEMI was expected to be positive. A positive coefficient was expected for the lagged breeding herd inventory variables (PBHI1, PBHI2), with the further specification that the sum of their coefficients must not exceed unity. A negative coefficient was expected for the input price (PCR1).

Market hog inventory is largely determined by the number of current-period sow farrowings. The positive coefficient was expected with the lagged hog inventory (MHI1) and sows farrowing variable (SF), since these are two sources from which hogs can be drawn for current market hog inventory (MHI). The lagged market hog inventory coefficient was expected to be less than unity because not all market hogs from last

TABLE 4. Correlation Matrix of Estimated Residuals from the Pork Sector Equations

Variable	SF	MHI	HS
SF	1.000	0.065	-0.016
MHI		1.000	-0.084
HS			1.000

period are carried into the current period. The "PBR" variable represented the movement of young stock into the breeding herd, which decreased the number of hogs available for market, and its coefficient was expected to be negative. Positive coefficients were expected for the lagged price of barrows and gilts (BGP1), with a negative coefficient for current feed cost (PCR).

The number of slaughtered hogs depends upon the number of market hogs in the current period (MHI), and number of cull sows and boars available (PBHI2). A six-month price lag (BGP1) is expected to reflect the longer-run investment-disinvestment decisions of a producer. The input price changes (PCR1), number of market hogs (MHI), and number of cull sows and boars (PBHI2) were expected to have positive coefficients. Changes in barrow and gilt prices were expected to demonstrate inverse impacts on hog slaughter in Virginia. Therefore, negative coefficients were expected for BGP and BGP1. It should be recognized that feeder pigs are often raised in Virginia for shipment to other states and, therefore, are finished and slaughtered in Virginia only to a limited extent.

POLICY ANALYSIS OF IMPORT LEVEL CHANGE

Policymakers frequently need to assess the impacts not only of changes in target variables during a single time period, but also to evaluate the accumulated impact and time path of adjustment of endogenous variables over several periods (Freebairn and Rausser; Reutlinger). In this study, immediate impact and interim multipliers derived from the Virginia beef, calf, and pork equations were calculated to represent these relationships.[1]

A linear model in the endogenous variables is used to illustrate estimation of these multipliers. The restricted reduced form equation is

$$(8)\quad Y(t) = AY(t-1) + BX(t) + CX(t-1) + DX(t-2) + EX(t-3)$$

where

Y(t) is a vector of current endogenous variables
Y(t−1) is a vector of endogenous variables lagged one period
X(t) is a vector of current exogenous variables
X(t−1) is a vector of exogenous variables lagged one period
X(t−2) is a vector of exogenous variables lagged two periods
X(t−3) is a vector of exogenous variables lagged three periods
A is the coefficient matrix of the lagged endogenous variables
B is the coefficient matrix of the current exogenous variables
C is the coefficient matrix of the exogenous variables lagged one period
D is the coefficient matrix of the exogenous variables lagged two periods
E is the coefficient matrix of the exogenous variables lagged three periods.

As a result of various lag structures in the Virginia model, the following adjustments are necessary: (1) D = C = 0 for the beef cattle subsector, (2) D = E = 0 for the calf subsector, and (3) E = 0 for the pork subsector.

The immediate net effects of changes in exogenous variables on endogenous variables is measured by impact multipliers. Taking the derivative of equation (8) with respect to X (t) and for n = 0, the immediate impact multiplier matrix is

$$(9)\quad \frac{\partial Y(t)}{\partial X(t)} = B.$$

Interim multipliers provide the accumulated net effects of changes in exogenous variables in time t on an endogenous variable to time t + n where n > 0. These changes may be expressed as the following derivative,

$$(10)\quad \frac{\partial Y(t+n)}{\partial X(t)} \text{ where } n = 1,2 \ldots \infty.$$

The influence of a one-unit change in the exogenous variables on the endogenous variables one year later is found by rewriting equation (8) for period t+1, substituting for Y(t) and then taking the derivative with respect to X(t). The resulting first interim multiplier is

$$(11)\quad \frac{\partial Y(t+1)}{\partial X(t)} = AB + C.$$

This process can be continued for any length of time. Thus, the sequence of events resulting from a "one-shot" change in the exogenous variables in any period can be found by making a series of

[1] An alternative procedure would directly link the Virginia or state model as a subroutine called by the national sector model computer program. Time and budget constraints, and the unavailability of a current national agricultural sector model at VPI and SU precluded this approach by the authors.

TABLE 5. Estimates of Multipliers for the Virginia Beef and Pork Sector Models

Exogenous	Endogenous	Immediate Impact and Interim Multipliers 1,000 head						
Variable	Variable	0	1	2	3	4	5	6
PV ($1/cwt.)	BCI	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	BCS	-2.84	-1.13	-0.45	-0.18	-0.07	-0.03	-0.01
	VI	0.00	2.29	1.66	1.20	0.87	0.63	0.46
	VS	-4.49	0.75	0.55	0.40	0.29	0.21	0.15
CORPH ($1/bu.)	BCI	0.00	0.00	0.00	-81.63	-77.80	-74.14	-70.66
	BCS	0.00	0.00	0.00	-9.48	-12.78	-13.66	-13.61
	VI	0.00	14.42	10.44	7.56	5.47	3.96	2.87
	VS	0.00	4.73	3.43	2.48	1.80	1.30	0.94
CUPO ($1/cwt.)	BCI	0.00	0.00	0.00	6.48	6.17	5.88	5.61
	BCS	0.00	0.00	0.00	0.75	1.01	1.08	1.08
DCI (1,000 hd.)	VI	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VS	0.357	0.00	0.00	0.00	0.00	0.00	0.00
BCP ($1/cwt.)	SF	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	MHI	0.00	1.30	0.58	0.26	0.12	0.00	0.02
	HS	-6.28	-3.55	0.27	0.12	0.05	0.02	0.11
PCR ($1/bu.)	SF	0.00	-1.65	0.00	0.00	0.00	0.00	0.11
	MHI	-10.91	-11.92	-5.34	-2.39	-1.07	-0.48	-0.22
	HS	-5.07	46.71	-2.48	-1.11	-0.50	-0.22	-0.10
BHI (1,000 hd.)	SF	0.41	0.10	0.00	0.00	0.00	-0.00	0.00
	MHI	-7.82	-3.10	-1.38	-0.62	-0.28	-0.12	-0.06
	HS	-3.64	-1.44	3.10	-0.29	-0.13	-0.06	-0.03

substitutions and taking the derivative with respect to X(t) in the desired time period.

If changes in exogenous variables are sustained over long periods of time, their cumulative effect on the endogenous variables can be estimated. The impact of a sustained change in the exogenous variables on the endogenous variables one year later is found by taking the derivatives of equation (10) with respect to X(t) and X(t+1)

$$\text{(12)} \quad \frac{\partial Y(t+1)}{\partial X(t)} + \frac{\partial Y(t+1)}{\partial X(t+1)} = (AB + C) + B.$$

The composite effect of a sustained change in the exogenous variables on the endogenous variables one year later is found by summing the immediate and first-period interim multipliers in the linear model. The immediate impact and interim multipliers derived from the Virginia beef and pork sector models are presented in Table 5.

The lack of quantitative knowledge of regional or local economic impacts resulting from certain policy actions often hampers policy formulation. The estimated structure of the Virginia beef-pork economy does not completely eliminate these problems. However, the econometric model does provide a basis for evaluating national policies on the Virginia agricultural sector. The econometric model can be used to derive estimates of the sensitivity of the Virginia beef-pork economy to various externally determined agricultural policies with a multiplier analysis.

National policy alternatives are usually specified to affect certain target variables. These target variables are endogenous at the national level but are specified to be exogenous at the state level. The process of impact linkage is schematically presented in Figure 1. The impact of a national policy alternative is measured by changes in the target variables endogenous to the national model. These include the national barrow and gilt prices (BGP), utility cow prices (CUPO), and calf prices (PV). In turn, these target variables affect the Virginia model, which

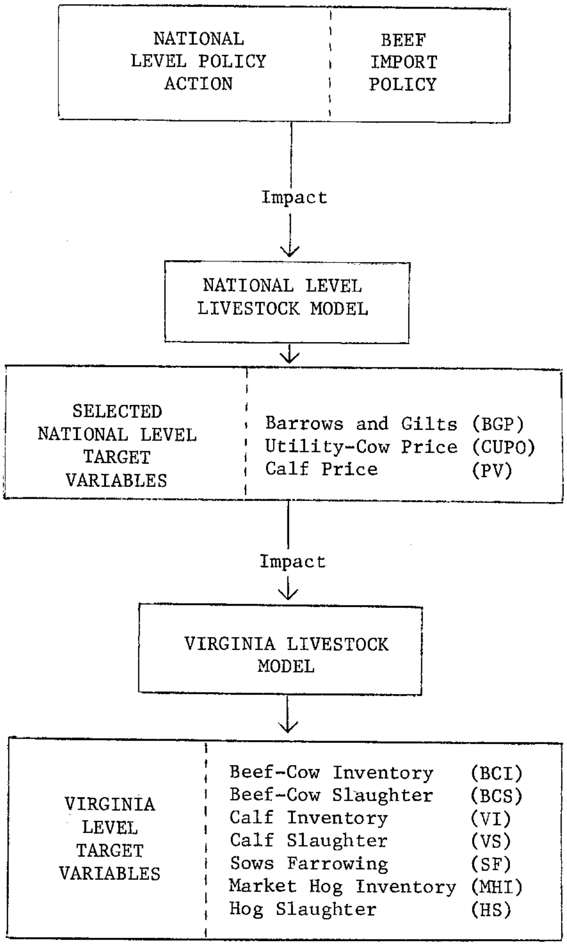

FIGURE 1. Schematic Integration of National and Virginia Livestock Models

also has a set of state target variables via the estimated multipliers, which include beef cow inventory (BCI), cattle slaughtered (BCS), calf inventory (VI), calf slaughter (VS), market hog inventory (MHI), and hog slaughter (HS). Therefore, any national agricultural policy that affects the national livestock model will provide an exogenous shock to the Virginia beef-pork livestock sector through the national model multipliers estimated (in earlier research) for the specific policy alternative (Table 6).

The dynamic impact of a national policy on the localized target variables is estimated by multiplying the changes of the national target variables by the multiplier matrix of the Virginia beef cattle, calf, and pork subsectors. The exact changes are designated by X(t+i), where i = 0, 1, . . . , 6. The effects of a maintained increase in the national level of beef imports in the current period from 1.18 to 2.43 billion pounds on the Virginia beef-pork sectors are presented in Table 7. These are cumulative effects resulting from concurrent changes in the three national target variables (BGP, CUPO, PV) and correspond to changes in succeeding period levels of state target variables

TABLE 6. Estimates of Multipliers for the National Model Due to an Increase in Beef Imports of 1.25 Billion Pounds (Yanagida and Conway)

Target Variables	Immediate Impact and Interim Multipliers						
	0	1	2	3	4	5	6
	(ΔX_t)	(ΔX_{t+1})	(ΔX_{t+2})	(ΔX_{t+3})	(ΔX_{t+5})	(ΔX_{t+5})	(ΔX_{t+6})
	($/cwt.)						
PV	-2.49	-2.99	-3.35	-3.31	-2.62	-1.77	0.65
CUPO	-3.27	-4.02	-4.24	-4.08	-3.15	-1.92	0.56
BGP	-1.55	-1.16	-.81	-0.58	-0.28	-0.04	0.15

(BCI, BCS, VI, VS, MHI, HS). Although the analysis used a sustained 1.25 billion-pound increase as a hypothetical example, the multiplier analysis allows other levels to be examined merely by multiplying these results by an appropriate scalar.

In the initial period, Virginia cattle slaughter increased by 7,080 head, Virginia veal slaughter by 11,180 head, and Virginia hog slaughter by 9,700 head, (column 0, Table 7). Evidently, the immediate impact of lower prices for feeder calves reduced the incentive for retaining cows to produce future income, and immediate income became relatively more important in producers' decision to retain cows for breeding.

In addition, the current period effect of increased beef imports on livestock prices and on livestock inventory decisions influenced the performance of the Virginia beef and pork sectors in subsequent periods, represented by interim multipliers. Virginia beef cattle, calf, and market hog inventories would decline three years later by 21,190, 15,630, and 2,130 head, respectively. In addition, Virginia cattle, veal, and hog slaughter would decline three years later by 12,500, 9,730, and 6,020 head, respectively. It should be noted that the apparent discrepancy between the inventory levels and slaughter represents out-of-state livestock shipments because Virginia, as all states, operates as an open economy. In addition, the three-year biological lag period before a heifer joins the cow herd provides a partial jus-

TABLE 7. Estimates of Multipliers for Virginia Due to an Increase in the Beef Import Level

Endogenous Variable	Virginia Average 1977-79	Immediate Impact and Interim Multipliers						
		0	1	2	3	4	5	6
		(1,000 head)						
BCI	940.7	-0-	-0-	-0-	-21.19	-46.24	-71.53	-95
BCS	128.7	7.08	11.31	14	12.50	7.03	-.49	-9.33
VI	418.3	-0-	-5.71	-10.33	-15.63	-18.90	-19.69	-18.31
VS	92.9	11.18	11.55	11.44	9.73	5.56	1.48	-3.09
MHI	723.3	-0-	-2.015	-2.41	-2.31	-1.71	-1.13	-.56
HS	2,918.8	9.7	12.80	8.80	6.02	3.38	.89	-1.04

tification for the three-year lag before any impact occurs on the beef cow inventory.

The behavior of the beef sector is not unexpected and follows intuitive economic logic. When cattle prices begin a cyclical downturn, the immediate reaction of cow-calf operators is one of cutting production costs to a minimum. Uncertainty about the future profitability of their operations also leads many cow-calf operators to maintain their entire herd of cows until prices drop to such low levels that eventual losses become evident. However, the specification of this part of the model would be more complete if separate steer and heifer inventory data had been available to estimate equations with more immediate impacts.

The beef sector reacted far more strongly to the increase in import levels than did the pork sector. Although these results confirmed prior expectations, it had been expected that the pork sector would be more significantly affected than indicated. Beef cow inventory decreased by almost 10 percent by the sixth year, decreasing almost 2.5 percent per year for the final four years. A more cyclical impact can be seen in the beef cattle slaughter multiplier indicating the relative importance of the Virginia cow-calf operator relative to neighboring states. The additional peak-to-trough swing in number of animals slaughtered of almost 20 percent would have a substantial impact on slaughter revenue. The veal or calf inventory is also immediately negatively affected and reaches a maximum of about 5-percent reduction in the fifth year. It then begins recovering as a result of higher expected prices. Veal slaughter increases by almost 13 percent over the 1977–79 average during the first three years. Apparently, cow-calf operators in neighboring states react more quickly and reduce their herd levels than do Virginia producers. Calf slaughter is reduced until the sixth year when herd additions begin to occur.

The pork sector is relatively unaffected by the increase in beef import levels, indicating that the brunt of the adjustment is borne by the beef sector. Market hog inventory is affected by only several thousand pigs and hogs. Although hog slaughter increases more substantially in the first three periods, its significance is minor relative to the total hog slaughter in Virginia.

SUMMARY AND CONCLUSIONS

The primary objectives of this study were to estimate a model of the Virginia beef and pork sectors, and then calculate the subnational impact of significant increases in the national beef import level quota. These results in Virginia were successfully analyzed with a conceptually simple, but quantitatively complicated, two-step estimation procedure. First, the multi-period effects of the sustained 1.25-billion-pound increase in beef imports on endogenous, national target variables were estimated. This information was then used as exogenous data in the second phase of the analysis, which estimated the resulting changes in the state target-variable levels, using multipliers derived from the Virginia model. Immediate impact and interim dynamic multipliers were calculated because of convenience and their ability to estimate differential impacts of alternative policy levels by merely multiplying the results with an appropriate scalar.

As expected, the composite impacts of a sustained increase in beef imports varied over time and by sector. Beef cattle and calf slaughter increased significantly and immediately, but returned to pre-shock levels by about the fifth succeeding period. A similar, but much more muted response was evident in the pork sector. By the end of the sixth year, beef cow and calf inventories had declined by about 10 and 5 percent, respectively, from their 1977–79 average levels. The calf inventory had begun to stabilize about the fifth year, while the beef cow herd was still declining. Finally, discrepancies between livestock inventory and slaughter figures demonstrated some of the data composition problems encountered during the analysis, but also indicated the importance of Virginia's livestock trading relationships with neighboring states.

In summary, the Virginia pork and beef production sectors were shown to be significantly affected by a change in national agricultural beef import level policy. Despite data limitations and an incomplete model specification, the macro to micro analytical procedure appears to be sufficiently flexible to permit the evaluation of additional agricultural policy and planning alternatives. It should be noted that data limitations similar to those encountered by the authors, or selection of a state with a more significant share of commodity production could restrict its general application. Nevertheless, although relatively little attention has been focused on building state agricultural sector models, their apparent ability to provide substantive information concerning subnational policy impacts or analyzing planning activities should increase in the future with additional research.

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