**The Government's Role in Stabilizing Beef Supply when BSE Strikes***

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**The research presented in this paper is funded by the Program of Research on the Economics of Invasive Species Management (PREISM) at USDA's Economic Research Service.*

**Abstract**

Bovine Spongiform Encephalopathy (BSE), also referred to as "mad cow disease", has struck almost every major beef and diary production country. The recent outbreak in the U.S. proved that it is more than potential threat. Using a dynamic simulation model designed based on the particular population dynamics of beef production process, we show that the government intervention can improve the social welfare by providing government payments to cattle producer based on the number of feeders. The $1.7 billion benefit we presented may seem to be "small" when compared to the necessary $13 billion payments, but it only includes the benefit accrued to cattle producers and consumers. The benefit wouldn't seem so small if we keep in mind the upstream and down stream producers that are not included in the model. For example, an unstable beef production would cause dramatic fluctuations in feedstuff prices. Fluctuations will also make the packing plants running either under or over capacity thus increasing unit processing cost.

## Introduction

Bovine Spongiform Encephalopathy (BSE), also referred to as “mad cow disease”, has struck almost every major beef and diary production country. First identified in the United Kingdom in 1986, BSE has been discovered in other European and Asian countries. Measures to control the dissemination of BSE were not taken until 1996 when 10 patients in the UK were identified to have a variant of Creutzfeldt-Jakob disease (vCJD) that was believed to be originated through consumption of BSE-infected meat. Most countries have institutionalized measures to prevent the spread of BSE and the contamination of meat product. Canada and the US banned the use of meat and bone meal (MBM) in 1997 as feedstuffs for cattle, which has been identified as the primary pathway for BSE dissemination. Nevertheless, another case was identified in 2003 in Canada followed by a case in the United States in December 2003. The crisis expedited the process of discussion and implementation of traceability of animal products to minimize the threat of contaminated meat products and provide assurance of safety to consumers.

The BSE experience has demonstrated important impacts on US livestock markets. Immediately following the discovery of the BSE positive cow in the U.S., major beef importing countries, including South Korea, Japan, and Mexico banned beef imports from the U.S.. Consumer demand for beef was slightly disrupted, but only temporarily (empirical evidence in the US suggests the demand shock is temporary in nature). If there is no further discovery of new cases within 36 months, the beef export markets are likely to reopen. However, in the longer run, ripple effects caused by the dynamic biological characteristics of the beef production process could cause dramatic supply fluctuations resulting in potentially large welfare losses to producers. This suggests that governments may have a welfare improving role in providing subsidies or disaster payments to reduce the producers' reaction to the temporary adverse situation so that the longer run ripple effects can be offset. For example, the Canadian government is providing producers with subsidies until the US resumes imports of Canadian beef.

In this paper, we investigate both short-term and long-term impacts of a BSE crisis in the US using a dynamic simulation model of beef production. The model is used to simulate outcomes of alternative government policy interventions. The welfare changes in these scenarios are compared to investigate the effect of government interventions.

**A General Modeling Framework for Livestock Production**

Livestock production is using living animals as growing machines to produce meat. The production process is constrained by the biological life cycle of the animals. Naturally, the whole process can be broken into two pieces, breeding and feeding. The total supply of meat is very much determined by the decision to save and bred the female animals. The fact that the female animal can serve both as a breeding animal and as a feeder makes the decision problem a capital-pricing model. As soon as the breeding decision is made, the ones that are not retained for breeding will be fed for meat (assuming there is no slaughtering of baby animals). The feedlot then chooses an optimal slaughter point to maximize unit profit.

***Population Dynamics (Live Animal production)***

We start the model specification with the evolution of the breeding stock population. Following Aadland (2002), breeding stock is differentiated by ages (to be general, age could be in months, quarters, and/or years). Each age group evolves according to the following equations:

(1) $$K_{t+1}^{j+1} = (1-\alpha_t^j)(1-\delta^j)K_t^j + M_t^j - E_t^j$$

where $K_t^j$, $M_t^j$ and $E_t^j$ are the number of domestic, imported, and exported breeding females of age *j* respectively. The variable $\alpha_t^j$ is the percentage to be culled (choice variable) for that group. $\delta^j$ is the death rate for animals of age *j*. The equation says that the female animals of age *j* that live through the period together with the imported age *j* animals minus the exported during the period would progress into age *j*+1 in next period. The total number of female animals $B_t$ that can be bred is given by

$$(2)\quad B_t = \sum_{j=m}^{s} K_t^j$$

where *m* is the age at which a female is ready to be bred, *s* is the age the productive life ends. These females could be bred and give birth in next period. Instead of birth rate, "weaning rate", the probability of weaning a healthy offspring, $\theta$ serves better to describe the productivity of a breeding animal. The newborns are given by

$$(3)\quad K_{t+1}^0 = 0.5\theta B_t \qquad Moff_{t+1}^0 = 0.5\theta B_t$$

with $K_{t+1}^0$ and $Moff_{t+1}^0$ being the female and male offspring respectively. With these equations, population of each category for every period is attainable once the initial stocks and the time path of the culling rates are given.

***Meat Production***

All of the male newborns and females not retained for breeding purpose that are not exported will go through a feeding program to produce meat. Theoretically, the producer could choose different feeding methods, such as limiting intake and/or changing ration composition according to the life stage and body condition of the feeders, to maximize their profit. While many very large feedlots practice these methods, most of the producers don't have the knowledge and resources. More often, feeders will be put through a fixed "optimal" feeding program suggested by animal scientists. Thus, to simplify matters, we assume all the feeders go through a typical feeding program and only allow the producers to choose when to slaughter them. Under the feeding program, let the growth function and cost function be

$$(4)\ G_\tau = f(\tau) \qquad C_\tau = c(\tau)$$

we use the Greek letter $\tau$ to allow a different length of time interval (usually on daily basis in feedlots) from that of the breeding decision. Let $p_\tau$ be the market price of the meat (on live weight base), profit as a function of $\tau$ is

$$(5)\ PF_\tau = p_\tau G_\tau - C_\tau .$$

Thus, the feedlot optimization problem is a linear search for the $\tau^*$ that gives the maximum unit profit $PF_\tau^*$ (assuming constant returns to scale). The decision to import and export feeders could also be introduced in the feedlot optimization. The feedlot will import feeders as long as the optimal unit profit (with importing cost being part of the cost) is greater than zero. Feedlots will export feeders so long as the revenue from exporting is greater than the optimal unit profit. The slaughter weight of the finished animals is predicted as $G_\tau^* = f(\tau^*)$. Total meat supply from domestically raised animals (excluding meat from animals imported for slaughtering) is then $S_t = G_\tau^* * (\alpha_{t-\tau}^0 K_{t-\tau}^0 + M_{t-\tau} + NMF_{t-\tau})$ with $\tau$ converted to the same scale as $t$ and $NMF_t$ being the net imports of feeders.

***Inventory Update Policy***

The breeding decision is to choose a series of culling rates, imports, and exports to maximize the total profit subject to the above biological constraints. Total revenue consists of meat sales, live animal exports, and salvage value of culled breeding animals. With $pw_t^j$ as the world price for breeding animals of age *j* (per animal), total revenue is given by

(6) $R_t = PF_t^*(\alpha_{t-\tau}^0 K_{t-\tau}^0 + M_{t-\tau}^0) + \sum_{j=0}^{s} pw_t^j E_t^j + \sum_{j=1}^{s} SV_t^j \alpha_t^j K_t^j$

with $\tau$ converted to the same scale as $t$. Let $MC_t^j$ be the unit maintenance cost breeding animal of age *j*, the total cost of the breeding herd is the total maintenance cost plus the cost of imports

(7) $TC_t = \sum_{j=0}^{s} (MC_t^j K_t^j + pw_t^j M_t^j)$ .

Total profit for period *t* is

(8) $\pi_t = R_t - TC_t$ .

And the producer's objective is to maximized the sum of the present values of all future profit by choosing the culling rates, imports and exports

(9) $obj = \underset{\{E_t^j\},\{M_t^j\},\{\alpha_t^j\}}{MAX} \{\sum_{t=0}^{\infty} \beta^t E_0(\pi_t)\}$

subject to the constraints of (1),(2),and(3).

Equations (1)-(9) complete the specification of the meat production process. Due to the complexity of the biological process, a closed form solution for the maximization problem is not practical. A numerical solution is more viable.

***Markets and Equilibrium Conditions***

The Almost Ideal Demand System (AIDS) is employed to define the domestic demand because it take into account the substitution effect as price changes and has the capability to generate exact welfare measures (Compensated Variation *CV* and Equivalent Variation *EV*) (Deaton and Muellbauer 1980). If we let $D_t$ be the demand vector, $P_t$ be the price vector, and $IN_t$ be the income, the demand system in price dependent form can be expressed as

(10) $P_t = F(D_t, IN_t)$.

Since we do not explicitly model the meat packing industry where the decision to import live animals for slaughter is made, the demands discussed here are the demands net out the meat from animals imported solely for the purpose of slaughtering. In the case of free trade, the export demand for meat would depend on the domestic price

(11) $ME_t = EDf(P_t)$.

Given that in most countries the volume of live animal trade for breeding is very small and most of the import and export are for the purpose genetic improvement, it doesn't severely impair the model by setting the import and export terms in equation (1) as exogenous variables. However, as important pathways for invasive diseases, they cannot be totally ignored.

The market-clearing price for imported feeders $Pfm_t^*$ is the one that makes the profit of feeding them zero. The number of imported feeders is given by the foreign supply at this price $MF_t = FFS(Pfm_t^*)$. The market-clearing price for exports of feeders $Pfe_t^*$ is the one that equate the revenue from exporting to the marginal unit profit from feeding. And the number of exported feeders is given by $EF_t = FFD(Pfe_t^*)$ with $FFD(\bullet)$ being the foreign feeder demand function. When a country engages in both importing and exporting feeders, the equality $Pfm_t^* = Pfe_t^*$ is dictated by the trade arbitrage.

For the market-clearing condition of meat, let $MM_t = FMS(P_t)$ be the foreign meat supply function and $EM_t = FMD(P_t)$ be the foreign meat demand function. Then the market-clearing price is the solution of

(12) $S_t + MM_t = D_t + EM_t$.

Both the imports and exports can be segmented into different countries or trade regions to better accommodate different trade policies and bilateral agreements between the home country and the others. Meat import can also include live imports for direct slaughtering with a fixed price markup to avoid explicit modeling of packing industry. Although in the short run the fixed price markup might not describe the actual price difference, it could very well represent the difference in processing costs in the long run.

By now, the conceptual model of livestock production is completely specified. With a proper choice of time interval, mature age, length of productive life, feeding pattern, growth function, and other biological parameters, the simulation model can be used to evaluate the effects of various events and agricultural policies on different aspects of the livestock production.

**Beef Production Model**

With minor modifications, the framework described above can be used to implement a beef production model. Specifically, the feedlot operation needs to be added to the model so that the whole production process is complete. Details are presented in the following sections.

***Population Dynamics***

An annual model can best describe beef production due to the annual reproductive cycle of the breeding herd. A heifer becomes productive at age 2 and the average productive life as a breeding animal ends at 10 (Aadland 2002). So we set $m = 2$ and $s = 10$ in equation (2). Typically, the weaned calves not retained for breeding purpose will go through a backgrounding phase and enter feedlots when they become yearlings where they are fed a ration with high grain content. Two more inventories are added to keep track of the number of female and male yearlings:

$$
\begin{aligned}
Fyg_t &= \alpha_{t-1}^0(1-\delta^0)K_{t-1}^0 \\
Myg_t &= (1-\delta^0)M_{t-1}
\end{aligned}.
$$

***Feedlot Optimization***

The equations for predicting the intake and growth of the feeders on feedlots are adopted form the *Nutrient Requirements of Beef Cattle* (National Research Council, 1996) and listed below.

$$DMI_t = DMA * BW_{t\text{-}1}^{\;0.75}(0.2435NE_{ma} - 0.0466NE_{ma}^2 - 0.0869)/NE_{ma}$$

$$NE_{rm} = 0.077BW_{t\text{-}1}^{\;0.75}$$

$$FFM_t = NE_{rm}/NE_{ma}$$

$$NE_g = (DMI_t - FFM_t)NE_{ga}$$

$$G_t = 13.91NE_g^{\;0.9116}WE_{t\text{-}1}^{\;\text{-}0.6837}$$

$$BW_t = BW_{t\text{-}1} + G_t$$

where $DMI_t$ is the predicted dry matter intake, $BW_t$ is the current body weight (shrunk weight), $NE_{ma}$ is the net energy fro maintenance of the feed, $NE_{rm}$ is the predicted net energy required for maintenance, $FFM_t$ is the predicted feed required for maintenance (dry matter), $NE_g$ is the predicted net energy for gain, and $WE_t$ is the equivalent weight (body weight adjusted by factors corresponding to breed frame codes, refer to Fox et al. (1988) for frame codes and adjustment factors) .

Since the profit of feedlots depends very much on the final quality of the meat products—the quality grade and yield grade in the context of a grid marketing system, we adopted the equations to predict the body composition, quality grade, and yield grade from Fox and Black (1984).

$$EBF_t = 100 * (0.037EBW_t + 0.00054EBW_t^2 - 0.61)/EBW_t$$

$$CF_t = 0.7 + 1.0815EBF_t$$

$$QG_t = 3.55 + 0.23CF_t$$

$$YG_t = \text{-}2.1 + 0.15CF_t$$

where $EBF_t$ is the percentage fact in the empty body, $EBW_t = 0.891BW_t$ is the empty body weight, $CF_t$ is the percentage fact in the carcass, and $QG_t$ and $YG_t$ are the quality grade and yield grade respectively. The $QG_t$ values is related to the USDA standards as follows: Select$^0$=8; Select$^+$=9;Choice$^-$=10; et cetera.

While all of these equations predict the mean values of certain traits, the actual values may vary for a particular feeder. To get the expected discounts for the whole population of feeders under a grid marketing system, we must take into account of the trait variability. Follow Amer et al. (1994), the traits are modeled as random variables follow normal distributions (empirical distributions can also be used for better results) with the mean predicted by the model and estimated variances. The proportion of cattle marketed in a certain grid cell corresponds to the probability mass between the boundaries of the cell. The expected total discount/premium for cattle marketed after *t* days on feed can be calculated, denoted as $Dis_t$.

Now we have enough information to calculate the revenue, costs, and profit of the feedlot when the feeders are marketed at time *T*. The current value of selling the feeder at time T is given by

$$R_T = EP_T * CW_T * \exp(-r\frac{T}{365})$$

with $R_T$ being the present valued revenue, $EP_T$ being the expected price adjusted by the total expected discount $Dis_T$, and $r$ being the discounting rate. The cost accrued at the slaughter point T includes ration cost and yardage cost

$$Ration_T = \sum_{t=0}^{T} (DMI_t * RC * \exp(-r\frac{t}{365}))$$

$$Yardage_T = \sum_{t=0}^{T} (0.25 \exp(-r \frac{t}{365}))$$

where $RC$ is the unit ration cost and yardage cost is assumed to be $0.25 per day. The expected profit from one feeder is then given by

$$Profit_T = R_T - Ration_T - Yardage_T$$

Since profit is only a function of the integer variable *T*, linear search within the domain of *T* could yield the optimal slaughter point and the maximum profit derived from the feeder. Let $T^*$ be the solution to this problem, the corresponding finishing weight *FW*, finishing cost *AFC*, and expected discount *OptDis* are then used in the breeding decision process.

***Meat Supply, Demand, and total Profit***

The total supply of fed meat $FMS_t$ is the number of feeders coming out of the feedlots multiplied by their finishing weight $FW_t$,

$$FMS_t = (1-\delta_1) FW_{t-1} (Fyg_{t-1} + Myg_{t-1}) .$$

The supply of non-fed meat is determined by the number of culled breeding animal multiplied by the average slaughter weight $ASW$,

$$NFS_t = ASW \sum_{j=1}^{m} (1-\delta_j) \alpha_{t-1}^{j} K_{t-1}^{j} .$$

Since we are only dealing with beef production with two products, fed beef and cow beef, that have very little substitutability, we use single-equation constant elasticity demand equations for fed and non-fed beef. The mid-point own price elasticity ranges from 0.5 to 0.8 in the literature. Using beef disappearance per capita and beef retail price obtained from ERS, we estimated the elasticity to be -0.8116. The demand for non-fed beef is usually less elastic, 0.5 is used in the non-fed beef demand. The two demand equations are

$$P_t = C_0 FMS_t^{-1.232} \text{ and } SV_t = C_1 (NFS_t \; / \; ASW)^{-2}$$

where $C_0$ and $C_1$ are two constant terms.

The revenue from fed meat is the market price minus the discount at the optimal slaughter weight multiplied by the total supply. The total feed cost $FC_t$ is the average fed cost per feeder $AFC_{t-1}$ (determined in last period) multiplied by the total number of feeders. The total breeding cost $TBC_t$ is the average breeding cost $ABC$, which is assumed to be constant, multiplied by the total number of animals retained for breeding purpose. Total profit equals to the sum of the revenues from fed meat $Rfm_t$ and from non-fed meat $Rnfm_t$ minus the feeding cost and total breeding cost. The equations are listed below,

$$Rfm_t = (Pm_t - OpDis_t) * FMS_t$$

$$Rnfm_t = SV_t * NFS_t \; / \; ASW$$

$$FC_t = AFC_{t-1} * (Fyg_{t-1} + Myg_{t-1})$$

$$TBC_t = ABC * \sum_{j=1}^{m} (1 - \alpha_{t-1}^{j}) K_{t-1}^{j}$$

$$\pi_t = Rfm_t + Rnfm_t - FC_t - TBC_t \, .$$

***Inventory Adjustment***

The complete set of Kuhn-Tucker conditions for profit maximization of breeding operations is specified. It is assumed that an increasing adjustment cost be applied when the total inventory changes from the previous period. The adjustment cost reflects the increasing difficulty in securing/liquidating necessary resources. Producers are assumed to form naïve expectations based on the last period’s observed price.

*Calibration and Some Simulation Results*

The model was calibrated using the PS&D data assuming the model is at long run equilibrium in year 2000. The death rate and birth rate are estimated from the cattle inventory data obtained from Production, Supply & Distributions Database, Foreign Agricultural Services USDA. Death rates and birth rates are assumed to be $\delta^j = 0.0324$ and $\theta = 0.85$ respectively. The ration we use consists of 70% corn, 25% alfalfa silage, and 5% soybean meal ( $NE_{ma} = 2.03$ Mcal/kg and $NE_{ga} = 1.28$ Mcal/kg ).

Production cost parameters are rough estimates taken from various budget forms from different USDA extensions. The maintenance cost of breeding cows is $400/year. The backgrouding cost is $100. The price of the ration is roughly $140/ton. Yardage cost is assumed to be $0.25/head/day. The time rate of preference is assumed to be 0.05. Interest rate is set at 0.09.

The grid pricing system is presented in the following table.

Table 1. A typical grid of discounts/premiums for fed cattle

| | YG1 | YG2 | YG3 | YG4 | YG5 |
|---|---|---|---|---|---|
| Prime | 10 | 9 | 8 | -12 | -17 |
| Choice | 2 | 1 | 0 | -20 | -25 |
| Select | -5 | -6 | -7 | -27 | -32 |
| Standard | -33 | -34 | -35 | -55 | -60 |
| Out Cattle | <500 | <550 | >950 | >1000 | |
| Discount | 30 | 10 | 10 | 30 | |

*values represent discounts/premiums for $100 per carcass weight

The standard deviation of carcass weight is assumed to be constant at 20 kg. The standard deviations of quality grade and yield grade are estimated using grading data obtained from Agricultural Marketing Service, USDA. They are 1.4 for quality grade and 0.8 for yield grade. The model is calibrated to the inventories and prices of year 2000.

Export demand elasticities for Mexico, Canada, and Japan are estimated using data published in World Trade Atlas. Since the data to estimate the elasticity for South Korea is not available, it is set to -1. There are also three foreign countries supplying beef for the U.S., including Canada, Australia, and New Zealand. The import demand elasticities for these countries are also estimated using data from World Trade Atlas. The constants in the export demand and import demand equations are set to the value that makes the quantities match those of the year 2000.

**Description of Scenarios**

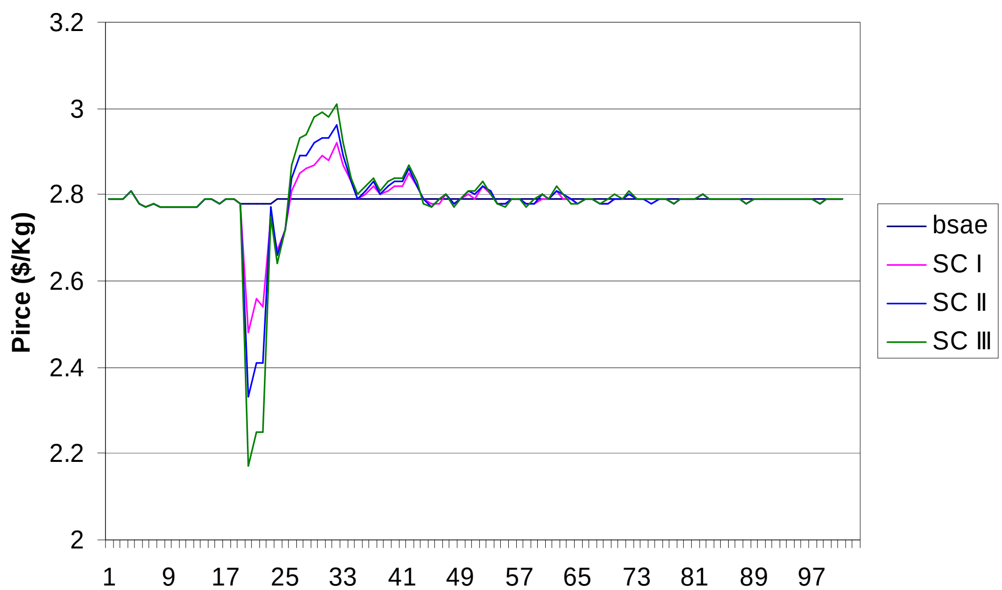
The calibrated near-equilibrium model is used as a base scenario for comparison. In all other scenarios, we assume that the major beef importers, including Canada, Japan, South Korea, and Mexico, ban beef imports from the U.S.. Although Canada didn’t impose a ban when the U.S. discovered the first BSE case in December 2003, that was due to the particular circumstance caused by their own BSE crisis and cannot be considered a general case. The bans are assumed to be lifted after 36 months period following the discovery. Since there are still no general conclusions on U.S. consumer response to the BSE outbreak, three scenarios regarding decreases in domestic consumption are included—no demand reduction, 5% reduction, and 10% reduction (referred as scenario I, II, and III respectively). These demand decreases are assumed to be temporary and they return to the normal level after 36 month. Since the long-run effect on demand is unknown, one more scenario, which assumes a temporary 10% reduction for 36 months and a moderate 2% reduction thereafter (Scenario IV), is included.

Since the best government policy in face of a BSE outbreak is to prevent producers from overreaction to the temporary demand shock, temporary direct price support for feeders the 36-month period is implemented in conjunction with Scenario III and IV to form Scenario V and VI. The government pays the difference between the market price and the support price. Although it is implemented as a price support, any other direct transfers to producers that are based on the number of feeders produces should have similar welfare effect as long as the transfer/feeder does not exceed the price support level.

**Simulation and Economic Implications**

The shocks start at the 19th period. In the first three scenarios, the import bans and temporary demand reduction are lifted at the end of 21st period. The price responses to the shock in the first three scenarios are plotted in Figure 1.

Figure 1. Price response to a BSE outbreak




Without consider the magnitude of fluctuation, the price response in all three scenarios are almost identical. The reduced demand for beef causes a lower price. The breeders lower their expectations and retain fewer heifers. The total future production will be less. Then the bans are lifted. Demand return to its normal level. The reduced production cannot meet the demand and the price is driven higher. Driven by the population dynamics, the system produces dampening cycles until convergence to long-run equilibrium.

The welfare measures produced by the model are domestic consumer surplus and producer surplus. The net present values ("present" being the start of the outbreak) of welfare changes relative to the base scenario are listed in Table 2.

Table 2. Welfare changes relative to the base scenario (Million Dollars)

| *Scenario* | *CS* | *PS* | **Total** |
|---|---|---|---|
| I (No Demand Reduction) | 4397.736 | -3000.44 | 1397.295 |
| II (5% Demand Reduction) | -3167.94 | -4780.84 | -7948.78 |
| III (10% Demand Reduction) | -10514.4 | -6954.35 | -17468.7 |

In Scenario I, consumer's demand curve remains the same as before the outbreak. Due to the price decrease, consumer enjoys a total surplus of 4.4 billion while cattle producer suffer a loss in terms of profit and adjustment cost of 3 billion. In Scenario II and III, the shifting of demand curve because of consumer's risk aversion to the risk content carried by beef products causes a net loss of consumer surplus. The bigger size of the shocks also results in bigger welfare loss to beef producer. As suggested by the distribution of welfare in the Scenario, the least the government could do in such as situation is to provide subsidies to beef cattle producers to ease their stress through welfare redistribution.

Welfare changes in Scenario III, together with those from Scenario IV, V and VI, are listed in Table 3 for comparison. Comparing Scenario III with IV, both consumer and producer suffer a much less welfare loss while the government pays the producer $13.3 billion. National welfare loss is reduced by $1.7 billion. In Scenario VI, the government payment is the same as in IV and the national welfare also improves by $1.7 billion. The difference from Scenario IV is that producer has to bear the cost of adjusting to the new demand level that is 2% less than before the outbreak. These comparisons show that the government could design policies to prevent dramatic fluctuations in beef supply when it is known that the shock is temporary in nature.

Table 3. Welfare changes relative to the base scenario (Million Dollars)

| *Scenario* | *CS* | *PS* | *Gov* | **Total** |
|---|---|---|---|---|
| III (10% Demand Reduction) | -10514.4 | -6954.35 | 0 | -17468.7 |
| IV (III+Price Support) | -2411.11 | 54.32707 | -13322.2 | -15679 |
| V (III+2% Permanent Demand Reduction) | -28069.5 | -10271.1 | 0 | -38340.6 |
| VI (V+Price Support) | -19957.3 | -3346.91 | -13322.2 | -36626.4 |

**Conclusions**

The incidence of BSE found in Washington in December 2003 caused a big splash among cattle producers, government agencies, consumers, and, of course, economists. After all, BSE is not that far away from us. While it is necessary to take measures to strengthen our food security, we also need to prepare us for the next strike. It will strike again no matter how unlikely it may seem.

This time we were lucky. The Canadians suffered the first, left the U.S. producers with a profitable beef market. The BSE outbreak did not seem to hurt that much. Will we be this lucky next time? What could we do if we were caught in a down time? Using a dynamic simulation model designed based on the particular population dynamics of beef production process, we show that the government can provide assistance to producers, which can not only ease the political pressure from the producers but also improve the social welfare. The benefit we presented may seem to be “small” when compare to the necessary payments, but it only includes the benefit accrued to cattle producers and consumers. The benefit wouldn’t seem so small if we keep in mind the upstream and down stream producers that are not included in the model. For example, an unstable beef production would cause dramatic fluctuations in feedstuff prices. Fluctuations will also make the packing plants running either under or over capacity thus increasing unit processing cost.

In practice, price support may not be a popular choice due to the bad experience we had in the 70’s. Alternative transfer method such as subsidies can be used instead provided that it is bound to the number of feeders produced. It’s easy to show that as long as the feeder price plus the transfer does not exceed the long-run equilibrium price level, the total welfare improves. And the best policy would be the one that achieves the long-run equilibrium price. This raises another practical issue, which is we usually don’t know the long-run equilibrium price. Unfortunately, “best” judgment has to be made in that case. One should be cautious not to avoid exceeding the long-run equilibrium price to avoid unnecessary and counterproductive inventory buildup.

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