Background

Considerable public resources are provided for the development and implementation of livestock traceability systems. It is generally believed such systems will help facilitate traceback when a disease outbreak occurs, minimizing its disruptive effects. There are also believed to be potential value-added benefits associated with a functioning traceability system.

The goal of this research was to determine the short-run economic impacts of a livestock traceability system on a foot-and-mouth disease (FMD) outbreak originating in the province of Ontario. Though there have been no cases in Canada since 1952, FMD remains a problem in several parts of the world. No other disease would have more dire economic consequences for the Canadian livestock sector than FMD.

An epidemiological disease spread model was formulated to estimate the duration and scale of a hypothetical FMD outbreak. Direct disease control costs and welfare effects were then calculated using an equilibrium displacement model (EDM).

Epidemiological Model

The stochastic disease spread framework used for this research was the North American Animal Disease Spread Model (NAADSM) described by Harvey et al (2007). The model requires a user to provide detailed information specific to the disease/region/species being studied. For this research, animal demographic data specifying herd sizes and locations for the Ontario dairy industry was provided by the Dairy Farmers of Ontario; cattle and swine herd distributions were approximated using agriculture census subdivision boundaries and ArcGIS software. The rate of disease spread is determined in part by indirect and direct animal contact rates and herd-level disease state durations; this information was obtained via a survey of Ontario auction barns with additional parameters being provided by CFIA experts or taken from previous published research.

Economic Model

An EDM incorporating two exogenous shifts caused by an FMD outbreak within a partial equilibrium framework of the Canadian cattle and beef industry was used, similar to Pendell (2006). It was assumed that all exports are halted upon outbreak discovery and announcement. Welfare changes (consumer surplus at only the retail level; producer surplus at each marketing level) based on outbreak length as determined within the epidemiological model as well as quantities were calculated using annual baseline values. Scenarios were constructed to reflect various possibilities with respect to animal identification and movement recording; benefits of animal traceability were calculated by comparing welfare effects within these scenarios depending upon number of animals culled, disease outbreak costs, and duration of border closure.

Within the structural model, supply and demand equations were created for each marketing level within the cattle/beef supply chain. Vertical linkages between levels are incorporated into the model through the use of quantity transmission elasticities. A partial budgeting framework was developed to aggregate the direct short-run outbreak costs (surveillance, disinfection, slaughter, and reimbursement). Sensitivity analysis with respect to allocation of direct outbreak costs was completed using three outcomes: (1) producers bear entire cost (2) cost split evenly between government and producers (3) government bears entire direct control cost. Sensitivity analysis for supply and demand function elasticities was also conducted.

Several types of data are required for the model: Supply, demand and transmission elasticities for each marketing level were based on prior estimates from Canada and the U.S. (Marsh 1994; Brester, Marsh, and Atwood 2004, Pendell 2006). Baseline prices and quantities were obtained from Canfax, Statistics Canada and AAFC. Per-unit direct cost estimates came from a consulting study that relied upon CFIA cost estimates.

Results

Epidemiological model simulations were carried out for low, medium and high traceability scenarios and medium, high and reduced movement control contact rates. Varying probability of a successful trace had modest effects on outbreak duration (around 81 days given medium direct contact rate), infection levels (60 to 65 farms), and numbers of animals destroyed (around 15,000). Results generated from the EDM suggest direct outbreak costs of around $205 million, approximately 94% of which are tied to enforcing movement restrictions through the setup of infected and restricted control zones. Welfare losses from an FMD outbreak are approximately $4.15 billion (reductions in producer surplus of $4.8 billion are partially offset by consumer gains of around $650 million); varying trace success probability again had only a modest effect on results.

Conclusion

Increasingly complex traceability systems may not generate net benefits in the event of an animal disease outbreak. Still, the presence of such systems is likely to result in gains associated with market access and enhanced consumer confidence.

References


