

Summary

This study uses a modeling framework to estimate the nature of economic impacts of outbreaks of foreign-source livestock diseases. The model is more comprehensive than previous work because (1) it has components for modeling both economic effects and disease-spread effects from an outbreak, for which the results can be integrated; (2) it assesses the effects of a disease outbreak on major agricultural sectors—livestock and crops—along vertical market chains, from production to consumption; and (3) it projects the impacts of the disease outbreak over 20 calendar quarters, rather than for just 1 year.

What Is the Issue?

As more is learned about the impacts of foreign animal disease outbreaks, questions arise regarding the efficacy of existing animal disease-impact models for capturing the array of effects across many economic sectors and over time. Previous models lacked adequate treatment of either the economic components or the epidemiological components, and, in some cases, both. Further, there is a need to address the ways that alternative control strategies affect the economic interests of the numerous agricultural sectors, both on and off the farm.

What Are the Major Findings?

While the framework can be applied to many livestock diseases, this study demonstrates the model with a hypothetical outbreak of foot-and-mouth disease (FMD). The outbreak is assumed to occur in small hog operations in the U.S. Midwest, a result of using contaminated garbage as feed. Various disease-control strategies are entered into the model. The economic effects from each control strategy are based on 50 iterations of the disease-outbreak epidemiological model, which randomly assigns different herd sizes, spatial distribution, and other variables for each iteration. The model produced the following key results:

- Epidemiological model results show that relatively few animals need to be destroyed because of the disease.
- Economic model results show large monetary losses for beef, beef cattle, hogs, and pork sectors, mainly caused by the loss of exports under a given set of foreign sanitary and phytosanitary policies. Other agricultural sectors experience small losses or, in some cases, small gains.
- Swine and pork sectors recover shortly after export restrictions end, while effects on beef and cattle sectors last longer due to the longer cattle production cycle.
- Disease control strategies that reduce the duration of the outbreak are the most effective choices for reducing the economic toll. The model found that three strategies reduce the duration to less than one quarter. In order of least to most effective, based on the mean number of days to end the outbreak, for the hypothetical outbreak these are:

- Destruction of only those herds within a radius of 1 km that have had direct contact with infected herds: Outbreaks average 56.48 days.
 - Direct-and-indirect-contact slaughter, which destroys direct-contact herds plus those herds indirectly exposed to an infected herd through movement of people, vehicles, or other possible sources of infection: Outbreaks average 54.99 days.
 - Destruction of all herds within a 1 km radius of the initial outbreak: Outbreaks average 36.8 days.
- Export embargoes increase domestic meat supplies, and domestic consumers benefit from lower prices during the quarters in which exports are embargoed.
 - Model results, extended to 16 quarters, show that for this hypothetical outbreak:
 - After 7 quarters, production of all commodities increases to the point where both domestic consumption and trade return to pre-disease levels.
 - Total trade losses, plus other disease-related costs to capital and management, amount to between \$2,773 million and \$4,062 million, compared with a disease-free baseline period (2001-2004).

How Was the Study Conducted?

The framework has two components: (1) The North American Animal Disease-spread Model (NAADSM), developed by the U.S. Department of Agriculture's Animal and Plant Health Inspection Service, which enables estimates of epidemiological damages (supply shocks) from varying disease-spread and control scenarios. These estimates can then be integrated with (2) an economic model, developed by Paarlberg, Seitzinger, and Lee, that assesses effects of supply shocks from the epidemiological model, along with demand and trade shocks, projected over the simulation period.

To illustrate the modeling framework, a hypothetical outbreak of FMD arising from feeding garbage in four small farrow-to-finish operations is examined under three alternative control strategies and three levels of disease intensity. The control strategies are (1) destruction of direct-contact herds, (2) destruction of direct-contact and indirect-contact herds, and (3) destruction of all animals within a 1-km ring. Disease intensity is examined at low, medium, and high levels. Each disease control scenario was simulated 50 times, with the epidemiological model determining effects of an outbreak.

Animal losses and duration of the FMD outbreak are sensitive to the conditions assumed for the outbreak, i.e., that it started on small pig farms and was confined to them. Alternative scenarios could result in higher costs than reported in this analysis. Future work will evaluate the robustness of these results.