H5N1 avian influenza was not detected in the Americas, the share values of the largest poultry producers in the U.S. declined by as much as 40% because of the indirect impacts on global poultry trade and consumption when consumer fears about the safety of poultry struck European countries in 2005–6 (Figure 1). When disease outbreaks result in complete embargoes of meat exports from a given country—not an uncommon event—the indirect economic cost of the embargo is often many times greater than the direct cost of the disease outbreak. For example, the trade embargoes imposed on Canada after the discovery of Canada’s first domestic animal infected with Bovine Spongiform Encephalitis (BSE) in May 2003 ultimately caused an estimated $4.9 billion (US) in economic damage to the livestock industry.

![Figure 1: Weak Poultry Exports Affected U.S. Companies](image)

The indirect costs of livestock disease are not limited to the livestock industry, but can in fact spill over to affect an entire region or country. In 2003–4, the mass culling of tens of millions of poultry in Thailand and Vietnam had ripple effects on regional economic activity in poultry producing areas. In addition, the outbreak had macroeconomic impacts on balance of trade, currency values, stock market valuations and other repercussions to the nation’s overall economy.

In human disease outbreaks, the indirect costs of disease outbreaks range from the interruption of air travel caused by the SARS outbreak in 2003 to the fear-related disruptions of village and regional economies caused by Ebola or avian influenza. For example, school closures invoked during the SARS outbreak required millions of workers who were parents of school-age children to remain home from work or make alternative child-care arrangements.
In some cases, at levels ranging from a village to a region to the entire world economy, disease outbreaks can have **systemic costs**. These are costs incurred when the effects of disease or, more commonly, the fear of disease has cascading negative consequences for economic activities, resulting in disruptions of trade, travel, and investment, loss of asset values, and the shut-down of basic economic and social functions. In the event of a highly contagious and severe pandemic, these types of economic losses would be likely to significantly overshadow the direct costs of the disease.

The SARS outbreak revealed the exposure of the global economy to the types of indirect and systemic economic costs just described. Bio-era estimates that the total economic damage caused globally by SARS was in the range of $40–50 billion (US). Yet, the direct costs of the disease, measured in terms of medical costs of diagnosis, treatment, and productivity losses accounted for less than 2% of the total economic damage incurred.

Figure 2 illustrates the impact of SARS on airline passenger traffic in 2003. For the nations most severely affected, airline passenger traffic declined by 70% or more. The average value of equities traded on Asian stock markets also declined significantly as the SARS case count rose, with sectors such as banking, materials, and real estate losing more than 10% of their market value (Figure 3 and 4). Tourism in the region plummeted, with sectoral earnings falling by 15–40% (Figure 5). Overall, even though the outbreak was short-lived, SARS had a significant impact on quarterly economic growth in Asia and even in Canada, where the number of SARS cases was quite small (Figures 6 and 7).
**Figure 3: Asian Market Share Prices During SARS**

![Graph showing market share prices during SARS](image)

Index: March 17, 2003=100, Ratio MSCI Local and MSCI World
- Singapore
- China
- Hong Kong

Right-hand scale: Reported SARS cases, Sources: Datastream and WHO

**Figure 4: Asian Sector Performance During SARS**

![Bar chart showing sector performance](image)

Asia ex Jp Performance (US$) from SARS Outbreak to SARS Low by Sector

Source: Citigroup Investment Research
**Economic Impact of Selected Infectious Diseases**

**Figure 5: Estimated Economic Impacts of SARS on Travel and Tourism**

- **China**
  - Decline in tourism earnings: 24.5%
  - Dollars lost from decline in tourism (US$ in millions): 20,400

- **Hong Kong**
  - Decline in tourism earnings: 41.1%
  - Dollars lost from decline in tourism (US$ in millions): 3,640

- **Vietnam**
  - Decline in tourism earnings: 14.5%
  - Dollars lost from decline in tourism (US$ in millions): 14

- **Singapore**
  - Decline in tourism earnings: 43%
  - Dollars lost from decline in tourism (US$ in millions): 2,590

*Sources: World Travel and Tourism Council and IATA*

**Figure 6: SARS Impact on Asian GDP Growth**

*Source: GAO analysis of data from national statistical offices in China, Hong Kong, Singapore, and Taiwan*
Considered more widely, the economic costs of the selected human and animal disease outbreaks included in Bio-era’s analysis, which represent only a fraction of the global disease outbreaks in the period from 1995–2008, total more than $125 billion in economic damages (Figure 8 and Table 1). More importantly, the evidence from recent disease outbreaks in both humans and livestock, attests to the fact that, in an era of increased global economic integration, the indirect and systemic costs of disease outbreaks often represent the largest share of the economic damages incurred. Policy decisions based on estimates of the direct costs of disease outbreaks alone will result in underinvestment in health promotion, disease prevention, research on emerging infectious diseases, and monitoring and surveillance to detect emerging infectious diseases.
**Table 1: Economic Impacts of Selected Emerging Infectious Diseases, 1995–2008**

<table>
<thead>
<tr>
<th>Disease</th>
<th>Factors believed to be associated with emergence</th>
<th>Animal and/or human populations affected</th>
<th>Estimates of economic impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>BSE/vCJD; UK, 1995</td>
<td>Prions in meat and bonemeal cattle feed</td>
<td>180,000 cases of BSE in livestock</td>
<td>$10-13 billion total economic loss to U.K.³</td>
</tr>
<tr>
<td></td>
<td></td>
<td>164 human deaths</td>
<td></td>
</tr>
<tr>
<td>Foot and mouth; Taiwan, 1997</td>
<td>Possibly livestock or meat trade</td>
<td>3.8 m pigs destroyed</td>
<td>$5.0 billion in total economic losses</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>$1.6 bn loss of pork exports to Japan⁴</td>
</tr>
<tr>
<td>Classical swine fever; Netherlands, 1997</td>
<td>Livestock trade</td>
<td>8 million hogs destroyed</td>
<td>$2.3 billion⁵</td>
</tr>
<tr>
<td>Lyme disease; United States, 1997</td>
<td>Land use patterns</td>
<td>&gt;250,000 human cases since 1991</td>
<td>Up to $1 bn per year in diagnosis, treatment, and lost wage costs⁶</td>
</tr>
<tr>
<td>West Nile Virus; United States, 1999</td>
<td>Human travel and/or transport of infected birds or mosquitoes</td>
<td>3,630 cases and 124 deaths in 2007</td>
<td>$300–500 m per year for U.S. direct in-patient medical costs and public expenditures on vector control</td>
</tr>
<tr>
<td>Nipah virus; Malaysia, 1999</td>
<td>Encroachment of human populations into wildlife habitat; domestic animals as “amplifier” hosts</td>
<td>&gt;100 human deaths (40% case fatality rate)</td>
<td>$350–400 m from losses and control costs in the pork industry</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1.1 m pigs destroyed</td>
<td></td>
</tr>
<tr>
<td>Foot and mouth disease; United Kingdom, 2001</td>
<td>Possibly introduced to U.K. via contaminated meat or meat products</td>
<td>2,026 confirmed cases</td>
<td>$18–25 bn total economic cost to U.K.⁷</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;10 million sheep and cattle destroyed</td>
<td></td>
</tr>
<tr>
<td>Severe Acute Respiratory Syndrome (SARS); 2003</td>
<td>Possibly spread through wildlife trade; SARS circulates in bats, spilled into civets, and emerged into humans</td>
<td>8,098 cases and 774 deaths in 2003</td>
<td>$40–50 bn in total economics costs worldwide⁸</td>
</tr>
<tr>
<td>Avian flu (H5N1 reemergence); 2003</td>
<td>Possible viral exchange between domestic and wild birds</td>
<td>&gt;200 million poultry destroyed</td>
<td>$20-30 bn worldwide</td>
</tr>
<tr>
<td>Exotic Newcastle Disease (END); United States, 2003</td>
<td>Human and poultry movements; cockfighting</td>
<td>3.5 million chickens destroyed in California in 2003</td>
<td>$100 million (largely from trade embargoes)</td>
</tr>
</tbody>
</table>

³ The U.K. government estimated the economic loss at £10-13 billion.
⁴ The loss of pork exports to Japan was estimated at $1.6 billion.
⁵ The estimated economic impact was $2.3 billion.
⁶ The estimated cost for diagnosis, treatment, and lost wages was up to $1 billion per year.
⁷ The estimated economic cost to the U.K. was $18-25 billion.
⁸ The estimated total economic cost worldwide was $40-50 billion.
**Table 1 Continued: Economic Impacts of Selected Emerging Infectious Diseases, 1995–2008**

<table>
<thead>
<tr>
<th>Disease</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Avian flu; Netherlands, 2003</td>
<td>Possibly poultry trade and/or contamination from wild birds</td>
<td>&gt;30 million chickens destroyed</td>
<td>$200 million</td>
</tr>
</tbody>
</table>
| BSE; Canada, 2003     | Prions in meat and bonemeal cattle feed                   | 13 cases since 2003                      | Total economic losses in 2003 $4.9 bn$^9$<sup>9</sup>  
Total cost to 2008 $8–10 bn$^10$ |
| BSE; U.S., 2003       | Livestock trade; prions in meat and bonemeal cattle feed | 3 cases since 2003                       | $3.2–4.7 bn$^11$                    |
Notes


3 It is estimated that cases of BSE have cost the EU member states 80 billion Euros (R. McKie, “Warning Over Second Wave of CJD Cases,” The Observer, August 3, 2008).


7 There are different estimates of the costs of the U.K. foot and mouth disease outbreak. See, for example, “The Economic Costs of Foot and Mouth in the UK: A Joint Working Paper, DEFRA, London, March 2002.

8 Bio-era estimate based on data for worldwide disruptions of economic growth and trade.

9 Total economic impacts were estimated to be $6.3 bn (Canadian). Serecon Management Consulting Inc., BSE Economic Impact Assessment, prepared for Canadian Animal Health Coalition, Calgary, Alberta, Canada, June 2003.

10 Recent estimates put lost income alone at $C5 billion and perhaps as high as $C8 bn with billions more lost by related businesses including trucking, input supply, equipment dealers, tourism, etc. W. Leiss, “What Went Wrong with BSE?” *Edmonton Journal*, March 11, 2005, Edmonton, Alberta, Canada.