

Economic Risks Associated with an Influenza Pandemic

Prepared Testimony of James Newcomb

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GOOD MORNING MR. CHAIRMAN, distinguished members of the Committee, invited guests. I am pleased to have the opportunity to address you today regarding the potential economic implications of an influenza pandemic. I am especially grateful to the Committee for calling attention to the global economic and trade-related issues that are closely conjoined with questions of how governments and other public and private institutions can better prepare for and respond to the risk of pandemic.

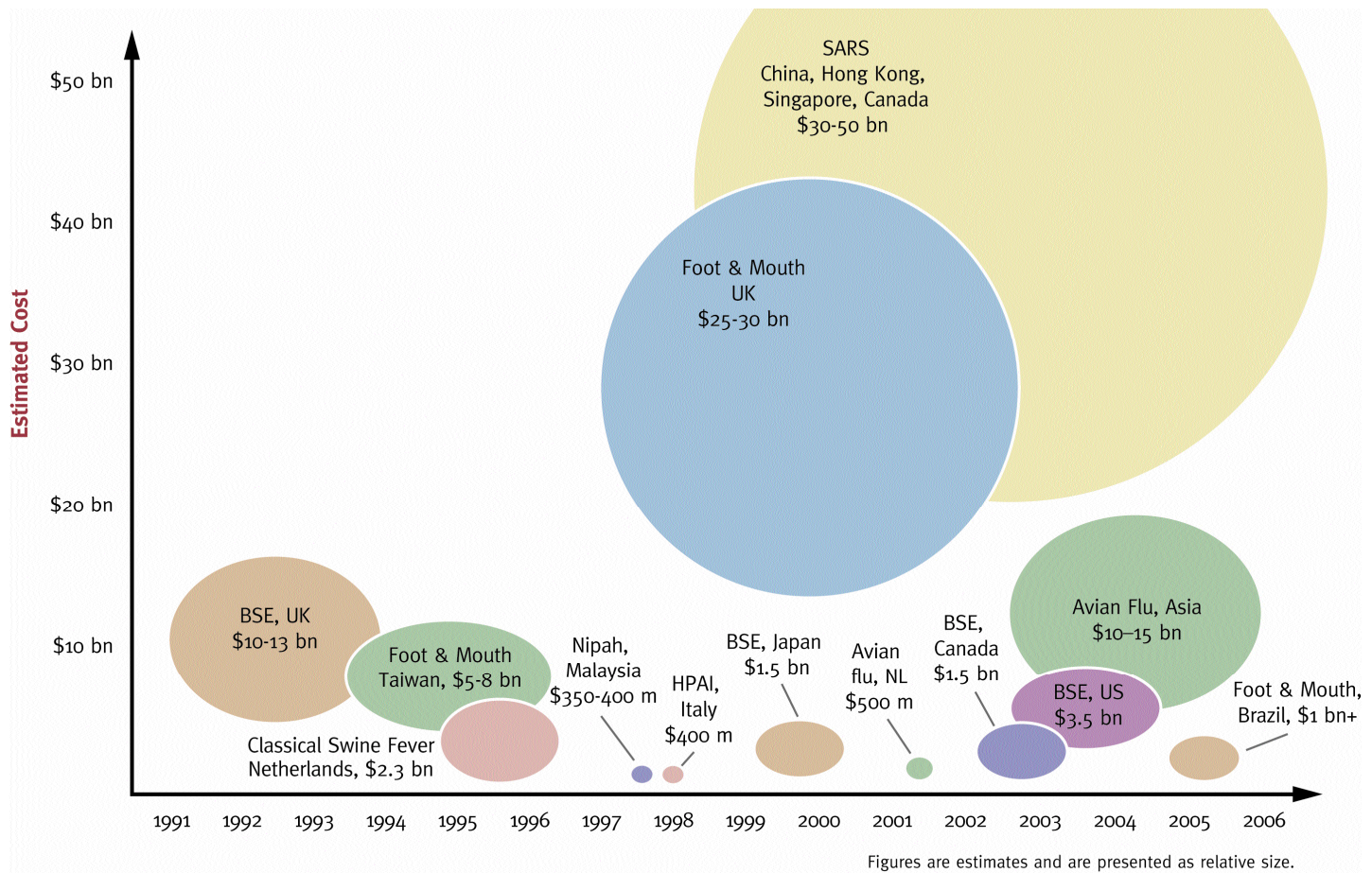
At bio-era, my colleagues and I have been studying the economic impacts of H5N1 avian influenza for more than two years. We agree with most other economic analysts that the emergence of highly virulent, pandemic influenza would be accompanied by significant shocks to the global economy, with costs ranging upwards of \$500–800 billion worldwide, depending on the severity of the disease. Table 1 provides a comparison of various institutions' estimates of the economic costs of a pandemic. The bottom line is that a pandemic could affect our highly integrated global economy in a way that has no real precedent in recent decades. While we know that human societies and economies are highly resilient in the long run, the economic disruption caused by a pandemic in the short run could exacerbate the problem of responding to the disease.

This risk falls in the context of a broader trend toward rising economic costs of emerging infectious diseases in animals and humans in recent years (see Figure 1). The ongoing spread of highly pathogenic avian influenza is exacting a significant economic toll on poultry producers in the countries already affected by the disease, often striking a heavy blow to poor rural farmers who are the least able to respond. But it is hardly the only disease to pose a significant threat to human health and economic prosperity.

From a policy perspective, our analysis of these risks underscores the message that “an ounce of prevention is worth a pound of cure.” By investing in efforts to control the spread of highly pathogenic avian flu in wild birds and poultry, we may reduce the risk that a human pandemic will emerge in the first place. Moreover, the investments we make in disease surveillance, monitoring, and prevention at the intersection of animal and human health are multi-purpose investments that may help to reduce the risks of emerging infectious diseases in general. Attacking the root causes from a long-term perspective will require an integrated cross-sectoral approach to human and animal health. It will take time to build the scientific, institutional, and regulatory systems to support this effort. But the potential returns from doing so are large.

TABLE 1: Estimates of Human Loss and Economic Damage from a Pandemic

Source	Estimated Economic Damage from a Pandemic	Comments
U.S. Centers for Disease Control (Meltzer, Cox, Fukuda; 1999)	<ul style="list-style-type: none"> • Cost to U.S. economy \$71–167 billion (1995 dollars); \$88–206 billion in current dollars 	Widely cited in the press and by other analysts; based on estimates of primary costs derived from case numbers, hospitalizations, and deaths, and the associated costs for each of these events. Assumes 89,000–207,000 deaths and 314,000–734,000 hospitalizations in the US.
U.S. Health and Human Services (Pandemic Influenza Strategic Plan; November 2005)	<ul style="list-style-type: none"> • \$181 billion in direct and indirect health costs alone (not including disruptions in trade and other costs to business and industry) for a moderate pandemic with no interventions 	Earlier press reports indicated that HHS estimated costs of a “worst case scenario” (1.9 million deaths and 8.5 million hospitalizations) to be \$450 billion for the U.S. economy
Asian Development Bank (November 2005)	Asian implications: <ul style="list-style-type: none"> • Mild shock: \$99 billion in lost consumption, \$14 billion in death and incapacity; losses equal 2.6% of GDP • Severe shock: \$297 billion in short term losses or 6.8% of GDP 	Both cases assume a relatively mild pandemic, with an infection rate of 20% and a case fatality of 0.5%. In the more severe scenario, the psychological impact on demand and consumption is greater.
World Bank (Brahmbhatt; November 2005)	<ul style="list-style-type: none"> • Total costs to the world economy could reach \$800 billion 	Assumes a case fatality rate of less than 0.1% in the U.S.
ING Bank (October 2005)	<ul style="list-style-type: none"> • “Large swathes of economic activity could simply cease.” • “A realistic scenario might involve GDP declines of tens of percent.” • “...fear of infection leading to drastically altered behavior would result in the greatest economic damage.” 	Assessment by a leading European bank.
Conference Board of Canada (October 2005)	<ul style="list-style-type: none"> • “A flu pandemic on a large scale would throw the world into a sudden and possibly dramatic global recession.” 	No quantitative estimates.
BMO Nesbitt Burns (August, October 2005)	<ul style="list-style-type: none"> • Cites CDC estimates in 1995 dollars • “Depending on [a pandemic’s] length and severity, its economic impact could be comparable, at least for a short time, to the Great Depression of the 1930s.” 	A report produced by BMO Nesbitt Burns; widely cited by the media.

FIGURE 1: Economic Impact of Selected Infectious Diseases: Recent Livestock Disease Outbreaks and SARS

In the event that a human pandemic does emerge, despite our efforts to prevent it, the economic impacts would likely spread around the world in two waves. The first wave of economic impacts would result from fearful anticipatory reactions to the spread of the disease; these effects include shocks to financial markets, reductions in consumption and investment, and disruptions of trade and travel. As in the case of the SARS outbreak, these reactions could ripple through the economy very rapidly.

Reactive and uncoordinated national actions to close borders or embargo trade could be exactly the wrong prescription in the early days of pandemic emergence. These could inadvertently fuel fears at the point of emergence and compound the challenges of disease management on the ground. Shutting down transportation hubs, such as airports and ports, would disrupt key supply chains and create unpredictable secondary effects that would compound the effects of the initial outbreak. These feedbacks, coupled with growing fears about the disease itself, would be increasingly difficult to manage as the pandemic spreads globally.

The second wave of economic impacts would be experienced as a result of the spread of the disease itself, with potentially large impacts on the workforce and the flow of goods and services as well as the overburdened medical system. While these direct economic impacts of the disease could be

quite significant, these costs are almost certainly manageable from a macroeconomic perspective, even in the case of a moderate pandemic, provided they are not overly compounded by fear-driven reactions.

The SARS outbreak illustrated the sensitivity of the global economy to such threats and, in particular, to the fear of disease. Although the number of people infected with the SARS virus was relatively small—with only about 8,000 infections globally and 774 deaths—we estimate that the cost to the global economy was \$30–50 billion dollars.

But SARS also marked a turning point for public and private institutions that must respond to human and animal diseases. SARS stimulated the response capability of political, social, and economic institutions globally by raising awareness of the economic potency of disease events. It is one reason for the high level of media attention and public policy discussion today about the pandemic risk posed by the H5N1 avian influenza virus. The subtle shift that began in 2003 is still incomplete, but governments and private companies have begun to take steps that could make it less likely that a worst-case scenario will actually come to pass.

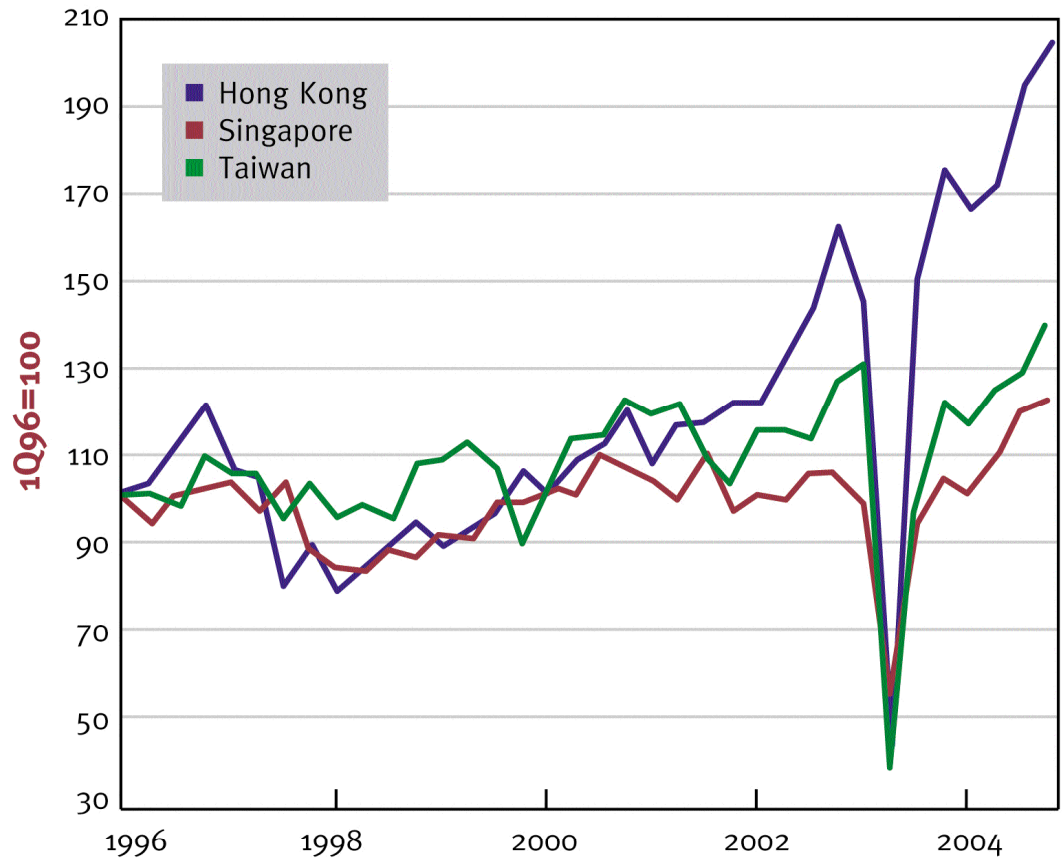
In my testimony this morning, I will focus on three topics:

- lessons learned from the SARS outbreak
- possible economic implications of a pandemic
- actions that the government and private companies can take to prepare for the economic consequences of a pandemic.

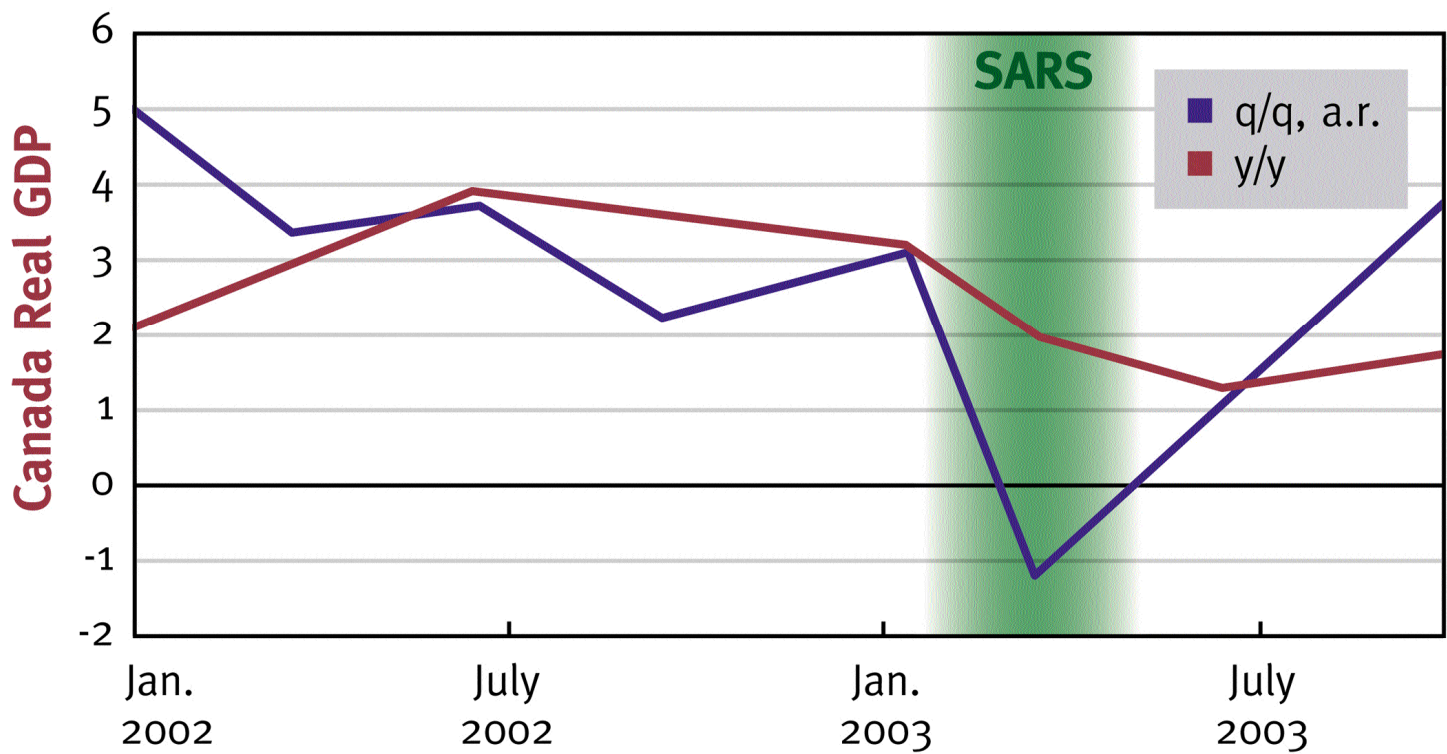
Lessons Learned from SARS

It is worth taking a close look at the events that took place during the SARS outbreak, since they offer us valuable insights that could reduce the unintended economic consequences of government policies in the future. While the SARS outbreak was quickly contained, the economic events that it triggered illustrate several key points:

The economic contagion of fear and uncertainty moved even faster than the disease itself. Between March and May of 2003, when international media attention was intensely focused on the disease, tourist arrivals in Asia dropped 30–80% for various countries in the region, compared with previous growth rates of 10–15% (see Figure 2). After travel bans were put in place in some affected areas on the heels of World Health Organization (WHO) warnings, almost half the planned international flights to Southeast Asia were cancelled. Even Australia, which was largely unaffected by the disease, saw a 20% decline in international arrivals between January and May. The downturn in travel and trade quickly rippled through economies in the region, with the most pronounced effects on those economies that are highly dependent on these sectors. According to the World Bank, SARS caused an immediate economic loss of approximately 2% of East Asian regional GDP in the second quarter of 2003. Foreign direct investment in the Asian region slowed sharply and almost instantaneously in response to news of the disease's emergence, while retail sales in Hong Kong fell by 8.5%. Canada suffered economic losses of more than \$1 billion, although the disease directly affected less than 500 people there (see Figure 3).

FIGURE 2: Decline in Tourist Arrivals During SARS

Source: CEIC data

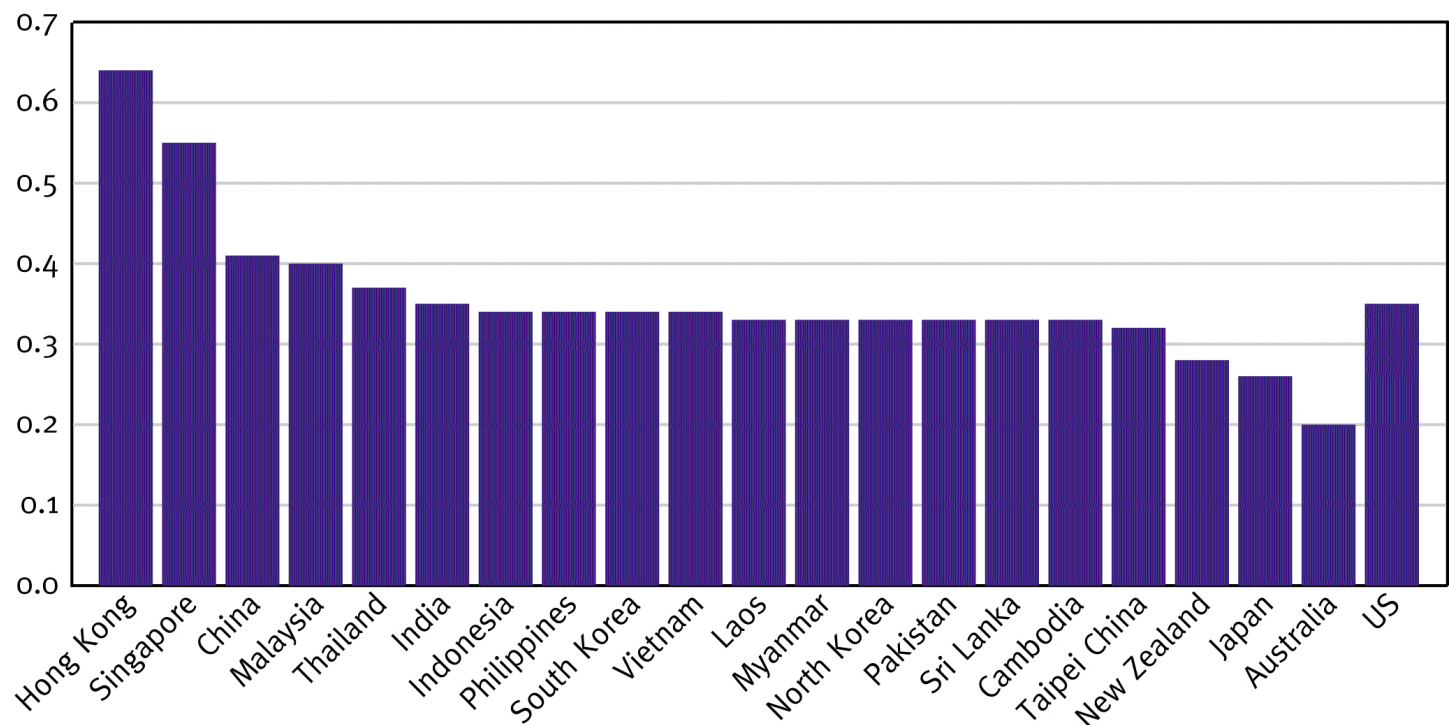
FIGURE 3: Economic Impact of SARS on Canada's Economy

The direct economic costs of the SARS—that is, the medical treatment costs and lost productivity associated with SARS cases—probably accounted for only about 1–2% of the \$30–50 billion of economic damage caused by the disease. The costs of the SARS epidemic were caused largely by the indirect economic impacts: disruptions of trade, travel and investment, interruption of product supply chains, and fear-based changes in behavior on the part of consumers, travelers, and businesses.

Public fears in the early stages of the SARS epidemic were amplified by concerns that some governments were withholding information about the disease. The SARS scare was made worse, and the economic reactions more severe, by the perception that some governments were less than completely forthcoming with news about disease outbreaks. We can say in retrospect that the public overreacted to the news of SARS in terms of assessing the risk of infection and death, but it was difficult for either the public or the scientific community to assess these risk in the early stages of the disease. Nonetheless, dissemination of credible scientific information as early as possible can significantly affect public responses.

The most “open” economies were the hardest hit. Hong Kong and Singapore were the worst affected Asian economies, largely because of their heavy dependence on international trade and travel. The number of tourist arrivals annually in these two economies is approximately twice the resident population. Overall, tourism accounts for a surprisingly high 11% of GDP in Southeast Asia. A ten percent reduction in tourism in Vietnam would have an economic impact eight times greater than that caused by the recent 15% contraction in the poultry industry there. Based on a composite index of economic factors, taking into consideration the openness of the economy and health care expenditures, Hong Kong, Singapore, and China are the economies in Asia most exposed to the risk of a pandemic (see Figure 4).

FIGURE 4: Relative Economic Risk Index for Influenza Pandemic (selected countries)



The secondary effects of the disease caused significant and unanticipated disruptions to global supply chains. While the direct impact of SARS was miniscule in terms of worker absenteeism attributable to illness, the epidemic nonetheless caused significant disruptions to global supply chains in some key areas. In the high tech sector, for example, the cancellation of commercial airline flights disrupted just-in-time delivery of some goods and components. In some key countries, approximately 50% of freight shipments by the semiconductor industry are carried on passenger flights. Trade and travel problems in some areas interrupted the flow of goods and services, with cascading effects in industries with tightly linked supply chains that depended heavily on suppliers in the affected areas.

There is little evidence that control measures asserted at national borders had a significant impact on the spread of SARS. Entry screening of travelers through health declarations or thermal scanning at international borders had little measurable effect on the detection of SARS, and exit screening appeared to be only marginally more effective.¹ On the other hand, basic measures taken in Hong Kong to increase “social distance” and improve community hygiene, including hand washing and wearing masks, during the SARS outbreak significantly reduced the incidence of respiratory viral infections.² From an economic perspective, control measures at borders, especially trade embargoes and travel restrictions that effectively close borders, are blunt instruments that come at high cost and can compound supply chain problems that reduce a nation’s ability to combat disease.

Once SARS was contained, the economic rebound was swift. The economic rebound in the aftermath of SARS was speedy and vigorous, partly because little lasting damage had been done to the affected economies. In this instance, the short duration of the crisis meant that most companies could withstand the financial impacts without facing insolvency or restructuring. While some service sector goods, such as those delivered by airlines, hotels, and restaurants are not recoverable, at least part of the losses incurred in other sectors, such as manufacturing, could be recovered.

Overall, SARS illustrates the tremendous economic damage that can be incurred as a result of the secondary effects of disease emergence in the context of the highly interconnected global economy.

Economic Implications of a Pandemic

The economic implications of an influenza pandemic are nearly impossible to predict, given the wide range of possible outcomes with respect to the evolution and spread of the disease, its virulence, and the availability of effective countermeasures such as antiviral drugs or vaccines. The often-cited estimate of the economic cost to the U.S. economy of a pandemic provided by the Centers for Disease Control and Prevention places these costs at \$71–166 billion in 1995 dollars, or approximately \$88–206 billion in current dollars. The estimate is based on estimates of the direct costs of illness and does not take into consideration the possible effects of global economic disruption, supply chain problems, and other secondary effects. More recent estimates of the possible costs of pandemic to the U.S. economy span a wide range, reaching as high as \$450 billion in a worst case outcome in which more than 1.9 million people in the country would die and 8.5 million would be hospitalized.

We can better understand the potential economic consequences of a pandemic and the related uncertainties and vulnerabilities, by addressing them in relation to the possible stages of the disease's emergence and progression (see Table 2).

TABLE 2: Economic Stages of a Pandemic

Stage	Features	Economic Shocks
Pandemic Alert	Increasing global demand for and investment in countermeasures; countermeasure production capacity operating at near 100% utilization rates; declines in poultry demand in areas of active H5N1 infection.	Mild, and largely localized. As the virus spreads, fear-based reactions cause mostly local disruptions.
Emergence	Global media amplification of pandemic spread. Trade and travel likely to be seriously disrupted locally, with unpredictable secondary effects on global supply chains. International cooperation and coordination is critical for minimizing economic disruptions.	The first serious shocks are likely to fall most heavily on the national and regional economies nearest the emergence event. Key determinants are: How deadly is the disease? How easily does it transmit? How rapid and resolute is the response? How responsibly does the media behave? Some fear-driven spillover into global financial markets should be expected.
Containment Efforts	Countermeasures to prevent spread rushed into outbreak area; political finger-pointing in the event that stockpiles are not accessible to outbreak areas could threaten coordinated, cooperative response.	If containment efforts fail, the inadvertent compounding of fear becomes a major threat. Will there be widespread, immediate, and uncoordinated national bans on travel and trade? Or, will there be a highly coordinated and measured response from national governments?
Global Spread	Despite containment efforts, disease enters the general population and begins global spread. The timing of spread to major urban centers is unpredictable, but for each wave of the disease, local epidemics mostly run their course in about 4-6 weeks. Supply strains on hospital beds and other countermeasures.	The depth of the shock to the global economy will depend on the severity (measured in terms of morbidity and mortality) and duration of the pandemic and the extent to which fear effects are minimized, effective countermeasures are available, and risk-reducing behavioral changes are widely supported and adopted.
Abatement & Recovery	Normal economic activity begins to resume as fear and disease incidences abate. Timing will depend on the damage done to economies and businesses, and whether concerns over a second wave of disease can be addressed.	Indications of a second wave of disease spreading, or fear of such a recurrence, could interrupt the recovery unless effective countermeasures are widely available.

Stage 1: Pandemic Alert. The world is now on high alert for the further spread of avian influenza among wild birds and poultry, especially in parts of Asia, Europe, and Africa. Additional human cases of the disease raise the possibility that efficient human-to-human transmission will emerge and, at the same time, the news of these cases heightens public fears about the disease.

The economic costs of H5N1 outbreaks in poultry, and the related damage to economies in Asia alone already totals \$10–15 billion. Significant costs are now being incurred in parts of Russia and Europe, where outbreaks have required the destruction of birds in some areas, intensified monitoring and testing, and have led to the imposition of new biosecurity regulations for poultry producers. Consumer fears about bird flu have led to declines of 20–40% in poultry sales in France and Italy.

The H5N1 virus could continue to spread to new regions around the world for years to come, with no evidence of efficient human-to-human transmission. The economic consequences of this situation could be further compounded by the simultaneous emergence of other diseases with significant effects on global livestock production and trade. Notably, Brazil's recent confirmation that foot-and-mouth disease has been detected among cattle in Matto Grosso do Sul has led nearly 50 nations to impose total or partial bans on imports of Brazilian beef, and could result in losses of more than \$1 billion. Such events could lead to a repeat of the situation in early 2003, when the UN Food and Agriculture Organization (FAO) reported that fully one-third of global meat trade was subject to embargoes due to disease outbreaks.

Media coverage and government communications at this stage have the potential to significantly influence reactions to a future announcement that a pandemic has begun, either by preparing the public for possible events or by heightening fear. The investment in medical countermeasures to combat a pandemic is rising rapidly, and probably exceeds by an order of magnitude spending on trying to prevent the further spread of the disease in birds and humans in the countries already affected. Likely commitments by governments around the world to stockpile antiviral drugs and vaccines to combat a pandemic already exceed \$6 billion (see Table 3)..

Stage 2: Emergence. An official announcement that H5N1 has acquired the capacity for efficient human-to-human transmission can be expected to trigger immediate reactions in financial markets around the world, stimulate intense media coverage, and provoke strong public interest accompanied by strident calls for immediate government actions. The initial market reactions might include downward shocks in financial markets in the parts of the world nearest to the initial outbreak of the disease, severe contractions in the most vulnerable industries, such as travel and tourism, and a weakening of consumer and investor confidence worldwide. As one of the largest sectors of the global economy, the impact on international tourism alone, which accounted for \$622 billion in revenues in 2004 and involved more than 763 million tourists worldwide, would have serious economic consequences, especially in Southeast Asia and other parts of the world that are heavily dependent on tourism.

There is a danger that fear of a rapidly spreading pandemic might trigger panic in the country or countries initially affected, as officials trying to impose quarantines confront citizens hoping to flee the affected areas. Some of the countries at greatest risk for emergence of an H5N1 pandemic have extremely limited resources to educate the public or to manage emergency responses in the event of a crisis. According to WHO, the total annual per capita health care expenditure in Vietnam is less

TABLE 3: Existing and Planned Stockpiles of Vaccines and Antiviral Drugs

Country	Product	Comments
Australia	Tamiflu	3.5 million five-day treatment courses.
	Relenza	3.95 million five-day treatment courses.
Canada	Tamiflu	35 million doses.
	H5N1 vaccine	“Several thousand” doses ordered for clinical testing.
China	H5N1 vaccine	Developing and testing H5N1 vaccine; planned stockpile levels unknown.
France	Tamiflu	13 million 5-day treatment courses.
	H5N1 vaccine	2 million doses.
Hong Kong	Tamiflu	2.7 million doses stockpiled; additional purchases planned to reach 18 million doses in 2007.
	Relenza	300,000 doses stockpiled; additional purchases planned to reach 2 million doses in 2007.
Italy	H5N1 vaccine	2 million doses ordered.
Japan	Tamiflu	Plans to stockpile 20 million doses.
Netherlands	Tamiflu	220,000 doses stockpiled; 5 million doses ordered.
New Zealand	Tamiflu	835,000 doses ordered; to be delivered by year-end.
Singapore	Tamiflu	350,000 courses planned.
S. Korea	Tamiflu	700,000 doses; 900,000 by January 2006.
Taiwan	Tamiflu	230,000 doses; 700,000 additional planned.
Thailand	Tamiflu	700,000 courses; 3 million planned by 2007.
United States	Tamiflu	Up to \$3.1 billion proposed for additional supplies
	H5N1 vaccine	Up to \$3.3 billion proposed for additional supplies
United Kingdom	Tamiflu	14.6 million courses; to be delivered over the next 2 years.

* Tamiflu stockpiles have been variously reported by governments and in the press in terms of numbers of “doses” (individual pills or the equivalent) and/or “courses” (a standard treatment course is two doses a day for five days—10 pills; taking the drug preventively might require two doses a day for several months). The data reported here reflect the best available public information based on press accounts and, in some cases, interviews with government officials. Substantial uncertainty remains about the timetable for delivery of the large amounts of Tamiflu ordered by many governments, as the amounts described here exceed Roche’s annual production capacity for Tamiflu.

than 25 dollars. Media coverage of an emerging crisis could heighten fears globally about the spread of the disease, spurring citizens in other areas to begin hoarding food and emergency supplies. The extent of economic disruption at this stage will be highly sensitive to the effectiveness of pre-pandemic planning and preparedness, especially the degree to which the public has come to trust government communications, leadership and responsiveness at all levels.

Stage 3: Containment Efforts. Governments around the world would quickly begin to take measures in an effort to slow the spread of the disease. Emergency plans including, under certain circumstances, restrictions on trade and travel that entail the complete closure of all international airports and ports have been announced by some governments. Such severe control measures at national borders would have profound economic consequences. Ideally, decisions regarding the implementation of various control measures, including travel and trade restrictions imposed at national borders, should be based on the best available information about the epidemiological features of the disease. Asian nations gathering at the recent APEC conference in Brisbane discussed containment policies in an effort to strengthen and coordinate these policies on a regional basis. Regional and global coordination of such policies could significantly reduce the economic disruption caused by a pandemic.

Nonetheless, the serious economic effects of a pandemic in the countries initially affected by the disease could disrupt global supply chains. Pandemic emergence in Asia could have serious consequences for China and India, which together account for more than one-third of the world's population and represent the fastest growing economies in the world. Moreover, lean inventories and just-in-time delivery in the high tech sector make this industry potentially vulnerable to disruption, especially in view of the high proportion of manufacturing that takes place in Asia.

Stage 4: Global Spread. As the disease spreads globally, economies in areas of the world not initially affected would begin to feel the direct economic impacts of the disease. These impacts would arrive through illness and absenteeism of workers, declines in consumption and spending, increased medical costs and hospitalizations, and pressures on the insurance industry.

In addition to the direct effects of worker illnesses, some workers would stay home to care for children during school closures, care for the sick, or to avoid the risk of infection. Analysis of scenarios assuming an infection rate of 40% suggest that only about 50–60% of workers would be able to come to work during the three or four weeks at the peak of the pandemic in a given area. But fear of infection could cause even greater absenteeism.

Fear of contracting influenza in the workplace and other constraints on workers' ability to come to work could contribute to absenteeism among healthcare workers at the same time that the healthcare system is under the greatest pressure. A survey of over 6,000 healthcare workers in the New York metropolitan area conducted by the Mailman School of Public Health at Columbia University indicated that only 48% of healthcare workers would be willing to come to work during a SARS outbreak. The combined effects of high worker absenteeism, curtailment of supplies and raw materials from other suppliers, and sharp changes in demand caused by the pandemic could hit many metropolitan areas simultaneously. The financial strain on companies whose cash flows are most severely affected by the pandemic will be greatest during this stage.

Stage 5: Abatement and Recovery. As the disease begins to abate, economic activity could rebound quickly, as was the case for SARS, or quite slowly, depending on the severity of the pandemic and the post-pandemic condition of major companies, the government, and the economy as a whole. The condition of financial markets, currencies, and interest rates will affect the speed of the recovery, but the underlying, real economy—the demand for goods and services—will be the fundamental driver of the recovery.

Watching for Signposts

The many unknowns inherent in the current situation make it difficult to reduce the level of uncertainty surrounding the pandemic risk posed by H5N1. There is little that can be done about this, and no fixed timetable by which the current questions about H5N1 pandemic risk will be answered. Still, governments and companies can prepare contingency plans based on scenario outcomes and, at the same time, make operational plans that take into consideration the broader range of possible emerging disease events.

Experience with the SARS outbreak indicates that the initial fears triggered by announcements of disease emergence can have sudden economic consequences. So far, events have paralleled those bio-era outlined in April 2005 under a scenario we named *Big Noise on Stairs...Nobody Coming Down*. The noise has certainly increased, but there is still no clear evidence that a human pandemic will ensue. Indeed, although most attention by policymakers is justifiably focused on pandemic risks, a scenario that entails the global spread of H5N1 among birds over the next 2-3 years—without efficient human-to-human transmission—remains plausible.

Rather than claiming that the possibility of a deadly global pandemic hangs over the world by a single thread—like a Sword of Damocles—we find a complex situation in which many different outcomes are possible. The course of the disease and the economic reactions to its emergence are, in fact, being significantly shaped by the actions and reactions of governments, corporations, and other stakeholders. In light of this, it is only prudent to prepare now by thinking through possible scenarios, and considering their implications.

How Can We Prepare?

Based on what we know about the potential economic dimensions of a pandemic, what steps can the government and other public and private institutions take in advance to reduce the potential economic damage?

First, these institutions should continue to work to **reduce the risk of pandemic emergence at its source**, by lowering the incidence of highly pathogenic avian influenza in birds and improving capabilities for responding rapidly to disease outbreaks where they occur. These are the most cost-effective investments that can be made in advance of pandemic. Specific things that should be done include:

- Strengthening disease monitoring and surveillance for humans, livestock and wildlife, and enhancing and integrating national, regional, and international reporting systems and networks

- Improving biosecurity standards and practices for the poultry industry globally and increase access to low-cost rapid diagnostic tests
- Enhancing early rapid response, including culling capabilities, deployable stockpiling of countermeasures, and targeted vaccination in countries facing the greatest risks.

Second, our analysis indicates that events and decisions at the interface between government and the private sector have the potential to significantly **encourage private companies to review supply chain vulnerabilities and other economic and business risks that might be incurred under various pandemic emergence scenarios.** Some leading corporations have already developed plans and strategies addressing business operations and continuity management, supply chain management, employee health and safety, and community involvement. But, many companies have not. In encouraging the development of these plans, the government should support public-private dialogue at the interface between the nation's pandemic preparedness plans and the role companies will play in the private sector.

Third, U.S. government response plans should **anticipate and respond to the challenges of fear-driven herd behaviors,** as has already been foreshadowed by the sudden surge in demand for antiviral drugs and other countermeasures. Efforts should be made to limit potentially damaging and unnecessary hoarding behavior, and the possibility of the sudden mass movement of populations. To date, government efforts to build strategic stockpiles have largely focused on antiviral drugs and vaccines of uncertain effectiveness against a pandemic virus. But medical and hygienic supplies, such as masks, gloves, sanitary wipes, hand-cleaning supplies, syringes and hypodermic needles will certainly be in very high demand in the event of a pandemic, and governments might be wise to secure ample supplies of these materials in advance as well.

Finally, given the sensitivity of economic consequences to disruptions of trade and travel in the earliest stages of a pandemic, **international coordination of border control policies to avoid misunderstanding and promote cooperation will be essential.** To the extent that these policies are transparently based on expert scientific advice from WHO and CDC authorities, and widely and jointly communicated to the public beforehand, the foundation for public reassurance and international cooperation will be solidly established—along with our best chance to minimize the severity of global economic disruption.

Notes

- 1 David M. Bell, "Public Health Interventions and SARS Spread, 2003," *Emerging Infectious Diseases*, vol. 11, no. 10, November 2004.
- 2 Janice Y. C. Lo et al., "Respiratory Infections during SARS Outbreak, Hong Kong, 2003," *Emerging Infectious Diseases*, vol. 11, no. 11, November 2005.

Bio Economic Research Associates (bio-era™) is an independent research and advisory services company providing insight into the global bio economy. Bio-era's mission is to help decision-makers understand and respond to the economic risks and opportunities arising from human-induced changes to biological systems.

Since the publication of a special report in 2003 calling attention to the rapidly growing economic costs of infectious disease (*Biology and Borders: SARS and the New Economics of Biosecurity*), bio-era has been engaged in helping private companies and other institutions understand and prepare for disease-related economic disruptions using scenario planning techniques and other analysis and planning methods.

Bio-era publications on the subject of avian influenza include *Avian Flu: Evolving New Responses to Emerging Diseases* (2004), *The Business Implications of an Avian Influenza Pandemic* (2005), *One Flu Over the Chicken's Nest: Is a Killer Bird-Flu Pandemic Upon Us?* (CLSA, 2005), and *Thinking Ahead: Using Scenarios to Understand the Risks of an Avian Influenza Pandemic* (2005).