

SPECIAL REPORT

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THE AVIAN FLU *CRISIS:*

an ECONOMIC
UPDATE

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Summary



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- Even though avian flu is spreading rapidly in the bird population, **it is still extremely difficult for humans to become infected.**
- **People cannot contract H5N1 by eating fully cooked chicken** and poultry products. Nevertheless, poultry demand has fallen sharply in Europe.
- **Human infection generally requires direct exposure to sick or dead poultry.** This is most likely in areas where backyard birds live in close contact with people—generally in parts of Asia, Africa and the Middle East.
- The spread of the virus to humans is most prevalent and problematic in developing countries because poor living conditions and malnutrition, as well as challenged immune systems, increase vulnerability, and health services are inadequate.
- A human H5N1 pandemic, if it were to occur, would likely be triggered in the emerging world, rather than in Europe or North America.
- **The poultry industry has already taken a big hit**, especially in France. Knock-on effects will manifest for industries such as poultry-feed growers, poultry processors, grocers, and restaurants, especially those specializing in chicken. These would include KFC, Swiss Chalet, St. Hubert, Church's and Kenny Rogers Roasters.
- **Global economic interdependencies**, China's importance in commodity markets and in exports of low-priced goods increase the economic disruption from a human pandemic. So does the prodigious volume of international trade and travel. **Supply chains are global and inventories are managed on a just-in-time basis.**
- Unlike other natural disasters or terrorism, pandemics are **prolonged and pervasive**, so the net economic loss is substantial and extended.
- **Immediate losers**—in addition to the poultry industry and its ancillary businesses—would be tourism, travel and transport sectors, the hospitality industry, public transportation, life and health insurers, theatres, casinos, sports facilities, spectator sports, religious facilities, convention halls, restaurants, retailers of nonessential goods, and providers of nonessential services or those that could directly spread disease such as dentists and hairdressers.

- **A pandemic would lead to considerable supply and demand effects.** Loss of labour and trade would dominate the supply-side effect and social distancing and fear would increase the demand for essentials such as non-perishable food, water, medical supplies and health-care services, but reduce the demand for virtually everything else.
- **The health-care system would be running beyond surge capacity.** Shortages of key medical equipment, supplies and trained personnel would be likely.
- We could suffer prolonged outages of power and utilities and disruptions in government services.
- Government, business, individuals and public health offices must further refine and develop continuity and preparedness plans and test and retest these plans as well as revise them as the situation changes.
- Death management is crucial, but likely inadequate.
- The current characteristics of the roughly 200 human cases of H5N1 show a meaningful similarity to the severe 1918 flu virus; human cases of H5N1 appear to manifest the highest fatality rates in the 15-to-40 age range, rather than in the very young or very old, who are the most vulnerable to ordinary flu. This results from a cytokine storm, where the immune system not only attacks the virus, but in the process, damages lung, brain and other tissue. Once this effect becomes acute, there is little that medical science can do to save the patient.
- Many experts suggest that we cannot handle acute cases of this condition today much more effectively than we could in 1918, even in fully-equipped and fully-staffed modern Intensive Care Units.
- **If there were a cytokine storm, as in 1918, pregnant women and 15-to-40 year olds would be proportionately the hardest hit. This would have a lasting impact on population characteristics and, therefore, a sustained effect on society and economic activity all over the world. Birth rates would plunge and the average age of the population would increase significantly.**
- An already-aging population in the U.S., Canada, Europe, Japan, China and the former Soviet states would become even more aged and dependency ratios would rise meaningfully. The most productive sector of the population would be the most devastated, with sustained labour shortages, reduced demand for housing, cars, electronics and other durable goods. Consumption growth, in general, would be slower and government and private pension plans would risk a fairly rapid insolvency. The same would be true of health-care systems. This lasting effect of potential pandemic is generally ignored in current economic analysis.

- Estimates of the economic costs of pandemic have been made by the Asian Development Bank (ADB), the Brookings Institution, and the Congressional Budget Office (CBO). ADB looks at only the effects in Asia. Brookings assumes the death rate is very high in Hong Kong, especially, and the rest of Asia, and very low in the U.S.—so their model results show far greater loss of economic growth in Hong Kong and Asia with only modest effect in the U.S. In a sense, they assume their result.
- The CBO makes a very credible attempt at estimating the supply and demand shocks in the United States, but considers only the loss of labour and labour productivity in its supply shock, omitting the impact of the disruption in trade and, therefore, the supply chain. None of these studies consider the lasting demographic, societal and economic effects of a potential cytokine storm.
- Our model adapts the CBO approach and considers the trade and supply chain effects. We also suggest the longer-term implications of a cytokine storm.
- **Our model predicts that a mild pandemic would reduce annual GDP growth by 2 percentage points from what it would otherwise be. A severe pandemic, similar to the 1918 Spanish flu, would reduce global GDP growth by 6 percentage points (again, from prevailing growth rates).** We assume that all countries will be similarly affected in GDP-growth terms, which of course is a simplifying assumption. If these numbers are reasonable for the U.S., which we think they are, given all of the constraints to our knowledge, we consider the results to be “low-ball” global estimates. Most likely, the number of countries suffering more than the U.S. will probably be larger than the number of countries faring better—but even that is uncertain. Given productivity differences between countries and varying reliance on multinational-corporate activity and trade, attack and case-fatality rates could differ between countries without changing significantly the GDP-growth effects.
- **Our model estimates are merely suggestive.** No one can accurately predict the characteristics of the particular mutated virus strain causing the pandemic or how these characteristics would evolve over time.
- No one can predict the effectiveness of the vaccines, antivirals and public-health response. And no one can predict the public reaction, except to say that we are better prepared today than we were a year ago, and, if we have another year or two, we will certainly mitigate some or much of the fallout from pandemic.
- **It is important to remember that even with a severe pandemic, roughly 99% of the world’s population will survive.** Borders will reopen and the free flow of goods, services and people will recommence. The global economy will survive the hit, and business and governments will learn many lessons.

The Avian Flu Crisis: An Economic Update

Avian flu is devastating bird populations in a growing number of countries, apparently carried from one place to another by migratory birds (*Map 1*). The current outbreak, which originated in Southeast Asia in 2003, has spread to the Middle East, Europe, India and Africa. By early March 2006, there have been 175 confirmed human cases of H5N1 virus, resulting in just under 100 confirmed deaths (*Map 2*). **Currently, it is extremely difficult for humans to contract avian flu.**

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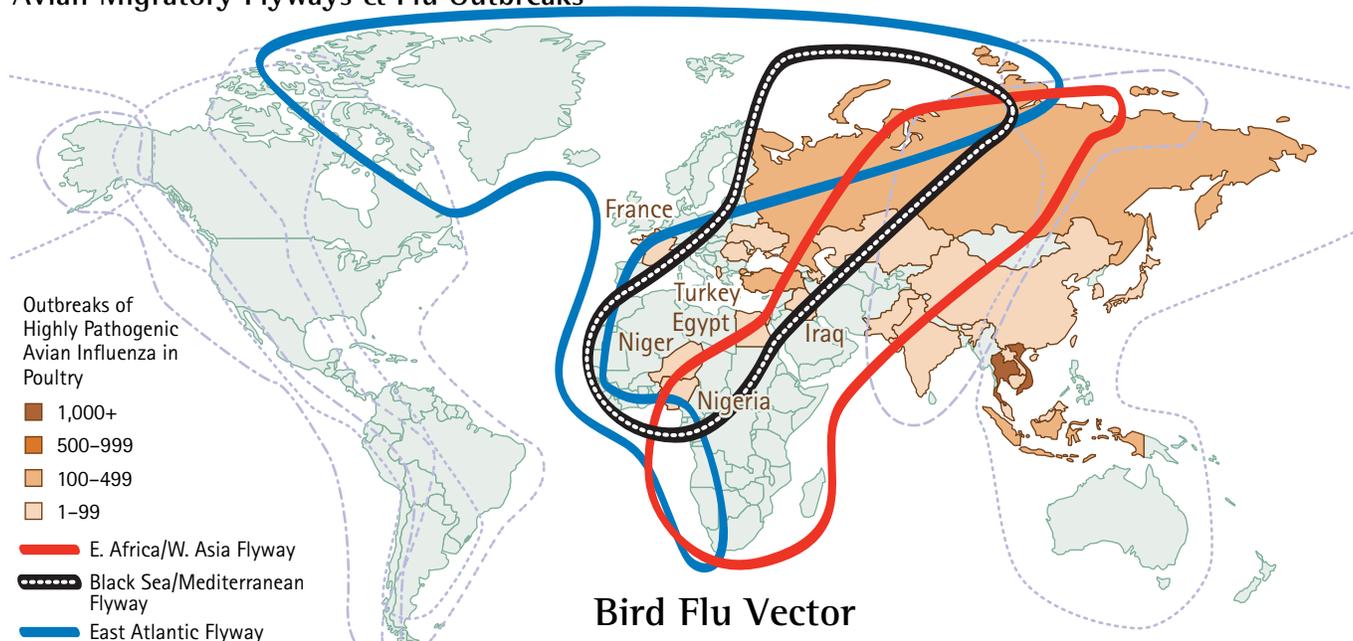
Misinformation Abounds

To dispel some of the myths—people cannot contract bird flu by eating fully cooked poultry or poultry products, yet poultry consumption has plummeted in Europe and Asia. In addition, it is nearly impossible to contract avian flu in developed countries where poultry is raised quite separately from the general population (and from mammals) and is tended to by experts in controlled environments.

MAP 1

Migratory Bird Flyways

Avian Migratory Flyways & Flu Outbreaks



Source: Wetlands International

Bird flu is not a new phenomenon. Outbreaks occur almost every year and the poultry industry is quite adept at dealing with normal outbreaks. Unfortunately, today's outbreak in birds has now moved to endemic proportions in Southeast Asia. It is an avian epidemic of unprecedented size and complexity, virtually uncontrollable in the bird population of Asia and already spreading to India, Europe and Africa. The host or carrier range is also spreading; there have been cases of H5N1 infection in tigers, cats, weasels, flamingos, migratory birds and ducks. Avian influenza viruses occur naturally in wild birds, but can cause devastating illness in domestic poultry. The current strain is highly pathogenic in poultry; however, some ducks are now asymptomatic carriers. The H5N1 virus is becoming more diverse.

This does not mean, however, that H5N1 will hatch the next human pandemic. **Thus far, the virus does not spread efficiently from one person to another.** You literally must have direct exposure to sick or dead poultry to become infected. This is most likely to occur in emerging countries where poultry is kept in backyards and often let into the house. This practice is common only in parts of Asia, Africa, and the Middle East. It is highly unlikely for people to contract infection from wild birds.

MAP 2

176 Human Cases of Avian Flu . . . 97 Confirmed Deaths Outbreaks & Human Cases (Dec. 2003 – Mar. 10, 2006)



Sources: OIE, WHO

Human cases thus far, in almost all instances, have resulted from close contact with infected or dead poultry or their faeces. According to the World Health Organization (WHO), almost all human sufferers caught the disease directly from birds, although WHO says there have been a tiny number of cases where an infected person has infected another; but, at the moment, the viruses cannot pass efficiently between people.

The spread of the virus to humans is particularly prevalent and problematic in developing countries because poor living conditions, malnutrition and challenged immune systems (as in those with HIV/AIDS) are likely to increase vulnerability. Plus, health services are woefully inadequate, and many live very far from appropriate medical facilities, thus antiviral medications are often beyond reach. A bird flu pandemic, therefore, would likely be triggered in the emerging world, not in Europe or North America, despite the media hype.

Predictable Surprises

Many public health officials, including Dr. Susan Tamblyn, public health consultant in Ontario, believe that the pandemic threat is looming closer. As she commented at a recent conference, "The pandemic clock is ticking; we just don't know what time it is."

There is evidence that the virus is mutating, suggesting that H5N1 viruses are becoming more infectious for humans. The greater the number of human cases, the greater the opportunity for the virus to acquire the ability to jump easily between humans. In the past century, all influenza pandemics have emanated from birds in Asia. With a human death rate of nearly 50% of those infected, most of whom are young people, this virus is particularly troubling. About half those who have died were under age 25. For the disease to become pandemic, it would have to mutate or reassort genetically to be capable of spreading easily from person to person, and the death rate would have to fall dramatically. The death rate for the very severe 1918 pandemic was only about 2.5% of cases.

Most public health officials believe that influenza pandemic is inevitable, but they don't know when it will happen or what strain of virus will cause it. Most also would concede that we are closer to pandemic today than at any time in nearly forty years. This is the first time we have had the ability to watch a potential pandemic in slow motion.

If H5N1 acquires the ability to spread the way normal flu does, it could be devastating, because there is no human immunity to the virus and it would likely take at least 4 to 6 months to manufacture a vaccine. Easy transmission of the disease between people could unleash a pandemic that would kill millions of people within months. It could happen soon, or in a year or two, or never. It is also possible that the virus could lose its dangerous qualities as it mutates and fizzles out.

Pandemic is a very low probability event, but it would have very serious global impact. Just like a category 4 or 5 hurricane in New Orleans, everyone knew it could happen, maybe even that it would happen sometime, but the risk at any given moment in time was very small. We saw just how big the outcome was. Evidently, the present value of such a low-risk but catastrophic event is somehow deemed to be lower than the cost to mitigate the damage. It is only after the fact that we see that the cost of preparedness is small in comparison to the consequential destruction.

Poultry Industry Suffers

Bird flu has already threatened the livelihoods of millions of people in Asia and Africa as health officials carry out mass poultry cullings and other countries ban imports. Over 200 million birds have died or been destroyed in Asia alone. In many of the poorer countries, poultry is a critical source of protein. Thailand lost its \$1.2 billion poultry export industry to the European Union overnight before the EU was hit with the disease. Many small poultry farmers in Vietnam have seen their flocks wiped out. Even in the developed economies, poultry products represent a small but meaningful component of economic activity. In France, it is a \$7.1 billion industry.

On March 1, U.S. Health and Human Services (HHS) Secretary Michael Leavitt said that “it’s just a matter of time” before birds infected with the virus find their way to the U.S. And, Pilgrim’s Pride—the second-largest poultry producer in the U.S. and Mexico behind Tyson Foods—recently withdrew its second-quarter and full-year earnings forecasts, partly because of fears about H5N1. A Wall Street food analyst downgraded his rating on several chicken stocks, saying news of avian influenza appears to be crippling those companies’ exports. U.S. poultry exports dropped 28% in December, and the analyst suggested that it may be down 40% in the first quarter of this year. Fear of the virus has led consumers in Europe and elsewhere to eat less poultry. About 15% of the \$30 billion U.S. chicken industry is exported.

The largest poultry exporters in the world are the United States and Brazil. Both countries are taking actions to protect their poultry stock to assure importers that their food is safe. Nevertheless, growing aversion to eating poultry in the rest of the world is hurting this industry even in so-far uncontaminated countries. If the American consumer were to follow suit and shun chicken, chicken-specialty restaurants such as KFC, Popeye’s, Church’s, and Kenny Rogers Roasters would feel the effects.

Over 40 countries imposed bans on French poultry products soon after the H5N1 strain hit a commercial turkey farm in southeast France. France is Europe’s largest producer and exporter of poultry and poultry products with most of their sales to the Middle East and Asia. The French Federation of Poultry Industries warned that bans will cut French poultry-meat exports by 60% to 65%, causing production cuts and massively falling incomes.

For those who believe that transport, trade and open borders would be only modestly impacted by a human pandemic, look closely at recent developments in France.

The French take their poultry very seriously. The chickens from Bresse have their own *appellation*, a prestigious insignia that is used to brand regional specialties in the same manner as fine wines. The Bresse chicken is a unique breed that must be raised, in part, free range with very particular care and specifications prescribed by long-standing tradition. These pampered and fattened chickens go for about double the price of ordinary chicken and they are served by the Michelin-rated restaurants of the world.

The threat of bird flu now forces those chickens indoors, which not only deprives them of their natural diet and conditions that are essential for their appellation, but also threatens their existence. If H5N1 were to contaminate the only hatching centre where all Bresse chickens are born, the centuries-old breed could disappear forever.

In the heart of the region, at least a dozen wild birds have died from H5N1 and the stricken French turkey farm is not far from Bourg-en-Bresse.

Not only are all poultry producers in France (as well as in many other countries) now forced to house their poultry indoors 24 hours a day to prevent new infections, but areas of the Bresse region have been recently locked down. The only people allowed on these chicken farms are the workers. Trucks delivering chicks drop their cargo at the top of country roads, rather than at the farmhouse door, and government signs are posted along the highways prohibiting the transport of live birds. At the single selection centre that preserves embryos of the Bresse breed, workers have been ordered to wear full-protection suits and to take multiple-hygienic steps before, during and after work.

The government agricultural authorities have so far refused the Bresse poultry producers' request for an exemption from the confinement order. **This could well be a harbinger of the way people would be handled in the event of pandemic.**

As far afield as Quebec, the impact of the bird flu in France has been felt; foie gras producers in the province have lost their easy access to the Mulard ducks they import from France. The Mulards are sterile, so new arrivals from France are necessary to continue production.

The Canadian poultry industry is, in general, little dependent on exports or imports, but new provincial rules forcing the confinement of birds make the practice of free-range raising more difficult. The three largest poultry companies in Canada are Lilydale Poultry Co-op, Maple Leaf Poultry, and Maple Lodge Poultry. KFC is the leading chicken outlet, followed by Cara's Swiss Chalet and St. Hubert. KFC is a

global company and sales have already nosedived in China, forcing the company to offer alternatives to chicken.

Poultry production cuts and culling are worrying poultry-feed processors as well: Prices for Argentine and Brazilian soy meal—used in chicken feed—and French corn have been affected amid concern about the market. The soy bean market has also been impacted. The downstream and upstream effects to food processors, packagers, grocers, restaurants, as well as feedstock, are quickly becoming quite meaningful.

The discovery of just one dead cat in Germany, killed by H5N1 which was likely contracted by eating an infected bird, has caused significant governmental reaction. Now, cat owners in the region must keep their felines indoors. Dogs may be let outside, but only on a leash. Several infected cats have died in Austria as well. Fear and panic from just a zoonotic pandemic give a hint of what we might expect if the disease were to spread easily to humans.

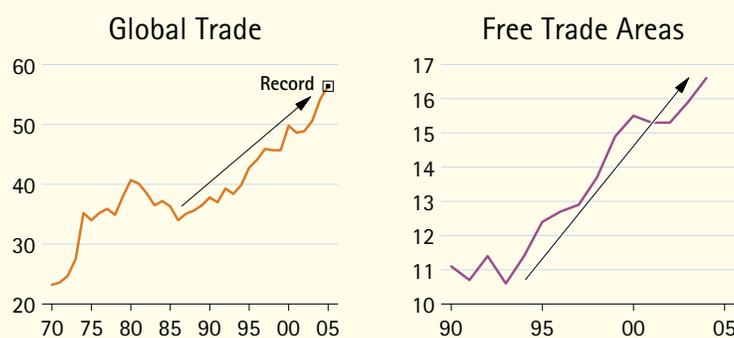
Economic Interconnections

It is evident that, in today’s world, national economic boundaries have blurred and no country is self-sufficient in all essential products. Supply chains are international; globalization and the surge in trade have increased competitive pressure like never before (*Chart 1*). Businesses, in consequence, have widened their profit margins and increased productivity by minimizing inventories of inputs, goods, machine parts, labour, virtually everything, managing on a just-in-time basis. Wal-Mart was a leader in developing the technology of just-in-time management, increasing efficiencies and driving down prices. Just-in-time practices work well when goods, services and people flow easily across borders to where they are needed, when they are needed. This requires open borders, smoothly functioning transport, efficient port and warehouse management and fully functioning technology. Any disruption can lead to crippling shortages (or stockpiles) and waste, which squeezes sales and profits, thereby dampening job growth and economic activity. We see a vivid example of this every time there is a dockworkers’ strike.

There are more multinational corporations (MNCs) than ever before—roughly 70,000 worldwide having 690,000 foreign affiliates with almost \$19 trillion in sales, nearly double the size of the U.S. economy. Many of these MNCs have affiliates in Asia and already have been directly impacted by H5N1. In developing preparedness plans, MNCs must deal with many different communities, as well as multiple local and national

CHART 1

Burgeoning Trade Exports+Imports (% of global trade)



Markets Without Borders: What if Borders Close?

Free Trade = ANDEAN+ASEAN+EU25+MERCOSUR+NAFTA intra agreement Sources: IMF, WTO

governments. Any breakdown in global flows of goods, services, financial capital and people can send shock waves through the entire system.

Adding to the interdependency of countries, international travel has never before been so common or so rapid (*Chart 2*). While it took weeks to travel from Asia to North America during the severe pandemic in 1918, it takes just hours today. World travel and tourism and its tentacles account for roughly 10% of global GDP and 8% of global jobs generating more than \$4 trillion in economic activity and over 200 million jobs last year. Inevitably, an influenza pandemic would disrupt travel, transport, and trade, even if no country were to officially shut its borders. While Canada plans to keep its borders open, there have been mixed suggestions in the U.S., and other countries, such as Australia and New Zealand, have discussed closing their borders. Regardless, voluntary social distancing would disrupt trade, transport, and travel and will probably do so for roughly one-to-twelve months. In fact, anecdotal evidence suggests that European travel bookings have already slowed due to H5N1 fears.

The Asian Factor

China and India are the fastest growing economies in the world, representing nearly 40% of the world's population (*Chart 3*). But, these are very poor countries. Income per capita in China is only one-seventh the level in the United States and that income is distributed very unevenly. While average income per capita in China is \$6,200 (in purchasing power parity, U.S.-dollar terms), the average Chinese farmer nets only \$365 a year. Income is lower still in Vietnam, Nigeria, Thailand and Cambodia (*Chart 4*). These are the countries that would be ground zero for pandemic flu. They are poorly equipped to conduct adequate prevention, surveillance, containment, and human-health care.

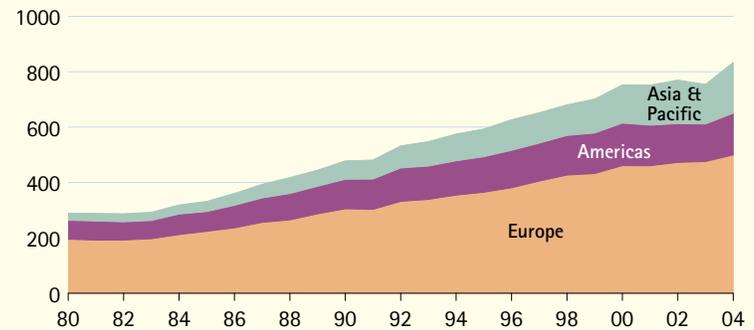
But, in the past several years, China has been a capital-spending powerhouse, particularly for infrastructure, residential and non-residential construction, and in preparation for the 2008 Beijing Olympics. The Middle Kingdom is the largest consumer in the world of cement, iron ore, steel, aluminium, coal, paper and pulp and the second-largest consumer of energy and oil. Due to skyrocketing Chinese demand relative to supply, commodity prices have surged. An economic slowdown

CHART 2

Globetrotters

(millions)

International Travelers

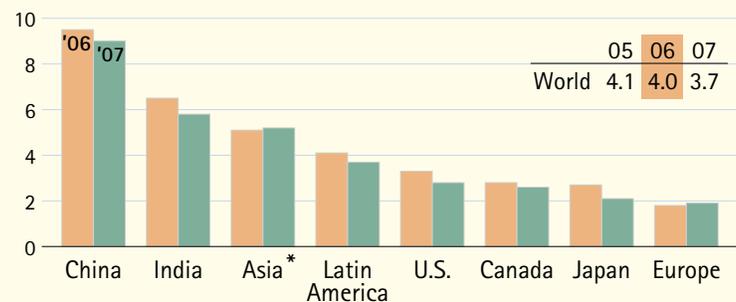


Source: World Tourism Organization

CHART 3

China and India: Growth Leaders But Still Poor

Real GDP (ann % chng)



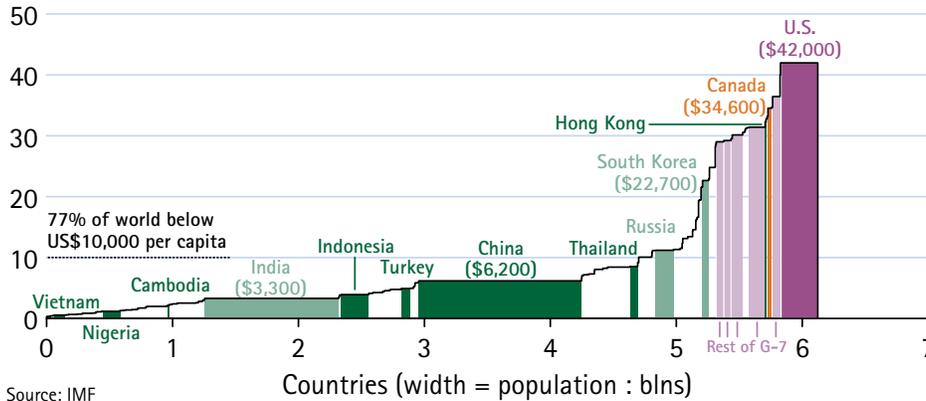
China the Global Growth Leader

Ranked by '06 * excluding China, Japan and India Source: BMO Nesbitt Burns

CHART 4

The Wealth of Nations

GDP per Capita – 2005 (US\$ 000s : PPP-terms)



Source: IMF

Flu Areas Are Poor

- South Korea GDP per Capita 1/2 of U.S.
- China 1/4 of South Korea
- Average Chinese Farmer Earns \$365/year

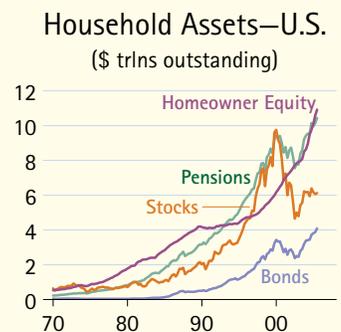
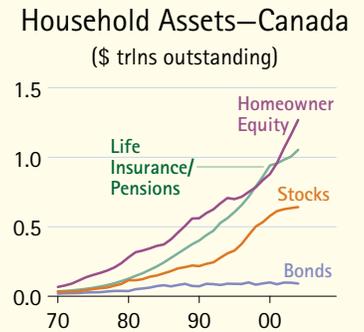
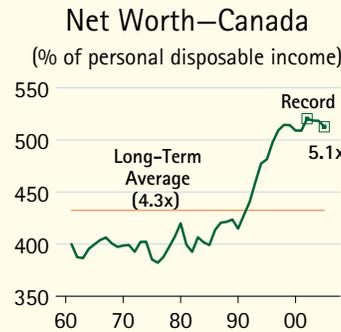
in China, not to mention Asia as a whole, could cause the commodity boom to bust. This alone would meaningfully damage the Canadian growth outlook, labour market, the stock market, currency and more, and the same would be true in varying degrees for all commodity-producing countries which have so enjoyed the fruits of the most recent commodity boom.

Moreover, consumer savings rates in North America turned negative last year as household wealth increased sharply (Chart 5). In Canada, household net worth surged to a record 5 times personal disposable income in 2005, apparently discouraging the desire to save out of current income. While in the U.S., the household wealth ratio has not yet returned to its bubble peak in late 1999, it has recovered sharply from the 2000 stock-market collapse owing mostly to the rise in house prices. Most of the components of household wealth would be meaningfully reduced by pandemic flu—homeowner equity (depending on the death toll and the severity of the downturn), the value of pensions and stocks. Government bonds might actually increase in value to the extent that economic activity slows and central banks pump liquidity into the system.

No doubt, consumers would be rattled like never before, because never before have active savings rates been so low nor have consumers

CHART 5

Wealth at Risk



(Household Assets - Debt) / Personal Disposable Income

Homeowner Equity Dominates

Sources: Statistics Canada, U.S. Federal Reserve, U.S. Department of Commerce

been so collectively indebted (Chart 6). Clearly, it would be prudent for people to hold sufficient high-quality, relatively liquid financial assets and precautionary cash balances to see them through a pandemic (were it to occur) without being forced to sell assets at markedly, and possibly temporarily, depressed prices. Indeed, from a financial perspective, it would be best to be in a position to buy assets when prices plunge in the initial panic and fear.

What If? . . . Severe Pandemic

Pandemic cannot be compared to most other natural or man-made disasters such as hurricanes, tsunamis, mud slides or even terrorism

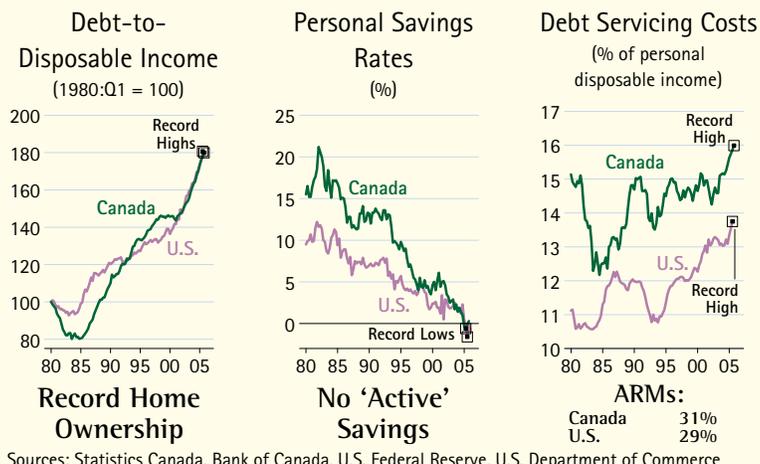
(other than bio-terrorism, which can be likened to a man-made pandemic) because it has no fixed location and no set end date. While the tragedies of 9/11 in New York and Washington and 7/7 in London were devastating and hugely disruptive, neither had a meaningful sustained economic impact. GDP growth fell during the quarter these events occurred—the same for the hurricane—but within a quarter or two, economic growth was boosted by the recovery and rebuilding efforts. The events were contained in terms of time and location, so the global economy suffered little if any sustained damage to economic growth. (The damage to wealth, however, remains substantial, but that is not measured in GDP.)

But pandemics are prolonged and pervasive. Outbreaks occur virtually everywhere almost simultaneously, and with the rapidity and frequency of global travel, the warning time could be very short. The peak of the illness would likely be 2-to-4 months from the initial outbreak, and not necessarily during the ordinary flu season. It could come in waves—increasing in severity, and it could well last for months and months. It is spread by airborne droplets from sneezes and coughs and by surface contact with the virus, followed by touching one’s eyes, nose or mouth, and it is highly contagious. The disease might be communicable even before symptoms are manifest and the period of greatest communicability would likely be the first few days of infection. Adults shed virus from 24 hours before the onset of illness and up to 5 days after. Children shed virus for longer—roughly 7 to 21 days. Schools would likely be closed.

A moderate scenario could mean that about 35% of the population took ill, even higher in severe cases. Public health officials in Ontario are assuming that up to 10% of these cases would be hospitalized and 0.4% to 2.2% of stricken patients would die, again depending on the severity. Absenteeism would shoot up; experts suggest that businesses plan for the possibility of 30% absenteeism at one time.

CHART 6

Household Finances a Concern



Fear and panic would no doubt ensue, at least temporarily, which could lead to unruly or criminal behaviour and most communities would have inadequate numbers of first responders. These first responders and health care workers should be among the first to get prophylactic antiviral medication. Safety and security would be a primary issue, particularly as shortages of Tamiflu, water, and food emerge. Employees would look to their employers for frequent, clear and accurate information; but rumours would be rampant and media hype could well contribute to the panic. Leadership would be essential, as we saw with Rudy Giuliani's handling of the World Trade Center attacks in stark contrast to Ray Nagin's (mayor of New Orleans) handling of Hurricane Katrina.

Some of the big immediate losers, joining the poultry industry, would be the tourism sector, travel and transport businesses, the hospitality industry, and luxury goods suppliers. We saw this vividly with SARS in Toronto, China and Hong Kong. Planes, to the extent they took off, would be virtually empty. Public transportation would be shunned. Life and health insurers would be devastated by the rise in death rates and the overwhelming demands for medical services. All public and private gatherings of people would likely cease, even if they weren't officially prohibited. Theatres, casinos, sports facilities, religious facilities, convention halls and restaurants would quickly empty. All food-service businesses would be hit, but particularly those that specialize in chicken. No one would go to the dentist or to doctors, except for flu or emergency conditions. Business as usual would be virtually nonexistent.

Shortages would emerge very quickly as supplies of water, food, medical products, and all other essential items would rapidly be consumed. Machinery and equipment might cease to function if key parts were no longer available, not to mention that there could be a shortage of sufficiently trained labour to provide many essential goods and services. This is why continuity planning is so important.

We can't rule out the possibility of prolonged government-service disruptions. Insufficient waste management, clean water and fuel might exacerbate the crisis all over the world. The electricity grid—already old and inadequate in the U.S. and Canada—might shut down for extended periods. Power generation, transmission and distribution are already running near full capacity and brown outs regularly occur during extreme heat, or cold weather. The average age of the infrastructure in the U.S. is 42 years; the average age of workers is over 50. The power systems have little shock-absorbing capacity. Pandemic would make any repairs very difficult and most industry experts suggest that outages will occur. Power outages already cost the U.S. roughly \$100 billion a year.

Prolonged power outages would have huge disruptive effects. Once systems break down, it is very costly and time consuming to start them back up. Without electricity, many would be without Internet access or other sources of news. Telephone service could continue for some period without power, but not indefinitely.

Cash machines would not work and credit card validation equipment might not function. Gasoline stations could not pump gas, reducing the value of generators as the gas runs out. Airports keep only a few days of fuel on hand at any one time. For deliveries, UPS and Fed Ex have very detailed continuity plans that they have not, thus far, released to the public for competitive reasons. Refineries would power down. Fresh food and certain medications would spoil. Hospital equipment would function only for as long as the generators were fuelled.

Preparedness planning is critical for government, businesses, hospitals, and individuals. Battery-operated radios and flashlights, large supplies of batteries, stockpiles of bottled water, gasoline, and non-perishable foods might be life saving. Extra supplies of essential medications for chronic conditions, syringes, face masks, antibacterial soap and cleaners should also be considered. According to Tommy Thompson, former head of U.S. Homeland Security, 80% of pharmaceutical ingredients come from outside the U.S. and supplies would quickly dry up.

For some products there would be excess demand, for others there would be excess supply. Voluntary social distancing could well ravage the earnings of many shopping-centre stores and other retail and wholesale providers of inessential goods and services. Who would get their hair cut, go to a restaurant or go to the mall? Many businesses would no doubt close, in some cases leaving employees without paycheques. Large businesses should introduce nonpunitive health and family-leave plans now, and encourage annual flu shots and staying home when sick. But, many small businesses could not meet payroll if they have no customers or nothing to sell. Clearly, anxiety and alarm would be prevalent, further increasing the need for community shelters, caregivers, and sources of reliable and frequent information.

Medical facilities everywhere would be pushed beyond surge capacity. Auxiliary locations—converting schools, hotels, gymnasiums and the like into triage centres and health care facilities—must be carefully planned and tested in advance. Individuals should learn enough about the symptoms and treatment of the potential influenza strain to manage and effectively respond to illness—what should you do, where should you go, how would you get there? Families and households, neighbours and friends, communities in general should plan, test, and update actions and resources in the event of pandemic, which could happen at any time with little notice.

There would be shortages of not only hospitals and health care workers, but also key medical supplies such as: beds, linens and towels; ventilators and respirators; syringes and IV supplies; antiviral drugs, vaccines, antibacterial cleaners and disinfectants; and the list goes on. Who will operate the dialysis machines or radiation equipment? Who will administer the chemotherapies, deliver the babies, treat heart attacks and respond to car accidents? These are just a few of the almost endless number of health issues that must be planned for in advance. And, as we

saw in New Orleans, plans on paper are not enough. They must be tested and retested. Coordination is essential at all levels.

Compounding all of this is inadequate death management, insufficient crematory facilities, morgues, coffins, body bags and refrigerated trucks. Gruesome as this is to think about, nothing could inflict so much lasting psychological damage as the sight of untended dead bodies. Traditional funerals would likely be dispensed with as people would be afraid to gather; what would take their place from a psychological and an emotional standpoint? Funerals are for mourning and healing, allowing completion and solace. The pandemic crisis could last for months, not days or weeks and it would be happening everywhere, so there would be no outside assistance to tap into. I recently spoke at a conference in Boston for humanitarian organizations, from the Red Cross to the WHO, and all of them would be confronted with the same disruptions and restrictions of movement and supplies as the rest of us.

A Cytokine Storm

Thus far, H5N1 in humans has shown some similarities to the 1918 virus; it appears to manifest the highest fatality rates in the 15-to-40 age range, rather than the very young or very old—most vulnerable to the ordinary flu (*Chart 7*). The disproportionate death of healthy young adults in the 1918 pandemic resulted from a ‘cytokine storm’, an event in which cytokine production causes enormous lung and other organ damage. Cytokines are regulatory proteins, such as the interleukins and lymphokines, that are released by cells of the immune system and act as intercellular mediators in the generation of an immune response. People with the strongest immune systems produce the most cytokines and, hence, have the highest fatality rate.

Once a cytokine storm becomes acute, nothing can be done to save the suffering, even in an Intensive Care Unit. Many experts suggest we cannot handle this condition much more effectively today than we could in 1918, even in fully equipped and fully staffed modern medical facilities.

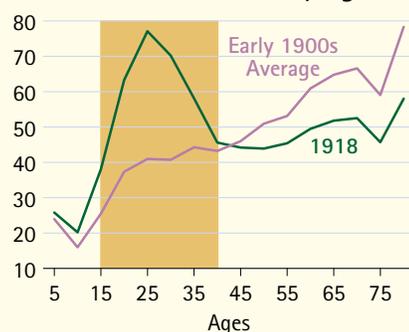
In 1918, pregnant women were the most susceptible to a virulent cytokine storm. Some researches suggest that the death rate for pregnant women was as high as 70% in some locations, and even for those who survived, the fetus did not.

A cytokine storm, therefore, would have a long-lasting impact on the global population and therefore the global economy. Birth rates would plunge and the biggest proportional loss would be for the 15-40 year olds, a group that is already relatively few in number in the U.S., Canada,

CHART 7

What if it’s a Cytokine Storm à la 1918? United States (per 1,000 deaths)

Distribution of Deaths by Age



Fatality Rates Highest for:

- 15-40 Year Olds
- Pregnant Women

Early 1900's Average = Average of 1900, 1910, 1915, 1920, 1921 Source: U.S. Census Bureau

Europe, Japan and China (Chart 8). These are among our most productive people, accounting for much of consumer activity, household formation, and ultimately, family formation (Chart 9). They are the ones that would ordinarily rent their first apartments, buy a few sticks of furniture and lots of home electronics, buy their first car and, in time, buy houses and take over the jobs of retiring boomers. There is already slated to be a shortage of labour as boomers retire; this kind of pandemic would exacerbate the situation dramatically.

The already aging population would suddenly age even faster as too many of those who contribute to government and business pension plans, buy stocks and bonds, and pay taxes would disappear. Social Security and Medicare systems would quickly become insolvent, unable to meet the burden of a rapidly aging and aged society. This would be worst in core Europe and Japan, where birth rates have been very low for some time (Chart 10).

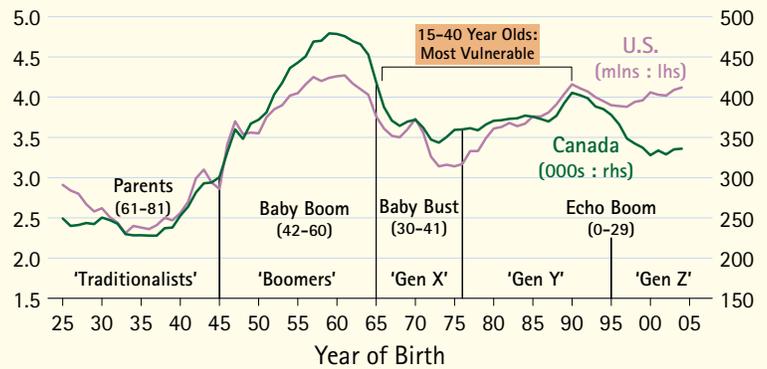
The Economic Implications: Guessing at Numbers

Any estimate of the economic impact of an H5N1 pandemic in humans is an educated guess, markedly affected by assumptions of unknowable factors. For example, the characteristics of the virus—its attack rate, affected age groups, virulence of the strain and rates of complications and death, and the speed of the spread are all important and unpredictable. The economic loss would also depend on the effectiveness of the response—vaccines, antivirals and public health measures—as well as public behaviour, which could vary widely from country to country, or even region to region.

The primary preventive measure is vaccination. It might not be available for about 4 to 6 months after the initial outbreak, and its availability would certainly vary geographically. Antiviral

CHART 8

Profound Demographic Implications Births



() = youngest/oldest age in 2006 Sources: Statistics Canada, U.S. Census Bureau

CHART 9

Long-Lasting Effects

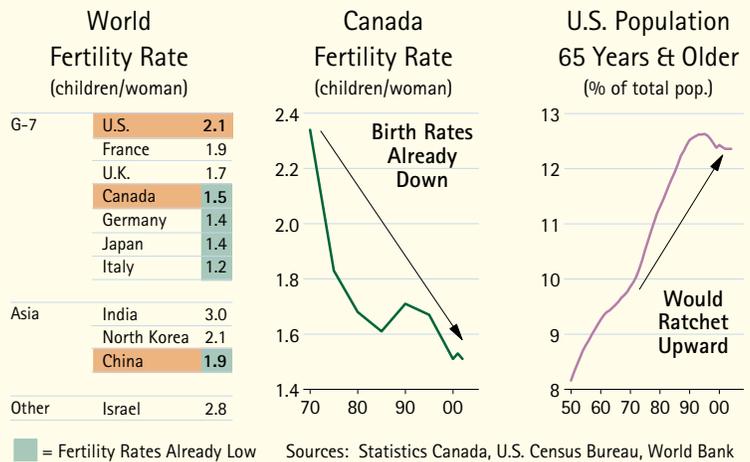
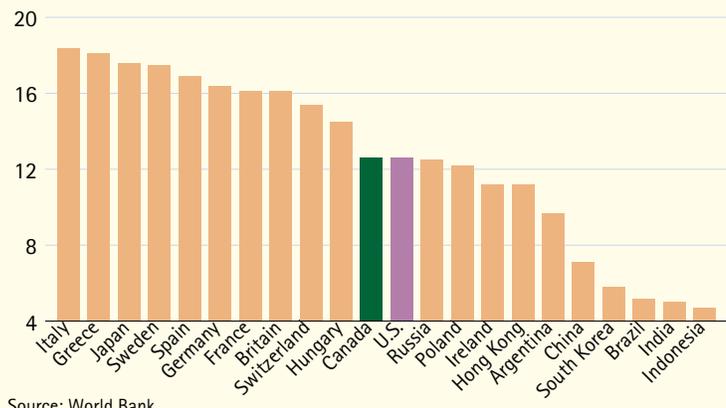


CHART 10

U.S. Still Young Compared to Most Population Aged 65 and Over (% of total pop.)



drugs would be the only virus-specific interventions until vaccines were to become available. They could be used to prevent or treat illness, but supplies are far too limited to use them prophylactically except for the most essential people—health care workers and first responders. But, what about delivery truck drivers, providers of food and essential supplies, key personnel at government service facilities?... And what about their families? Poor countries would be hit harder than rich ones in terms of individual vulnerability and response.

Earlier Studies

There have been a number of very credible attempts at putting numbers to the probable economic impact. Studies by economists at the Asian Development Bank (ADB), the Brookings Institute in the U.S. (and the Lowy Institute in Australia), and the Congressional Budget Office (CBO) have received the most attention (*Table 1*).

ADB Pandemic Estimate

The ADB’s estimate of the economic effects of a pandemic was among the first and is modeled assuming only Asia (excluding Japan) was affected by the pandemic. The ADB models a separate supply and demand shock. The supply shock is estimated as lost labour productivity due to incapacity and mortality. The demand shock is a reduction in consumption, trade in services, and investment. The pandemic is assumed to last one year, with the attack rate of 20% and a case fatality rate at 0.5%. The CBO study makes similar assumptions regarding duration and virulence of the pandemic. Workers who become ill are assumed to be absent from work for two weeks. The ADB does not break down the economic effects by industry, as in the CBO model, but rather by country.

The ADB’s first scenario assumes that the psychological impact of the pandemic will be mild and last only two quarters. The demand shock is modeled as the major impact, costing Asia 2.3 percentage points of growth, while the supply effect cuts growth by a paltry 0.3 percentage points. After the initial two-quarter shock, the economy will also suffer a 6-quarter period of “milder contraction.”

Scenario two, the more severe pandemic, assumes that the psychological impact of the pandemic lasts four quarters, or twice as long as in the first scenario. The demand shock in this case costs 6.5 percentage points of growth, while the impact of the supply side is unchanged from the first scenario at 0.3 percentage points. After the initial 4-quarter shock, the economy will manifest a 4-quarter period of “milder contraction.”

TABLE 1

Model Estimates: Pandemic’s Economic Impact

(percentage points of GDP growth decline)

Region	Model	Severity	Demand	Supply	Total
Asia	ADB	Mild	2.3	0.3	2.6
		Severe	6.5	0.3	6.8
U.S.	Brookings (Lowy)*	Mild	0.0	0.6	0.6
		Moderate	0.2	1.2	1.4
		Severe	0.4	2.7	3.0
		Ultra	0.8	4.8	5.5
	CBO	Mild	0.5	1.0	1.5
		Severe	2.0	3.0	5.0
Global	BMO Nesbitt Burns	Mild	0.7	1.3	2.0
		Severe	2.3	3.7	6.0

* includes risk factor not shown

The ADB models the psychological effect on demand, which seems to be appropriate. Their two scenarios are realistic from a demand perspective, as we cannot predict how consumers will react, and how long the fear of a pandemic will keep them from resuming normal activities. However, on the supply side, their model, in our view, is incomplete; only the absenteeism of the sick and deceased are included in the supply shock. Healthy workers who choose to stay home out of fear or to care for family members are ignored, and so is any trade or supply-chain effect.

Another problem with the model is that it assumes that pandemic is only an Asian problem, not a global one. A pandemic, by definition, is global. Considering that Asia exports a significant proportion of their output to the rest of the world, it would be more appropriate to include the impact of a decline in exports owing to the disruption in trade and international demand. Ignoring these factors meaningfully underestimates the supply-side impact of pandemic. In addition, while there is no fundamental problem with the assumed attack rate or case-fatality rate, they are just assumptions. Varying the two would have given the authors a more complete result.

Brookings (Low) Pandemic Effects

The Brookings model develops four scenarios: mild, moderate, severe and ultra. The length of the pandemic is not specified for any of the scenarios. The attack rate is assumed to be 30% for all four scenarios. It is the change in the case-fatality rate that distinguishes one scenario from another.

Brookings also separates the supply and demand shocks. The supply shock is broader in this model and is manifested in two ways: 1) lost labour productivity due to incapacity and mortality, and 2) increased operating costs. The demand shock shows up as a reduction in demand for goods and services. Workers who become ill, are assumed to be absent for two weeks (10 working days).

The researchers assume that there will be 'affected' economies (Asia, especially Hong Kong), and 'less-affected' safe-haven economies (North America and Europe). Most researchers believe that all countries will be impacted, and the severity and duration of the effect depends primarily on the characteristics of the virus rather than the characteristics of the country in question. However, there is some sense to their assumption as attack rates and case-mortality rates might well be higher in poor countries for the reasons we have already discussed. However, when it comes to the economic impact, it could be argued that the countries most dependent on trade and outsourcing would suffer the greatest loss, which, of course, puts the developed world at the top of the hit list.

The Brookings approach has a number of additional shortcomings. Firstly, they assume only women stay home to care for a sick family member, and somehow,

the other members of the family go about their business despite their exposure and fears of exposure when outside the residence. In addition, the assumptions regarding U.S. health care and financial risk are far too rosy. The U.S. is assumed to manifest the lowest mortality rate in the world under each scenario—somewhat lower than in Canada, and substantially lower than in Europe, let alone Asia. The researchers assume the U.S. has the best health-care and vaccine capability. While it is true that the U.S. spends proportionally the most for health care, it does not necessarily follow that it has the best health-care system or that its vaccine capability is superior to other developed countries, particularly those with large domestic vaccine manufacturers and effective non-pandemic systems of distribution. In fact, the U.S. has woefully little domestic vaccine-production capacity, no widespread public-health distribution system, and had trouble in 2005 meeting ordinary-flu vaccination needs. Moreover, the U.S. is the most litigious society, so vaccine creators and producers must deal with the real risk of law suits in the event of nasty side effects. To date, the U.S. government has refrained from indemnifying vaccine companies from this risk.

The Brookings study also assumes there is no 'country risk premium' for the U.S., while it is meaningful and even very large everywhere else. Brookings calculated a country risk premium index, which is an average of three subjective components: a governance index; a health index; and a financial risk index. The governance index measures government transparency (corruption), effectiveness and ability to respond to the pandemic threat. Here, the U.S. is ranked 6th below the U.K., Canada, Singapore, New Zealand, and Australia. The health index is based upon per capita health care expenditures and does not adjust for quality or breadth of service. As the U.S. is the largest per capita spender on health care, it performs best in this index. The financial risk index is the current account balance-to-GDP ratio in 2002, measuring the reliance on foreign capital inflow. Here, certainly, the U.S. would be ranked behind most developed countries (with the exception of New Zealand).

The Brookings study assigns the U.S. with a risk-premium-index number of zero, and gives every other country an overall-risk rating relative to the U.S. in excess of zero.

They bias their results by using a SARS-based model which exaggerates the negative economic impact on Hong Kong, and minimizes the impact on the U.S. economy. For example, under the ultra case (which is the 1918 flu example with the elderly dying in disproportionate numbers as well as the 15-to-40 year olds), they assume that the mortality rate in the U.S. is 0.7%, while for Hong Kong, it is 2.4%.

The Brookings demand shock also appears to be too low, by assumption. Even in the worst-case 'ultra' scenario, the demand shock in the U.S. is only -0.8 percentage points. The authors assume people will behave according to the 'life-cycle

hypothesis'. This hypothesis states that people smooth consumption over their lifetimes based on what they expect the present value of their lifetime earnings to be. In other words, because the pandemic is transitory, spending patterns will be little impacted as the effect on lifetime income is small. The researchers also assume that central bank actions can control consumption behaviour during the pandemic; in other words, central banks can ease monetary and credit policy enough to induce people to spend close to what they otherwise would had the pandemic not occurred. It is more likely, in our view, that fear and shortages could well reduce spending, regardless of the level of interest rates.

Lastly, the way they chose their scenarios is troubling. The difference between the mild and moderate scenarios is small. The mild scenario is based on the 1968-69 Hong Kong flu, when an estimated 1 million people died, and the moderate scenario is based on the 1957-58 Asian flu, which caused roughly 2 million deaths. The percentage of the global population killed in either case is extremely low, so treating them as 'mild' versus 'moderate' is a relatively meaningless distinction. The 'ultra' case also seems to be overblown, as the world has not experienced anything like it, at least in the past century.

The CBO Pandemic Effects

The CBO looks at two scenarios for the U.S. economy: mild and severe. The severe pandemic scenario assumes a 30% attack rate in the nonfarm economy and a case fatality rate of 2.5%. Those who are stricken, but recover, are assumed to be absent from work for three weeks. These numbers are similar to the 1918-pandemic experience.

The mild scenario assumes a 25% attack rate and a 1.14% case fatality rate. Those who take ill, but recover, are off work for 0.75 weeks (one-fourth the time off in the severe scenario). In both cases, the pandemic is expected to run its full course within one year and no distinction is made between one big supply shock and a series of smaller shocks. The impact in the farm sector is assumed to be much smaller, which is odd given the impact we have already seen on poultry and feed-stock farmers.

Like the others, the CBO modeled the economic consequence of pandemic as a separate supply-side and demand-side shock. The supply shock is measured as lost labour productivity. The demand shock is observed as the change in demand at the industry level.

The most negatively affected sectors are arts, entertainment, accommodation and food. Under the severe scenario, economic activity in these sectors is projected to drop a whopping 80% for one quarter. This is followed in impact size by transportation and warehousing—down 67%. Health care is the only sector that experiences an increase in demand—up 15%. Economic activity in most other

sectors, for example agriculture, construction and manufacturing, is forecast to decline by about 10% or remain relatively unaffected.

The demand shock in the mild scenario is assumed to be one-quarter the sectoral magnitude in the severe scenario. For example, the arts, entertainment, accommodation and food sectors suffer a decline in demand (output) of 20% for one quarter.

Assuming a severe pandemic, the CBO model estimates that U.S. annual GDP growth drops 5 percentage points from what it otherwise would be. So, for example, if U.S. GDP is slated to grow around 3.5% this year—similar to last year’s pace—a severe-pandemic impact of a 5-percentage-point decline in growth implies a -1.5% growth rate for the U.S. economy, which is comparable to the 1981-82 recession, the worst in the post-WWII period.

According to this study, a mild pandemic would reduce the U.S. economic growth rate by 1.5 percentage points over the course of one year, which is not enough to cause a formal U.S. recession at current growth rates. Note that this is annual growth, and if compressed into one quarter, the annualized impact would, of course, be roughly four times larger.

An Alternative Model of Pandemic Effects

Although one can get picky about the CBO’s assumptions (for example, the education sector is assumed to be unaffected), the major flaw in the model, in our view, is the absence of a trade impact on the supply side. We adopted the CBO model as the basis for our estimates with the addition of a supply-side disruption in trade and, therefore, significant supply-chain dislocations.

Estimating this effect is not straight forward. We assume that the rest of the world’s (ROW) economies, in the aggregate, would have a similar demand and supply shock as the CBO estimates for the U.S. We treat the ROW demand shock as a hit to U.S. exports and the ROW supply shock as a hit to U.S. imports, and then gross up the CBO’s shock estimates by the trade shares of U.S. GDP. The real-exports-to-GDP ratio in the U.S. is 10.4%, and the real-import ratio is 16.0%. Thus, we use an export gross-up factor of 1.104 and an import gross-up factor of 1.160.

For the severe scenario, the CBO’s grossed-up estimate would be 5.7 percentage points, which, after padding a bit for our quibbles with the CBO assumptions, gives rise to our working result of 6 percentage points. For the mild scenario, the CBO’s grossed-up estimate would

TABLE 2

BMO Nesbitt Burns Model: Economic Impact of a Flu Pandemic

Annual Loss of Real GDP Growth* (2005 US\$ blns)

	Mild Pandemic	Severe Pandemic
Annual Growth Loss (percentage points)	2 ppts	6 ppts
Global Economy (\$ loss)	1.1 trln	3.2 trln
U.S.	220 bln	670 bln
Eurozone	165	490
Japan	70	220
U.K.	30	100
Canada	20	60
Other Advanced Economies	70	210
China	140	420
India	60	190
Africa	40	100
Other Emerging Economies	250	750

* assuming pandemic lasts 3 months

be 1.8 percentage points, which, again after padding a bit, gives rise to a working result of 2 percentage points (*Table 2*).

To estimate the global dollar impact, we started with actual real U.S. GDP in the third quarter of 2005. To construct an estimate of real global GDP (in US\$ as of that time), we employ the fact that the U.S. economy was 20.9% of the global economy in 2004 according to the IMF using purchasing power parity (PPP), which generates dollar values for the other regions based on PPP-valued GDP shares. We also assume that all countries suffer the same pandemic hit to GDP growth as the U.S.:

- **Mild Pandemic Effect on Growth** is an annual loss of 2 percentage points,
- **Severe Pandemic Effect on Growth** is an annual loss of 6 percentage points,

which we still consider to be a “low ball” global estimate given that the number of countries suffering more than the U.S. will likely be larger than the number of countries faring better.

Thus, in a severe pandemic, the world economy would contract for the first time since WWII, as most countries experience outright recession. A mild pandemic would not be enough to cause a formal recession at current growth rates in some countries—such as the U.S., Canada, China and India—but for underperformers, for example core Europe today, negative growth rates would be posted.

Merely Suggestive

No doubt, one can poke holes in these assumptions, just as we have in others'. That is why no one should see these results as anything more than suggestive. Our model creates what we consider to be a reasonable mild-scenario case and a reasonable severe-scenario case given historical experience and what we think we know, or can guess, about the characteristics of the particular mutated virus strain that leads to the pandemic. But the fact is, these characteristics are very uncertain and subject to change at any time.

Moreover, the effectiveness of the response to pandemic is also unpredictable and will, hopefully, improve considerably the more time we have to plan and prepare. We are far better prepared globally than we were one year ago, but we will be far better prepared one year, five years or a decade from now. The technology of vaccine development and production is under intense study and ongoing progress is evident. The production of antiviral medication has been stepped up sharply and through the auspices of the United Nations, countries have raised nearly \$2.0 billion to fight the bird pandemic in the underdeveloped world. More money is needed, and more will come. We are also creating and testing public health measures of improved surveillance, detection, rapid effective response, treatment and containment. Governments and businesses all over the world are taking the risk of pandemic more seriously. The more time we have, the better the response will be, mitigating some of these negative effects.

Another unknowable factor is public behaviour. Some fear and panic might not be such a bad thing if it causes people to plan and take action. Simple hand washing and sneeze and cough hygiene can make a difference in attack rates for all types of influenza—ordinary and pandemic. The more knowledge people have about pandemic, the better the response.

Many studies are available in print and online regarding suggested business continuity and preparedness measures for every sector. I spoke at a conference last month in Minneapolis co-sponsored by the American Chamber of Commerce and the Center for Infectious Disease Research & Policy of the University of Minnesota under the leadership of Dr. Michael Osterholm. The conference addressed specific business preparedness and continuity plans by sector or industry; many such seminars will be conducted around the world.

The Bottom Line

It is important to remember that even if there were to be a severe pandemic, roughly 99% of the world's population would survive. Borders would reopen and the free flow of goods, services and people would recommence. The global economy would survive the hit, and business and governments would learn many lessons. One would certainly be that grass-roots community support is essential to effectively deal with pandemic. Collaboration worldwide is also key. What happens to one country can have dramatic effect on all others. It is essential to supersede geopolitical differences and turf wars, and work together to reduce and eliminate the fallout from the ancient risk of influenza pandemic. Sooner or later—and let's hope it's later—we will put these plans to the test.

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