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A Case for Multilateral Investment in Avian Flu Prevention

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Key Findings

- Influenza virus is a perennial companion of human society, posing substantial direct threats to lives and livelihoods and indirect mutagenic risk in animal populations.
- Realistic investments to manage this risk, including public spending on research, public health, and agro-food practices, may seem large as individual commitments, but they are small relative to the cost of averted mortality and economic damages.
- Prevention of contagious disease is a global commons, with economic benefits to each nation commensurate with their living standards. For this reason, there is a strong case for significant and sustained multilateral coordination, particularly as this entails investment by high income countries to reduce risk arising in lower income countries.

Since the beginning of the new millennium, governments and international organizations have spent billions of dollars on various activities aimed at containing and controlling the emergence and spread of influenza viruses originating in domesticated animals. Much of this funding has been allocated to educational activities, subsidization and support of disease prevention efforts, and compensation to farmers for culled animals. While reducing the likelihood of a global pandemic is socially desirable, there has not been much macroeconomic quantification of the benefits of these expenditures. This research brief provides some perspective on the expected benefits of these expenditures. Our analysis should be seen as indicative in nature because of uncertainties associated with severity of outbreaks, effectiveness of prevention and control measures, and overall expenditures. Despite this caveat, however, we believe there is a convincing and robust case for sustained and coordinated multilateral commitments to reduce global flu risk.

Influenza viruses of various types are endemic throughout the world. Every year, a new or existing strain circles the globe, killing over 35,000 people in the US alone (mainly infants, the elderly, and infirmed). Influenza pandemics, on the other hand, have occurred only three times in the last century, but they resulted in substantially higher fatality rates which include healthy people in their prime (Simonsen et al., 1998). For example, the Spanish Flu epidemic of 1918-1919 killed an estimated 40-50 million people (WHO: 2009a). As a percentage of the world population that figure today would correspond to 140-175 million. However, advances such as antibiotics that control secondary infection (Taubenberger and Morens, 2006), early warning systems, and better institutional preparedness in developed countries would likely reduce the proportion who are fatally afflicted. In fact, WHO (2009b) estimates that a severe influenza pandemic occurring today would result in two to 7.4 million fatalities, though the wider universe of fatality estimates for a contemporary pandemic range as high as 50 to 80 million (Murray et al., 2006).

This reduction in global pandemic vulnerability is directly attributable to prior investments in disease prevention and preparedness. The resulting state of disease prevention can be seen as a global commons, particularly for highly contagious diseases that can spread virtually anywhere in a globalized economy. Moreover, the economic benefits that individual nations draw from this commons are roughly proportional to their current living standards, as this is a proxy for the magnitude of damages that would arise from worker disability, mortality, and other economic disruptions. Thus, regardless of the geographic origin of such diseases, wealthier countries have a greater economic stake in protecting this commons, and should thereby be willing to make greater investments to conserve it, regardless of where those investments are made. It is in everyone's interest that preventative investments be allocated most efficiently, and to economists this means the place where one dollar yields the largest reduction in risk of pandemic origination. In the case of HPAI, for example, most experts believe that the most cost-effective risk reductions can currently be concentrated in the so-called "epicentre" countries of Southeast Asia, where there dense human and poultry populations live in close daily proximity.

To inform general policy insights into this question, we developed a simple model to assess the expected benefits from additional investment, assessing performance in terms of the implied statistical value of lives saved. The model is used here for an indicative numerical exercise using various estimates for expenditures and disease prevention effectiveness. Avian Influenza (AI), and particularly the highly pathogenic types (HPAI), cause two major problems: loss of birds and risk to people. An economic framework for supporting effective public policy will aim to minimize the combined expected costs of lost livestock, risk to people, and prevention, i.e. control and treatment of the disease in poultry and humans. The cost of lost livestock includes both costs to farmers and welfare lost by intended consumers of poultry and poultry products. In this context, an effective policy design should account for the epidemiological processes that govern the disease risk to both livestock and people. In light of the degree of uncertainty about underlying behavioural and biological processes, such a decision tool should also consider alternative approaches to managing risks.

In the present context, it is important to distinguish between actions to control HPAI and the policies leading to them. Actions can target infection both in animals and humans, including:

1) Disease Risk Management: prevention activities on farms, in markets, and with respect to wildlife disease reservoirs;
2) Monitoring and Surveillance: information gathering activities in prospective or currently affected areas;
3) Disease Risk Coping: control activities, like culling infected and exposed flocks, ring vaccination, and quarantines, as well as medical treatment and other public policy measures for AI in humans.

The universe of potential policy responses should be as wide as is consistent with implementation capacity and cost effectiveness, including incentives like subsidies (e.g. in the form of compensation payments), fines, facilitation and even direct investments in individual and shared infrastructure, and direct command and control activities.

The Model

Pandemics are random events that can be characterized by a yearly distribution of fatalities. Since pandemics are infrequent, in most years the number of fatalities is effectively zero. But pandemics are severe, and in a seemingly negligible number of years, the numbers of fatalities can be quite large. Investment in pandemic control measures targets this distribution of fatalities [severe outbreaks]. Our stylized model considers the effects of investments in terms of their impact on the average, or expected, number of yearly fatalities, N. For example, if an annual investment of Z dollars will reduce the expected number of yearly fatalities by a fraction F, then the cost of a statistical life saved is C=Z/FN. One can develop a more elaborate analysis that assumes a social utility function where differing weights are given to higher loss of life (to take account of, e.g. social disruption).

From this perspective, with a fixed frequency of three times per century, WHO data indicate that the yearly average number of fatalities from influenza pandemics, *N*, falls roughly between 60,000 and 222,000 (based on two to 7.4 million fatalities occurring every 33.3 years). These are relatively conservative numbers, compared to Murray et al (2006), who suggest that *N* is more likely in the range of 1.5 – 2.4 million. Estimating a more precise relationship between *F* (the fraction of expected annual fatalities saved) and Z (the annual investment in prevention and preparedness) is a challenge for future research. For simplicity, we assume *F* to be proportional to *Z* (in dollars), where $F=Zf/10^9$ and f is the fractional reduction of expected annual fatalities per billion dollars invested. For example, if $f=0.01$ and $Z=10$, then an annual investment of ten billion dollars will reduce the magnitude of a pandemic by 10% ($F = Zf = 0.1$). With this notation, the cost per statistical life saved is $C=10^9/fN$ dollars, which suggests that the cost of saving a statistical life is inversely related to both the expected number of annual fatalities and effectiveness of prevention efforts.

Results

Under these assumptions, the cost of a statistical life saved (SVLS) is $C=10^{11}/N$, which corresponds to roughly $450,000 to $1.67 million for the WHO pandemic estimates ($$10^{11}$ divided 222,000 and 60,000, respectively), and $41,700 to $66,700 for the Murray estimates. To provide context for these numbers, the United States Environmental Protection Agency (USEPA) uses $6.9 million as the statistical value of a life saved. To obtain a global average for this figure, we take the USEPA value as a benchmark and assume that the SVLS rises in proportion to per capita GDP.[1] The US per capita GDP is roughly $47,000, while the worldwide per capita GDP is $10,400 (CIA World Factbook, 2008), implying a worldwide statistical value of a life saved (based on the US standard) of roughly $1.53 million. This figure suggests that a billion dollar annual investment in safety is justified if it saves, on average, 654 people per year. If our assumptions are reasonable, and a $10 billion annual

[1] It must be emphasized, particularly in the context of cross country comparisons, that SVLS is a purely pecuniary indicator, measuring only the local economic losses of human mortality.

influenza safety investment reduces the expected fatalities of a pandemic by 10%, then the cost of a statistical life saved is in the ballpark of the worldwide value, according to the more conservative WHO estimates. Thus, if a ten billion dollar annual investment instead reduces fatalities by 20%, or just 10% if the Murray estimates are correct, then it is a real bargain for humanity.

While our results are only indicative, it is clear from this analysis that investment in Avian Flu control can be worthwhile from a global perspective, the value to individual players depends on the costs they incur and the benefits they gain. However, the stakes of high income countries in the global commons of disease prevention are clearly greater, and so therefore would be their optimal investment levels. The reasoning laid out above suggests a strong rationale of self-interest for significant and sustained commitments to coordinate multilateral investment in pandemic prevention. This would follow a two stage process. First, individual countries can assess their financial commitment based on the value of averted economic losses. Second, effective coordination will be needed to allocate these combined resources most effectively around the world. Two stages with relatively simple incentive and efficiency criteria, but the two figures below suggest the coordination problem could be a subtle one.

Figure 1

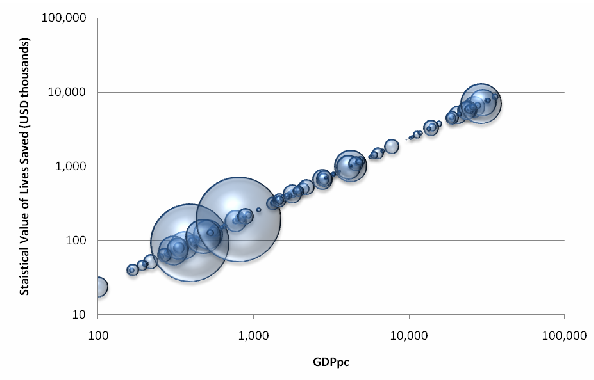
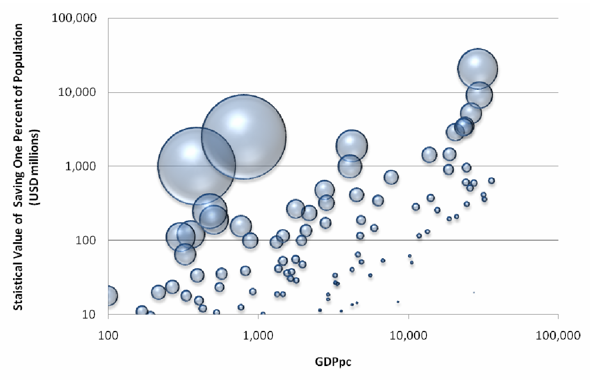


Figure 2



Both depict 114 countries, with per capita GDP (corrected for purchasing power) on the horizontal axis. The size of each bubble is proportional to domestic population and all axes are logarithmic. Figure 1 shows SLVC in USD thousands for each country on the vertical axis, and suggests that paying for risk reduction would be a much higher priority for wealthy countries. While this reasoning holds true for individual cases of disease prevention, it must be recalled that each national entity draws from the global commons in proportion to their population. Figure 2 shows the statistical cost of losing one percent of domestic population, which reflects this perspective. We leave this interesting policy issue for further study.

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