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Actuarial reflections on pandemic risk and its consequences

May 2006

Preface

The paper presents the individual viewpoints and calculations by the following five people. It does not represent an official Commission opinion. Its figures and calculations are based on a number of publicly available hypotheses considered plausible by the scientific community. However, they should not be read as definitive, lacking any precise knowledge of the possible pandemic.

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May 2006

Foreword

Directorate General Health and Consumer affairs - DG SANCO - has been a catalyser in the European Commission's efforts to prepare for a pandemic, possibly resulting from the Avian Influenza. As part of these efforts, DG SANCO emphasizes the importance of obtaining and benefiting from expert knowledge of various areas to support better understanding of the possible consequences of pandemics or other global health threats. In this context an informal group of insurance actuaries was invited to reflect, from the viewpoint of their profession, on the risk of a pandemic outbreak, its probabilities and possible impacts. This reflection focussed on two areas: firstly, whether actuarial methods can give more insight to the extent of the risks, probabilities and impacts of a pandemic. Secondly, how could an outbreak of a global pandemic impact the insurance industry, and how and whether it should prepare for that situation.

The aim of this paper is to provide more insight and work as a basis for further discussions on how various parties should protect themselves against possible economic consequences of a pandemic. It seeks this aim by assessing what extent those consequences could take and how different areas of society could be affected. These assessments are then translated to the world of insurance in reflecting on consequences on various types of insurance products.

This paper was produced by a group of experts from the Groupe Consultatif Actuariel Européen and the European Commission. The Groupe Consultatif was established in 1978 to represent the actuarial profession in discussion with the European Union institutions on existing and proposed EU legislation which has an impact on the profession. The two Commission experts work in DG SANCO.

1. Background

The bird flu, which is slowly but surely covering the whole of Europe, has woken up grave concern of its possible mutation into a virus which can transmit human to human. This note attempts to address two issues: to assess the possible impact a major pandemic – such as that following from the bird flu – would have for the insurance industry, and to identify the increased risks for society in general. It is based on information which is publicly available and some actuarial reflections.

It is evident that the impacts of a pandemic could be very serious for insurance companies, not only because of extra claims but also following related economic reactions and operational risk issues.

The first part of this note reflects briefly what we have learned from the experts: how a pandemic can develop from the bird flu, what a pandemic can look like, and what the likelihood is that we will have to deal with a pandemic in the coming years.

1.1. How influenza causes a pandemic

Definitions of a Pandemic

According to the World Health Organization,

a pandemic can start when three conditions have been met:

- *the emergence of a disease new to the population*
- *the agent infects humans, causing serious illness*
- *the agent spreads easily and sustainably among humans*

Wikipedia, the free Internet encyclopedia, advises that

*A **pandemic** (from Greek pan all + demos people) is an epidemic (an outbreak of an infectious disease) that spreads worldwide, or at least across a large region.*

AON: Pandemic Influenza, Managing the risks of an invisible threat, indicates that

"*A pandemic arises when a disease that affects at least 25% of the globe causes high morbidity, excess mortality and social and economic disruption. Pandemics always cause a sudden explosion of illness, putting health services under strain, and spread very rapidly around the world.*"

The H5N1 virus ("Bird Flu virus" in this text) has been spreading in the world since it emerged in 2003 in South East Asia. At present, humans can be infected by the virus only after intensive contact with infected birds. Once humans are infected, the death rate of known and reported cases has been very high, it would seem to be as high as 50%. However, it should be noted that "only" around 100 humans have been killed worldwide since 2003 until March 2006 because of the virus; all cases except a few unclarified ones were people who had intensive contacts with birds, for example children living at chicken farms.

The danger of a pandemic appears when the Bird Flu virus mutates or mixes with a Human Flu virus. Normally humans build up immunity against seasonal flu viruses. But nobody has built up immunity against a new virus that would be created through a major mutation of an old virus or through a mixing of genetic material between existing viruses. Such a new virus could then spread from human to human until it is defeated by other viruses, an immune system defence, vaccine or other medicines.

1.2. Recent history of pandemics

In the twentieth century the world was hit by three influenza pandemics:

1. **Spanish Flu, 1918** (H1N1)**:** This is seen as by far the most deadly influenza pandemic in recorded history (400 years). In a 'normal flu' 90% of the deaths are people older than 65 years. However, 99% of the deaths caused by the Spanish Flu in 1918 were people under age 65. Some assessments have indicated that its death toll worldwide was as high as 40-50 million people. However it is unclear as to how much these deaths were actually caused by the Spanish Flu and how many of them were actually due to other consequential reasons or as result of several factors.
2. **Asian flu, 1957**: The global death toll resulted in around 2 million (in the US this meant an additional 70,000 deaths that year), significantly lower than in 1918. It is also remarkable that the deaths were this time more amongst elderly persons and infants. The picture looks more like a normal seasonal flu, but with a much higher infection rate - more than 25% of the population.
3. **Hong Kong flu, 1968:** This flu had a similar pattern to the 1957 pandemic, but with clearly fewer deaths (36,000 in the US).

It is significant that for all three pandemics the spread over the world was very quick. For example, the Asian flu first emerged in China at the end of February 1957, reached Hong Kong by mid April and the rest of the world within the next 6 months.

Experts do not (yet) fully understand why the 1918 flu was as deadly as it was. 1918 was at the end of the First World War. Indeed in countries who were involved in that war the impact of the Spanish Flu was higher than in other countries not directly involved (e.g. in the Netherlands the extra mortality rate was lower than in Great Britain). Some experts believe that the combination with the tuberculosis epidemic that also appeared in the same period caused extra deaths.

Whatever the reasons were, in 1918 some virus strains were so fierce that people died directly of the virus attack, in some cases within eight hours of detecting the condition. During a normal flu, and also in 1957 and 1968, deaths occur mainly due to secondary complications like pneumonia, normally of bacterial origin. It is important to note that during all these pandemics the infection rate concerning the flu in question has been roughly the same: around 25% - 30%. Hence the differences for these pandemics would mainly be in their different mortality rates.

1.3. Will there be a pandemic?

Conclusively, history gives us little to go on in order to answer key questions such as "How likely is it that we will face a pandemic in the next few years?" "What will that pandemic look like?" "Will it be similar to the very grave 1918 scenario or more like the milder cases of 1957 and

1968?" Taking a precautionary measure indicates taking the Spanish flu scenario into consideration in our calculations.

Regarding the first question, "How likely is it that we will face a pandemic in the next few years?", experts have no doubt some pandemic will occur, the only question being when. Opinions on timing vary. Some experts state that the risk of a pandemic within the next 10 years is greater than 50%. This could be a "normal" influenza epidemic or one emerging from the Bird Flu. Statistically we could reason that there has been a pandemic in the world more or less every 40 years, with a duration in total of 1-1.5years. This means a probability of 3-4% for any given year to be that of a pandemic. The probability of world having continued without a pandemic for any given ten years would thus be roughly 70%. However, since we have had no pandemics since 1968, we are going on our 38th pandemics-free year. One could argue that the likelihood for the next 10 years to continue to be such would thus be lower than that for any given 10 years. Very theoretically one indeed could calculate that the probability of experiencing 47 pandemic-free years in a row – that is, the probability for the next ten years also to face no pandemics – is less than 20%.

It is still not clear how likely, or even whether, the present H5N1 virus could cause a pandemic. Some experts are of the opinion that this possibility is very low - were it to happen, it would already have happened because this virus has existed and expanded its territory since 2003. It is possible, they say, that the H5N1 virus is finally simply not able to mix or exchange genetic material with a human flu virus. Other experts see that the virus is still mixing within the same family of viruses so that at some point a mix with a human flu virus could be possible. Recent research reasons that due to the behavioural patterns of the H5N1 virus and the normal human flu virus, it is unlikely that they will mix.

If Bird Flu (H5N1) does not develop into a pandemic, it would of course be very good news. But notably other avian viruses can still cause pandemics. The H7N3 virus has recently been found in Vietnam, and it is not yet known what the impact of this virus could be. Furthermore the possibility still remains of a pandemic originating from swine flu or human flu viruses rather from bird flu.

Conclusions:
From a purely probability theoretical point of view, the probability for a pandemic to incur in any given ten years is roughly 30%.

2. CONSEQUENCES

2.1. Mortality

Experts do not know what the impact of a new pandemic could be. There is nothing like a best estimate scenario for its likelihood or frequency. The only possibility is to work with "what if" scenarios with different severities. There is, however, general agreement on the fact that the Spanish Flu scenario is very extreme, and is unlikely to happen in nowadays. The medical development since 1918 has been huge. Furthermore, we are now better prepared for a pandemic. Also the conditions in 2006 are better than in 1918 when the tuberculosis epidemic and First World War were notable factors. Therefore we assume that the 1918 scenario is an extreme one. The likelihood that a similar scenario will occur is estimated to be less than 1 in 400. As yet, there is no cure against the mutated virus. Scientists simply do not know what the virus will look like.

There are some medicines that slow down the infection, but they do not cure it. When a virus is identified; it may take up to 6 months to prepare a vaccine.

History shows that a pandemic normally comes in waves with a couple of months in between. The second wave is worse than the first one. Subsequent waves may be lower because of increased resistance against the virus. The combination of the availability of medicines that slow down the infection and the time between the first and second wave can help reducing the impact of the pandemic.

Several governments are preparing for a 0.25% excess mortality, a figure also used by the WHO, due to avian influenza. What would this excess mortality imply, firstly for the insurance industry, and, secondly, in general for society?

This impact depends on answers to several questions such as:

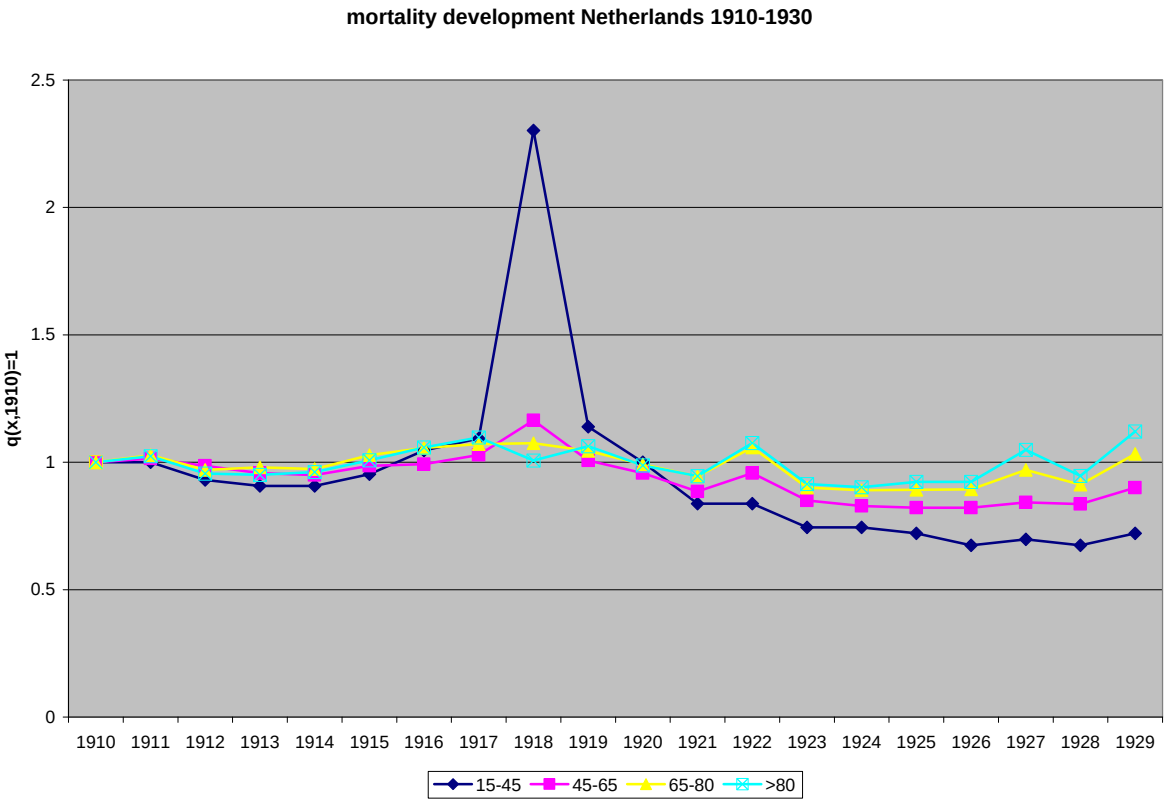
- Can the new virus easily infect humans?
- How easily can the virus transfer from one person to another?
- What is the ability of the new virus to make people ill, with possible death as a result?
- Incubation period?
- How fast can a cure be developed after the virus is discovered for the fist time?

Because this virus is still unknown, these questions can not be answered, and nothing can really be said about the possible number of deaths, and which one of the mentioned scenarios is more likely to apply.

Besides the extra claims because of deaths, an insurance company also has to deal with extra claims for health insurance. Other possible economic impacts, like a fall in interest rates or a fall of the stock market, should be considered. Except for the most extreme scenario, the idea is that these impacts are temporary. Also because of an estimated infection rate of 25%, each business should be aware of ensuing operational problems.

In order to find out what the impact could be for an insurance company if the worst case scenario becomes reality, we did some calculations with 0.25% excess mortality.

First of all, the deaths are spread over all the ages/gender. The question is whether the infection rate and the extra death rate will be age dependent. Looking at the Spanish flu in 1918, the mortality rate for some countries looks fairly constant over the ages. In the Netherlands, the impact on the younger ages was larger than for the older ones.



History shows that epidemics with a low mortality rate impact more on the older people; epidemics with high mortality rates impact more on the younger. The theory is that older people have built up a better resistance against the virus. Older people in 1918 had survived earlier pandemics around 1870, so were better protected against the Spanish Flu. Another explanation could be that in those days most of the people were younger than 65 (so bias in data). In the hypothetical analysis below, a constant, age-independent impact is assumed.

Some analysis based on recently published RIVM scenario for the Netherlands

Age group	pandemic deaths	normal deaths	Extra mortality
0-25	12201	2362	516.53%
25-45	12781	4631	276.00%
45-65	9609	20506	46.86%
65-85	4848	71736	6.76%
>85	561	35841	1.56%
total	*40000*	*135075*	*29.61%*

Based on 40,000 extra deaths (RIVM scenario, constant impact over ages and gender: 25% sick rate and 1% death rate)

Age/gender distribution Netherlands 1999

Normal mortality based on Dutch whole population mortality 1995-2000

Age group 25-65 (= positive risk group): 89.08%

Conclusively for an average portfolio, the impact of this scenario would be around 90% excess mortality. This is close to the 100% excess mortality which in some companies in the European Union Member States is assumed to be an extreme event. The real impact will depend on the composition of the portfolio (ages and distribution of the gender).

Normally the mortality for insured populations is lower than the average overall population mortality. We assume that, also for the impact of a pandemic, those insured are in a better health condition, and hence better protected against the flu. Therefore we assume for the insured population a death rate of 60% of the population death rate. The 0.25% extra morality for the whole population would therefore translate into a 0.15% rate for the insured population. Table 2 shows the impact for several European countries of this scenario.

Table 2

Additional Mortality due to Pandemic table with 0,25% additional mortality	
Country	**no of additional deaths**
eu25 European Union (25 countries)	**1.148.721**
be Belgium	26.115
cz Czech Republic	25.552
dk Denmark	13.529
de Germany	206.252
ee Estonia	3.368
gr Greece	27.689
es Spain	107.595
fr France	151.403
ie Ireland	10.273
it Italy	146.156
cy Cyprus	1.873
lv Latvia	5.766
lt Lithuania	8.563
lu Luxembourg	1.138
hu Hungary	25.244
mt Malta	1.007
nl Netherlands	40.764
at Austria	20.516
pl Poland	95.435
pt Portugal	26.323
si Slovenia	4.994
sk Slovakia	13.462
fi Finland	13.092
se Sweden	22.529
uk United Kingdom	150.086

Conclusion:
The excess mortality rate could be at the level of 0.25%. On the European level this would indicate more than 1.1 million deaths due to the pandemic.

2.2. Morbidity

As previously indicated, the impact on morbidity – the infection rate in this context, seems to be rather independent of a specific pandemic and to remain at the level of 25%-30%. This would indicate significant figures in absences and an immense burden on the public health care systems. As one can safely expect the health care personnel to experience at minimum similar infection rates as their patients, it is clear that the reduced amount of personnel combined with the increased amount of patients would lead to an exponential additional load. Evidentially part of this overflow would flow into the private health care systems, which would be struggling with their own patients already, with the same problems of lack of staff. In particular, insurers and health service providers with guaranteed service levels would experience problems. Table 3 gives the number infections assuming the infection rate of 30%.

Table 3[1]

Infection rate table Additional infection rate of 30% due to pandemics	
Country	**no of infections**
eu25 European Union (25 countries)	137.846.520
be Belgium	3.133.770
cz Czech Republic	3.066.180
dk Denmark	1.623.420
de Germany	24.750.240
ee Estonia	404.100
gr Greece	3.322.710
es Spain	12.911.400
fr France	18.168.360
ie Ireland	1.232.760
it Italy	17.538.720
cy Cyprus	224.760
lv Latvia	691.920
lt Lithuania	1.027.590
lu Luxembourg	136.500
hu Hungary	3.029.250
mt Malta	120.810
nl Netherlands	4.891.650
at Austria	2.461.950
pl Poland	11.452.140
pt Portugal	3.158.790
si Slovenia	599.280

[1]population statistics: Eurostat

sk Slovakia	1.615.440
fi Finland	1.570.980
se Sweden	2.703.420
uk United Kingdom	18.010.350

It is to be expected that the pandemics come in waves, the first of which is the dangerous one, if vaccines have been created for the second and possible third ones. Absences of this magnitude would take place during this first wave, duration of which can be presumed to be around two months.

Conclusion:
The infection rate could be 25%-30%. On the European level this means that 110 Million to 140 Million people would be infected during two months.

2.3. Economic impacts (WD)

2.3.1. GDP

The economic cost of pandemics, defined as an output loss (in % of GDP), is a controversial subject. The main reason for concern at present is the fact that it is likely that flu pandemics in particular could cause a global economic shock. Globalization and cross-border connectivity significantly alter the transmission mechanism of the next pandemic relative to those of the past, reducing the absorption capacity. Most economies will not be able to shrug off exogenous shocks by reallocating capital and jobs to where they can be used relatively more safely and therefore productively.

Even though the pattern of economic impact will remain largely similar throughout the globe, the actual extent of the impact of the pandemics will be country specific. The bigger the economy the better it is able to absorb shock more easily. The openness of an economy would also be considered a negative factor, with the countries dependent on foreign capital and international trade being the most affected. In addition, the countries with market structures with less regulation of capital and labour markets will be able to recover quicker. Finally, the extent of the disease's spread will play a crucial role, resulting directly from a country's ability to contain the disease and re-establish regularity.

Historical evidence and current estimates

In recent years there have been several internationally spread diseases that resulted in significant economic costs:

- BSE – mad cow disease, (1996 – 1997): for UK only – 0.5% of GDP.
- FMD – foot and mouth disease, (2001 – 2002): for UK only – 1.2% of GDP, mainly in agriculture / food chain (30%) and tourism (50%).
- SARS – severe acute respiratory syndrome, (2003): East Asian economies – 0.6% of GDP (ADB) – 2.0% of GDP (WHO), even though only about 800 people ultimately died from the illness.

In the above-mentioned examples, the overall effect on the economy was rather small, however losses that have been incurred by particular sectors or within certain sectors were considerable.

Several research centres and international organisations, mainly by analysing historical patterns, have already carried out analysis of potential costs of avian flu pandemics. Up to date, the ongoing outbreak of highly pathogenic Avian Influenza in Asia has led to the death or culling of over 125 –

140 million birds, leading to economic losses estimated at EUR 8-12 billion (0.1% of GDP) and the death of around 60 people.

The estimates of economic costs of human flu pandemics vary substantially depending on the scenario assumed. The average approximation of the economic cost lies between 0.6% - 1.3% of GDP loss (US National Center for Infectious Diseases – 1999). The World Bank estimates warn of costs reaching up to 2% of GDP of affected countries, while the Asian Development Bank (2005) cautions that the costs can reach up to 6.5%, especially in cases of more vulnerable Asian economies. To illustrate the extent of possible impact, 2% of global GDP represents US$800-1000 billions.

It should however be stated that historical evidence proves that following a major economic downturn, any economy exceeds its normal development rate once the shock is absorbed and operational stability restored. In addition, these analyses do not take into account different exposure to the infection of various groups, as well as dissimilarities between various countries. In addition, it ignores the fact that increase in costs in some cases will be partially mitigated by decrease in others, as the distribution of resources will change.

The following analysis indicates factors to be considered in the calculations.

Calculation of the economic cost of pandemics

In calculating the economic costs of pandemics, the division between the immediate and long–term effect has to be made. The length of each phase will depend largely on the duration of the actual pandemics. The demand shocks have greater effects immediately than in longer terms, while supply shocks affect mostly in short–term and the patterns are just carried over to long-term. Below are some findings clearly demonstrating the different nature of immediate and long–term effects, hence affecting different industries.

Immediate effects (epidemiological uncertainty)

Apart from official efforts towards containment of the spread of the disease causing the pandemic, other immediate effects would be rather psychological, therefore would probably be short lived, and would not exceed more than 4-6 months.

On the demand side, the economic costs would not only include the preventive, control and coping strategies adopted by the public and private sectors to avoid or reduce illness and death, comprising also prevention and potential treatment of infected people and animals. The most immediate economic impacts of a pandemic might arise not from actual death or illness but from the uncoordinated efforts of private individuals to avoid becoming infected. Over-reaction to the actual threat can result in panic behaviours and thus the economic impact could be magnified.

Conclusively, on one hand the demand for health related products will increase, while on the other hand the demand on other areas would be reduced. The impact on the industries will be largely distributional, with gains going to sectors that used the depressed commodities, against the hit to the export industries. The following parts of the economy could be affected:

- Impacts of increasing demand:

  Health care system - hospitalization and medical treatment.

  Pharmaceutical companies - manufacturers both of medicines and vaccinations. (In the short – term these could be net beneficiaries in terms of market value, however in the long – term it is harder to estimate since likelihood of compulsory licensing may have an impact.)

  Masks, gloves, antimicrobials and other sanitary improvements

  Costs of surveillance, inspections and potentially costs of birds culling.

- Impacts of decreasing demand (people trying to avoid infection by minimizing face-to-face interactions and contacts with some food):

    Food manufactures (poultry producers in case of avian influenza) – despite substantial losses of poultry due to the disease and to culling, in some countries the public demand for poultry products decreased by 20%-30%. It also affects upstream and downstream sectors such as poultry traders, feed mills, breeding farms etc. The effect is rather limited on the macroeconomic scale; however it is very severe for the industry itself.

    Retail/shopping – the commodity prices are likely to drop as a consequence.

    Restaurants

    Mass transport

    Leisure and tourism

    Education systems

On the supply side, the main economic cost is a result of the increased illness and death among humans and animals. This would eventually lead to workplace absenteeism, disruption of production processes, shifts to more costly procedures and eventually less productivity. If psychological impact of the pandemic is especially severe, the absenteeism of otherwise healthy workers can also be expected. This subject will be discussed in detail in Section 2.3.3.

The supply side related costs are estimated to account only for 10-15% of all immediate effects as most of cost is caused by demand shocks.

Long term – effects (economic uncertainty)

Long – term effects mainly result from reduced demand, and the decrease in both domestic and foreign confidence. Depending on the type of the economy these costs can exceed the immediate effects by three or even more times, as they result from decreased overall efficiency of the whole economy.

The Asian Development Bank, analysing Asian economies, warned in its report that long term costs can exceed short – term costs by a factor of 3-times, and can reach up to 6.5% of the a economy. As European Union economies on average are much more stable than Asian emerging markets, their costs will be lower with trade companies being the most affected.

Decrease in domestic and foreign confidence may potentially lead to:

increased risk to domestic and foreign investments

weakened small and medium size enterprises (SMEs) as opposed to multinational corporations (MNCs)

increased inventory stockpiling – no “just-in-time” inventory management

decrease in world trade

However, on the other hand, these costs can be largely reduced by means of efficient public information and communication. There is a need to reassure the public in order to avoid large over-estimation by private individuals of the perceived probabilities of infection and death. This is necessary to minimize panic and disruption and indeed to mobilize the public as a key partner in beating the disease.

Conclusion:

The cost estimates of a pandemic vary from 0.5% - 6.5% of GDP. These costs could be magnified substantially by lack of efficient and timely public information and communication. Indirect (long–term) costs would significantly exceed immediate costs (short – term).

2.3.2. Financial markets

The financial markets hate uncertainties. A pandemic would therefore certainly take its toll. Firstly, the investors would diversify into safer investment options ('flight to safety'), like government bonds, gold or even cash. However, in cases of pandemics, this phenomenon can be less profound. Bearing in mind that the threat of a pandemic has already been under discussion for some time, the financial markets have by now partially incorporated that risk into their investment strategies. This current diversification is however still mainly driven by unstable oil prices and the risk of higher inflation. The gold price, so-called index of fear, has already reached its 25-year high.

Nevertheless, and particularly since a flu pandemic would be likely to be global and occur simultaneously globally, there is a risk that international markets would respond to this systemic risk in a correlated movement, reducing the gains from international diversification of assets and penalizing investors with highly leveraged positions.

Equity prices would be likely to fall sharply, reflecting the huge economic and profit uncertainty. A drop of 15%-25% is probable, as investors tend to overreact to bad new in good times (and under-react to good news in bad times), reflecting their risk aversion and their willingness to hedge against higher uncertainty. The sell-off would also, and immediately, include corporate bonds, so credit spreads would surge and new issues would be impossible. Commodity (base metal, coal, steel) and real estate prices would decline less profoundly.

The extent of sell-off in equities and corporate debt would to a large extent depend on the degree of leverage in the market. Because interest rates globally have been relatively low and confidence quite high over the last three years, the leverage is unusually high. However, if historical patterns were to be repeated, share markets are likely to rebound, as early as the market operators anticipate that the pandemic is over, even though the actual economic conditions might still remain bleak.

Consequently there would be a sustained rally in sovereign OECD government bonds. The currency markets impact would favour safe currencies with deep sovereign bond markets, against any emerging market currency.

Despite a preparation phase, and implementation of Business Continuity Plans, the flu pandemics would also adversely affect the banking system. The majority of banks' balance sheets would deteriorate through asset devaluation, which would be additionally intensified by many debtors' difficulties in meeting short term financing commitments.

WHO argues that in case of pandemics, the capital markets may even suspend their operations for some time. This situation would be unlikely as there are many instruments for absorption of shock of this magnitude.

The main tool is a monetary stimulation. Even though - as a consequence of pandemics - many governments would face fiscal imbalance, the majority of central banks all over the world would be under tremendous pressure to pump liquidity into the markets and hence a sharp decline in interest rates could be expected. A significant slowdown in any region of the world would also

reduce the capacity to buy the most popular sovereign bonds i.e. US and EU treasuries, which is frequent especially among Asian economies, thus adding to the pressure for an interest rates cut. The monetary stance may be eased, as central banks would also need to ensure an adequate supply of cash notes and capacity to deliver them to the financial institutions.

In addition, in the situation of a massive panic, it would be likely that as a result of banking / clearing systems overload, the demand for cash would increase dramatically thus causing severe liquidity crisis. This would additionally reduce the efficiency of the economy in the short term.

Conclusion:

Flight to safety – diversification to safer investments. It is likely that a rebound would follow the first devaluation of most assets resulting from the shock. In many countries, the shock on capital markets could be self–correcting, while in others further steps to restore macroeconomic stability and fiscal sustainability would be needed. Interest rates would be likely to be reduced to stimulate recovery. Financial institutions would be struggling not only with overall economies' decline but also potentially with tougher solvency and risk management regulations.

2.3.3. Operational consequences - impacts on absences

Absences in a case of a highly contagious disease are dependent on family structure. It is clear that the absence rate would be higher than the infection rate, as people would have to stay home taking care of their ill family members. It can be assumed that public advice may also indicate it wisest to stay home instead of spreading the disease at the work place and in public transport once a member of family has fallen ill. Although there are various uncertainties, some assessments can be made.

As a "lighter version" we assume that if a member of a family falls ill with the pandemic, the probability of that resulting in an absence of all family members is 80%. Moreover, this lighter scenario assumes the duration of absence to be 5 days. Whilst we assume that across Europe we would find 110 million people infected, there would be 80 million cases of absence. If these all take 5 days, allowing for some overlap when family members are ill, this would result in a significant figure of 3 million years of absence. This scenario would result in 42% of the working population being absent from work at least once due to the pandemic hitting him/her or a family member. All this absence distributed over a period of two months would mean an average of 6% of working population absent in average.

A more severe scenario would indicate a fierce virus that is highly contagious. Whilst the mortality and morbidity figures would remain the same, the duration of the illness would be 20 days and the need for a member of a family to stay home in case of illness within the family would be clear. Implications for the functioning of European markets would be heavy indeed with a total of 10 million years of absences from work during the two months the pandemic would strike. These figures would clearly affect normal functioning of basic services such as food and waste logistics, electricity, gas, hospital services. The world would enter into a crisis due to malfunctioning of these services. In this model more than 50% of the working population would be at least once absent for the duration of 20 days due to his/her own illness or that of a family member. On any given day an average of 28% of the work force could be absent.

The impact of these absences would be heavy in all areas. However, the public and private health services would experience a very heavy burden. The impact is hard to calculate, lacking data of doctors' visits. Nevertheless, with the assessments above, the mild scenario of 6% absence rate of

the working population and an assessment of 20% increase in doctors' visits could lead to almost 30% increase in burden for those remaining at health care work. We can well expect the overflow from the public health side to lead to an increase in private health care demands. In this scenario that could add to the work load for those remaining at work by almost 40%.

In the scenario where, due to the seriousness of the illness, an increase of 50% occurs, and due to the pandemic 28% of health care staff were absent, the work load in number of patients to care for could double for those remaining at work, and the demand for private care could be four times higher than normal. Obviously these figures would not be possible, but some part of the population could not receive the necessary health care services. This could in turn further increase the mortality rates.

Conclusion:
On the European level there would be 80-90 Million cases of absences from work. Depending on the severity of the virus, total absence could be between 3M and 10M man years. 42% to 50% of the population would be absent from work at least once due to the pandemic.
An average absence rate during the two months would vary from 6% to 28% of staff depending on the duration of the illness, taking into account stay at home due to family members being ill.
The health care providers would experience a double impact due to lack of normal staff and an increase in number of patients. For private health carers this could be accelerated due to overflow from public to private services.

3. Impact on Insurance Companies

3.1. Economic impacts on insurance

The analysis of economic costs demonstrates that a substantial part of the costs of pandemics borne by the insurance industry would be consequences of an economic downturn. Another important aspect are the consequences due to an increased number of claims.

As far as amounts of claims are concerned, depending on the scenario, the US authorities estimated they could range from US$31 billion (1957/1968 type pandemics) to US$ 133 billion (Spanish flu type pandemics) in death claims for US alone. In some countries, like the UK (and the US) much of the mortality risk is reinsured and would be born by the reinsurers. In such countries, it could be estimated that around half of the mortality shock would be born by the reinsurers and half by the direct insurer. Only a very small percentage would be born by the capital market through mortality bonds and other securitization arrangements. In other countries with less dependence on reinsurance, most of the mortality chock would have to be absorbed by the direct insurer.

The economic recession could also be expected to have indirect impacts. Firstly, in the short-term after a pandemic commences the demand for insurance products would surge, as customers are expected to switch to more basic products and services. Nonetheless, this effect would be partially offset by likely increase in the demand prior to the outbreak of pandemics.

Secondly, the insurance companies' funds would be managed less efficiently. The capital markets would operate less cost-effectively and be regarded as more risky, thus leading to switch to less efficient but safer methods of investment. The impact would largely depend on the length of the pandemic. Lost investment opportunities could be then recovered to a degree following the recovery of the economy.

The exact extent of economic impact on insurance companies is difficult to calculate; however it is highly likely that the overall drop in economies' efficiency would leave the insurance industry as one of the most severely affected.

Conclusion:

Indirect economic costs are likely to exceed direct costs resulting from increased claims. Global character of pandemics makes cost-minimizing diversification of assets less effective. Impact of overall economies' decline but also with tougher solvency and risk management regulations would be felt severely by the insurers.

3.2. Life insurance

The effect of increasing mortality in life insurance may be in either direction because of different constructions of the two building blocks, death benefit and savings part, which is sometimes called pure endowment or longevity benefits. These parts act in different directions in case of increased mortality.

Longevity benefits are paid if the insured is alive at a certain, pre-agreed age. The continuing trend of increasing life expectancy has caused losses for insurers in the past on insurance policies of this type. Increasing mortality may mitigate past losses, partly or totally. Further increase in mortality would be profitable to the insurer for these policies.

Death benefits, on the other hand, are paid as a lump sum to beneficiary (often widow/widower and/or orphans) if the insured dies. Increased mortality will cause losses from these policies to the insurer as the provisions and rates have been calculated according to a lower mortality and hence would not be sufficient to cover the claims.

The total impact is either loss or profit, depending on the portfolio of the insurer. For most life insurers, the death benefits form normally the majority of the life policies underwritten, thus one can expect loss rather than profit. For combined life and pensions insurers, the effect might be the opposite.

The required solvency margin for mortality risk in the European Union is 0.3% of sums at risk for individual policies and 0.1% for group policies, the total therefore being in between, depending on the mix of the portfolio. Thus, excess mortality of 0.15% or 0.25% due to pandemic would be around the same magnitude as the required solvency margin. The impact of such pandemic may therefore be that insurers with available solvency margin below double the required solvency margin may not fulfil the solvency requirements and therefore would need new capital to continue their business. One may hope that the life insurance industry looks lucrative enough in those circumstances to attract new capital – otherwise several companies with tight margins would face the threat of insolvency.

Conclusion:
The impact could be serious for life insurers, depending on the insurance portfolio. Increased mortality could cause losses for which the company may not be sufficiently prepared.

3.3. Pensions

As is the case for life insurance, the effect of increasing mortality in pension insurance may be in either direction because of different constructions of two building blocks, old age pension and survivors' pension, acting in different directions in case of increasing mortality.

An old age pension is paid if the insured is alive at the pre-agreed age. The continuing trend of increased life expectancy in pension insurance has also caused losses for insurers in the past. Increasing mortality may mitigate past losses, partly or totally. Further increase in mortality would be profitable to the insurer.

Survivors' benefits are paid as a pension to widow and orphans if the insured dies. Increasing mortality will cause losses to insurance companies underwriting survivors' benefits. The amount of loss in each individual case may be heavily dependent on the ages of widow and children, if any.

The total impact is either loss or profit, depending on the portfolio of the insurer.

For those pension insurers whose policy mix is concentrated in old age benefits conclusively there will be no solvency problems due to pandemic mortality.

For those pension insurers whose policy mix is concentrated on survivors benefits, solvency may be an issue. The required solvency margin for mortality in European Union is 0.3% of sums at risk for individual policies and 0.1% for group policies, the total being in between, depending on the mix of the portfolio. Therefore, excess mortality of 0.15% or 0.25% due to pandemic would in this case also be around the same magnitude as the required solvency margin. The impact of such pandemic may therefore be that insurers with available solvency margin below double the required solvency margin may not fulfil the solvency requirements and therefore need new capital to continue their business. Again, should that not be available, some insurance companies could face insolvency.

Conclusion:
The impact could be serious for pension insurers with emphasis on survivors' benefit product, this depending on the insurance portfolio. Increased mortality could cause losses for which the company may not be sufficiently prepared.

3.4. Health

Health insurance includes benefits due to sickness, such as

- daily allowance in case of disability
- lump sum payment in case of permanent disability
- medical expenses caused by illness
- daily allowance in case of hospitalization
- benefits in case of defined sicknesses (sometimes called Critical Illness insurance)
- benefits in case of incapacity to take care of oneself (sometimes called Long Term Care Insurance)

The effect of increasing morbidity on health insurance is in general smaller than that on life insurance. The main insurance product to face extensive expenses is the basic insurance covering doctors' and hospital visits and medication. Notably, however, this is often the most common health care insurance product.

Regarding the listed health care insurance products, one can assume the following impacts: Daily allowance in case of disability is paid after a specified waiting period, usually at least 21 days. If the average duration of sickness were to be around 10 days, then this would not be not long enough to give right to daily allowance. This means that this type of insurance would probably not face increased claims.

Lump sum in case of permanent disability would not be badly hit, assuming that almost all would recover – or, unfortunately, die. Normally influenza pandemics themselves do not cause disability – their consequential illnesses, nevertheless, might do so. They might lead to some increases in lump sum disability payments. However, one should not forget that pandemics due to other causes may act differently. Moreover it should be noted that high fever can in extreme cases cause disability which could be covered under this insurance product.

Medical expenses caused by sickness will be severely affected because of the increasing use of medical services. The size of the effect will very much depend on the detailed policy conditions. Policies which mainly cover planned services like operations would be less hit, while policies which mainly cover acute needs would be very heavily hit. However the capacity of the medical industry will present some limit to the increase in claims. Those insurers who guarantee their customers a level of services in terms of waiting time or services' availability would face problems. If these guarantees were not met, they could also face losses.

Daily allowance in case of hospitalization would increase too. However, here also the total amount of claims would be limited by the total capacity of hospitals.

Benefits in case of defined sicknesses would probably not be hit by a pandemic, because illnesses that can create a pandemic are usually not listed among those illnesses giving right to benefit.

Finally, in the case of insurance against incapacity to take care of oneself, namely long term care insurance, the insurance claims relate typically to the elderly population, when weakness caused by advanced age causes permanent incapacity to undertake everyday necessities. This type of insurance would mainly experience profits due to increased mortality, as the period of illness due to a pandemic illness is not sufficient to justify benefits and any incapacity would not be expected to be permanent..

Regarding health care insurances in general, the required solvency margin is around 18% of premiums or 26% of claims. This is lower than in life insurance which is why the possibility of solvency problems due to morbidity in health insurance may be larger than due to mortality in life insurance. This risk is however decreased by the fact that the health care services have a limit up to which they can take care of patients. Exceeding this limit would leave people ill but would not increase health care insurance expenses. However, depending on the seriousness of the pandemic, it could further increase mortality as patients not receiving needed treatment might die. This might cause further problems to life insurers but would not affect health care insurers.

Conclusion:
A pandemic could have a significant effect on the health insurance industry.

3.5. Non-life

Non-life insurance is less clearly affected by possible pandemics. The indirect consequences come in the form of uncertainty of adequacy in value of funds involved and in possible additional risk experienced in several fields due to lack of competent permanent staff

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The possible significant increase in absences described above could have two-fold consequences: Firstly, it would have an impact in business interruption and corresponding insurance products could experience considerable amounts of claim requests. Secondly, importantly, as the whole society structure would experience absences, it would be open to new risks. These risks would result from lack of competence and manpower in running the key processes of the society.

It is clear that, where the pandemic is linked to an animal disease, such as Bird Flu, the effect can be massive on that livelihood. Consequently corresponding insurance products will experience an excessive amount of claims. However, at present these areas are mainly co-financed by the European Commission, the Member States and the farmers themselves. The farmers' part of the expenses may be covered by voluntary or other insurance schemes. For an insurer specialising in this area the risk increase will be clear regarding these insurance types. Most importantly, of course, for the farmer in question such a disease may at worst indicate loss of complete livelihood with very heavy re-starting costs. These losses can at worst result in permanent changes in the structure of the European agricultural area and may bear heavy implications to the society and Member States as well as the European Commission.

Finally, it is difficult to assess changes to risks in motor third party liability insurance and other motor car insurance or travel insurances. Pandemics could mean losses to the travel industry, but probably fewer losses – and less income - for the travel insurance industry. Possibly also motor insurance could experience a decrease in losses due to decreased circulation, but pandemics could increase driving by those who are not used to driving regularly, indicating a possible increase in motor insurance claims.

From the economical point of view, it is clear that non-life insurance funds would face the same risk as other insurance types – life and health insurances. Most non-life insurers, however, are following a rather safe investment policy with a low exposure to equities and with a good duration match between assets and liabilities, thus the problems are less than for most life insurers
Non-life solvency margins are (mainly) defined as a percentage of premiums. As most non-life business lines would not be heavily affected by a pandemic, so their solvency position would not be much affected. It could be noted, finally, that many non-life insurers have catastrophe reserves that could be released in case of heavy increases in claims.

Conclusion:
Non-life insurance would probably not be very much impacted by a pandemic, except maybe for some special lines like business interruption.

3.6. Reinsurance

The impact of a major pandemic on a reinsurer mainly follows the effects on direct insurance. A few short comments could however be made:

It will mainly be life reinsurance that will be affected. Pure life reinsurers will have most problems, while composite reinsurers will have much more internal risk diversification and therefore fewer problems.

Within life reinsurance, problems will mostly affect those reinsurers who concentrate on pure mortality risk. Those who are diversified with disability, critical illness and other risk products will have a better situation. One option could be to retrocede the mortality risk into the financial market through mortality bonds, the way a few reinsurers have already done, even though the market for such bonds is probably limited.

Reinsurers with a high proportion of older reinsured risks will be in a better position than those with younger risks, since a pandemic is expected to hit younger persons relatively harder than older persons.

Some risk mitigation could be done through the writing of longevity risk, even though such risks are mostly for elderly people for whom the pandemic mortality might be different from that for the younger people who normally have life risk. If the longevity risk is written with large margins, returned to the client through profit participation, then the hedge will not be efficient.

If the mortality risk is written with large margins and profit participation, then loss carry-forward provisions will mean that no profit commission is paid in the following years. The loss during the year of the pandemic would therefore partly be compensated by future profits and thus by an increase in Value of Business in Force for the reinsurer.

Reinsurance of lapse risk will probably not be a major problem in a pandemic. One could expect some lapses since economic problems might lead to problems for some people to continue their premium payments. On the other hand, the pandemic as such will make most insured more eager to retain their protection.

Reinsurers who are exposed to financial risks from their cedents may have problems if the cedent has financial problems as the result of a pandemic.

Reinsurers who are exposed to medical expenses business might be heavily affected, depending on the conditions of the original policies.

Reinsurers are normally not very exposed to the financial market. Non-life reinsurers with long term business with high reserves are normally invested in matching bonds and not equities. Life reserves are normally deposited with the cedent or not reinsured at all, why life reinsurers normally have very low reserves. The net reserves after deferred acquisition costs could in some cases be negative.

As for direct reinsurers, there could be liquidity problems also for life reinsurers, depending on the type of assets it has invested in and on how fast it has to pay claims.

Conclusions:
The effect on reinsurers would mainly be for reinsurers who write only or mainly life reinsurance, especially those exposed to mortality risks. Also reinsurers exposed to medical expense risk could be affected, depending on policy conditions.

3.7. Consequences on Future Solvency Requirements?

One part of the Solvency II rules (Pillar 1, life and pension insurance) will include the definition of the solvency requirement for calamity risk. At the moment it is planned to set the solvency requirement at a confidence level based on 99.5%. It looks as if the described scenario based on "Spanish Flu" statistics could be used for Solvency II. This means that the solvency capital for calamity risk should be based on an age-independent excess mortality of 0.15%, assuming that pandemic is the most important threat for life and pension insurance. Regarding health care insurance, the application of experience from Spanish Flu is less straightforward due to lack of information on morbidity caused by that pandemic. It is not clear if the presently required solvency margin of three months claims expenditure in health insurance is sufficient, compared with the present one to three years claims expenditure required in life insurance. It could be useful to ensure that these requirements are reviewed from the viewpoint of pandemic risks in the Solvency II process regarding health care insurance.

Finally, regarding non-life insurance, except for some special lines of insurance, pandemics would seem to have little impact on solvency requirements.

4. Conclusions

This reflection has focussed on two areas: firstly, whether actuarial methods can give more insight to the impacts of a pandemic. Secondly, how a global pandemic could impact the insurance industry and how – or whether – the industry should prepare for that situation. There is a lot of information and speculation, but little certainty on issues relating to pandemics in general, and to Bird Flu in particular. The few calculations necessary had to be based therefore on various assumptions using the little actual data available, thus limiting the possibility of carrying out any sophisticated analysis. Some conclusions could nevertheless be drawn: the economic consequences of a pandemic could be very severe, possibly exceeding, for the insurance industry, the consequences of an increased insurance risk. In addition to economic consequences, the absenteeism could have a significant impact on all areas of employment. Naturally the health care providers could be heavily overloaded due to their own absenteeism and increased numbers of patients.

The report assesses that the world should prepare for an excess mortality of 0.25% and this to translate to 0.15% excess risk for those insured. It also assesses the probability of a pandemic in the next ten years to be high. The excess deaths would be more than 1 million in the European Union itself and more than 110 million could fall ill. Depending on the severity of the pandemic, there could be an absence rate of up to 28% of staff during the first wave of the pandemic. Its cost estimates vary from 0.5% to 6.5% of the GDP, depending largely on the duration of the pandemic and effectiveness of response measures. All these figures are high and would have serious implications to the functioning of society. The long term effects would significantly exceed the short term effects. The key factor in economic consequences would be appropriate and timely communication to avoid social panic and business uncertainties.

As regards the insurance industry, life insurance is likely to be the most heavily hit as well as corresponding areas of pension insurance. The impacts on health care insurance would also be severe, and some areas of non-life industry would be likewise affected. In general, pandemics would probably be least felt in non-life and its reinsurance industry. Considering the solvency requirements and the Solvency II project, the calamity risk provisions could be reassessed to ensure that a possible pandemic is taken into consideration.

This report combines the specific knowledge of qualified actuaries with more general expertise of the European Commission officials. The significant amount of uncertainty on the impact of potential pandemics still remains, however the report throws some light as to the mechanisms behind pandemics and may allow for more accurate predictions when more data is available. Moreover, for the insurance industry the report gives some practical proposals.

In the future, as yet unknown how soon, we may be faced with a global pandemic. At the time of finalising this report – May 2006 – it is not yet clear whether a family of 6 in Indonesia that has died from the Bird Flu virus in recent days had caught it via human to human transmission that could develop into a pandemic although it seems very unlikely. However, should it be so we are one step closer to a pandemic.