

# **Study of the Effect of a Flu Pandemic on Economic Values**

## **Using the Delphi Method**

Project Oversight Group  
Tom Edwalds, Chair  
Scott Cochran  
Robert Gleeson  
Max Rudolph  
Bill Sayre  
Jan Schuh, SOA staff  
Ronora Stryker, SOA staff, Principal Investigator

May 2007

Please direct questions and comments to:  
Ronora Stryker  
SOA Research Actuary  
[rstryker@soa.org](mailto:rstryker@soa.org)

## TABLE OF CONTENTS

Introduction	1
Summary of Individual Responses	2
Question 1	3
Question 2	4
Question 3	6
Question 4	7
Appendix A Study Participants	9
Appendix B Round One Questionnaire	10
Appendix C Round Two Questionnaire	15
Appendix D Round One Individual Responses	20
Appendix E Round Two Individual Responses	38

# Study of the Effect of a Flu Pandemic on Economic Values

## Using the Delphi Method

### Introduction

The SOA initiated and sponsored a research project studying the potential impact of a pandemic on the U.S. life insurance industry. A committee was established to oversee the project and to work closely with the researcher, Jim Toole of MBA Actuaries, in finalizing the project report to the membership. Recognizing there are few studies that exist offering insights into how a flu pandemic might affect insurer assets values, the oversight committee (“POG”), performed a Delphi study examining potential economic effects of a flu pandemic. While historical data from past pandemic periods exist, the applicability of the results from these analyses to today’s economic environment is unclear.

The POG surveyed life insurance industry experts for their judgments on how a flu pandemic might affect U.S. asset values. Three asset classes were examined, the S&P 500 index, Aa Corporate Bond Yield and the Federal Funds Rate. Study participants were asked to provide estimates of the maximum change in the values of the asset classes within 180 days from the onset of the flu pandemic in the U.S. Two pandemic virulence scenarios were analyzed; a moderate scenario similar in severity to the 1957 pandemic and a severe scenario similar in severity to the 1918 pandemic.

In addition to the estimates for the maximum change in the asset value classes, participants provided their assumptions and reasoning for the estimates as well as future developments that might impact the estimates.

SOA staff executed the study on behalf of the POG. Two survey rounds were performed. The responses garnered by the initial survey questionnaire (Round One) were tabulated and analyzed. A summary of the results was fed back to participants for consideration in responding to a second survey (Round Two) containing the same questions as posed in the initial round. At the conclusion of the second round, responses again were synthesized and results from this round as well as the initial round were given to the POG and researcher for examination and possible inclusion into the final pandemic research report, “Potential Impact of Pandemic Influenza on the U.S. Life Insurance Industry,” by Jim Toole.

Although the number of questions was limited in each round to encourage participation, few responses were received making it difficult to analyze and interpret the results. Thus, the results of this study were not utilized in the SOA’s larger study on the potential impact of a flu pandemic on the U.S. life insurance industry.

A summary of the individual survey responses are shown in the following section. The opinions expressed by the participants were interesting and diverse. While very little consensus exists among the participants concerning the estimated change in asset values as a result of a flu pandemic and the reasoning for the estimates, the responses do uncover some of the methods, thought processes and considerations in developing such estimates.

## Summary of Individual Responses

Twelve individuals participated in one or both rounds of the study and the list of participants can be found in APPENDIX A. To encourage participation in the study, questions for each round were limited. In total, the study contained 4 distinct questions. All questions appeared in both survey rounds. The questionnaires for each survey round are shown in APPENDIX B and APPENDIX C.

In each survey round, background information regarding flu pandemics was provided for a participant’s consideration in responding to the survey. Included in the information was the U.S. Department of Health and Human Services’ (HHS) projection for the number of excess deaths as a result of a flu pandemic:

*Under a moderate scenario similar to the 1957 pandemic, the estimate of the number of excess U.S. deaths is 209,000 (approximately .7 excess deaths per 1000). For a severe pandemic scenario using mortality rates similar to 1918, the projected excess deaths are approximately 1.9 million (approximately 6.5 excess deaths per 1000).*

These projections are the underlying assumptions for U.S. general population excess mortality in the SOA’s pandemic research examining the impact of a pandemic on the U.S. life insurance industry. Thus, in responding to the questionnaires in each round, participants were to have assumed that a flu pandemic had occurred, medical technology and transportation patterns at time of occurrence were similar to today, and the HHS projection for excess mortality was accurate.

In addition to the virulence assumptions, participants were given information about possible macroeconomic effects of an avian flu pandemic that was prepared by the Congressional Budget Office (CBO). Per the Dec. 2005 report, “A Potential Influenza Pandemic: Possible Effects and Policy Issues“, the CBO estimates:

Virulence Level Scenario	Change in GDP
Mild/Moderate (Approx. 100,000 deaths)	Real GDP would be about 1.5% lower relative to what would have happened without a pandemic
Severe (Approx. 2 million deaths)	Real GDP would be about 5% lower over the subsequent year

A summary of the individual responses for each survey question is presented below. Individual responses for each survey round can be found in APPENDIX D and APPENDIX E. The same respondent numbers are used in both rounds so that the reader can review an individual's response from round to round. For example, a "Response 4" in Round One and a "Response 4" in Round Two are attributable to the same study participant.

**The results provided represent the estimates, rationale and opinion of the study participants. It is not to be assumed that these results are indicative of the estimates, rationale, views and beliefs of other individuals, study panels, insurers, or companies.**

**Question 1: Estimated asset values**

In this question, participants were asked to provide their judgment for the maximum change within 180 days from the onset of a flu pandemic in the U.S. Table 1 shows the mean and median of the 12 responses received in Round One. To illustrate the wide range of opinion observed in the responses, the minimum and maximum values for each asset value estimate is also presented.

Table 1  
Moderate Scenario (209,000 deaths)

	Maximum % Change in S&P 500 Index within 180 days from the onset of the flu pandemic in the U.S.	Maximum Change in Aa Corporate Bond Yield within 180 days from the onset of the flu pandemic in the U.S.	Maximum Change in the Federal Funds Rate within 180 days from the onset of the flu pandemic in the U.S.
Mean	-11%	28bp	-27bp
Median	-6%	10bp	-50bp
Min Value	-2%	-30bp	-100bp
Max Value	-30%	100bp	100bp

Severe Scenario (1.9 Million deaths)

	Maximum % Change in S&P 500 Index within 180 days from the onset of the flu pandemic in the U.S.	Maximum Change in Aa Corporate Bond Yield within 180 days from the onset of the flu pandemic in the U.S.	Maximum Change in the Federal Funds Rate within 180 days from the onset of the flu pandemic in the U.S.
Mean	-24%	35bp	-77bp
Median	-22.5%	35bp	-100bp
Min Value	-10%	-120bp	-250bp
Max Value	-50%	200bp	200bp

In Round Two, there were 6 participants. All had participated in the first round survey. Table 2 summarizes the same information as in Table 1 for the 6 respondents. Although 5 out of the 6 participants changed their responses in Round Two from the estimates provided in Round One, the values shown in Table 2 are fairly consistent to the values of these metrics for Round One.

Table 2  
Moderate Scenario (209,000 deaths)

	Maximum % Change in S&P 500 Index within 180 days from the onset of the flu pandemic in the U.S.	Maximum Change in Aa Corporate Bond Yield within 180 days from the onset of the flu pandemic in the U.S.	Maximum Change in the Federal Funds Rate within 180 days from the onset of the flu pandemic in the U.S.
Mean	-7%	12.5bp	-37.5bp
Median	-5%	0bp	-50bp
Min Value	-25%	-50bp	-100bp
Max Value	-5%	100bp	50bp

Severe Scenario (1.9 Million deaths)

	Maximum % Change in S&P 500 Index within 180 days from the onset of the flu pandemic in the U.S.	Maximum Change in Aa Corporate Bond Yield within 180 days from the onset of the flu pandemic in the U.S.	Maximum Change in the Federal Funds Rate within 180 days from the onset of the flu pandemic in the U.S.
Mean	-18%	18.3bp	-75bp
Median	-20%	42.5bp	-125bp
Min Value	-40%	-200bp	-200bp
Max Value	20%	150bp	200bp

While 5 out of the 6 participants changed their responses in Round Two from the estimates provided in Round One, there was very little change to the values provided in the above table between the two rounds.

### Question 2: Estimate of Recovery Period

In each survey round, study participants were asked about the recovery period of the asset values. The survey wanted to know participant beliefs about the anticipated amount of

time before asset values return to the levels experienced before the onset of the pandemic. Table 3 summarizes the 12 responses received in Round One for each virulence scenario

Table 3

Moderate Scenario (209,000 deaths)

	Recovery Time for S&P 500 Index (expressed in number of months)	Recovery Time for Aa Corporate Bond Yield (expressed in number of months)	Recovery Time For Federal Funds Rate (expressed in number of months)
Mean	11	9	8
Median	6	6	12
Min Value	3	0	0
Max Value	36	36	12

Severe Scenario (1.9 Million deaths)

	Recovery Time for S&P 500 Index (expressed in number of months)	Recovery Time for Aa Corporate Bond Yield (expressed in number of months)	Recovery Time For Federal Funds Rate (expressed in number of months)
Mean	30	27	28
Median	24	18	24
Min Value	12	0	0
Max Value	60	60	60

Table 4 summarizes the 6 responses received in Round Two.

Table 4

Moderate Scenario (209,000 deaths)

	Recovery Time for S&P 500 Index (expressed in number of months)	Recovery Time for Aa Corporate Bond Yield (expressed in number of months)	Recovery Time For Federal Funds Rate (expressed in number of months)
Mean	8.1	5	10
Median	6.8	4.5	12
Min Value	3.0	0	0
Max Value	18.0	9	18

Severe Scenario (1.9 Million deaths)

	Recovery Time for S&P 500 Index (expressed in number of months)	Recovery Time for Aa Corporate Bond Yield (expressed in number of months)	Recovery Time For Federal Funds Rate (expressed in number of months)
Mean	25	16	27
Median	21	15	27
Min Value	12	0	24
Max Value	42	36	30

**Question 3: Reasoning and Assumptions**

The 12 participants had many varying viewpoints for their responses to Questions 1 and 2. The following summarizes the reasoning given in both survey rounds:

1. Many participants believed that a moderate pandemic would have less impact on the U.S. economy than a severe pandemic. Several participants mentioned with a moderate pandemic the work force would not be materially affected by the number of excess deaths. Others also believed under a moderate pandemic there would be a drop in sales as individuals stayed away from shopping in crowded malls but to a lesser degree than with a severe pandemic in which malls and other public places might be closed to prevent the spread of the illness.

On the other hand, a few participants indicated there would be no difference in the markets between a moderate and severe pandemic. One participant commented that the reaction of the markets would be similar under each scenario as the severity of the pandemic would not be known within the first 180 days. While another individual had a similar idea in that the initial shock effect on the market would be just as large under a moderate scenario as the severe scenario.

2. Some participants felt the economic impact from a moderate pandemic would be small and short lived. While several participants mentioned that there would be some fear and panic resulting in an initial drop in stock market, corporate bond yields, and the federal funds rate, the recovery period would be much shorter than with a severe pandemic. Several respondents also indicated that under a severe pandemic there would be lingering economic effects such as lasting effects of lost workers lengthening the recovery period.
3. Several respondents thought public fear and panic would be much greater for a severe pandemic than a moderate. An individual noted in the response that while the assumption used in the study is 1.9 million deaths, the actual perception by society will be much greater as they see friends, family, and public figures become ill. Another individual had a similar belief noting that the media could

greatly influence public perception. Even if a pandemic is of low or moderate virulence, the media could emphasize the sick and dead, creating a perception that the flu outbreak is much worse than it really is.

4. Several members of the study panel thought the government would need to take action and provide economic stimulus. For a severe pandemic, it was believed the government response would be more timely and aggressive than with a moderate pandemic.
5. Several indicated the Federal funds rate would be the last to recover since generally the government reacts more slowly than capital markets.
6. For the severe scenario, a few participants mentioned considering the economic reaction from 9/11 to develop responses to the pandemic questions. Another individual noted estimating the impact of a pandemic on bonds as a function of equity declines using a Merton model.
7. In one of the responses, it was noted periods of economic growth have historically followed pandemics.
8. Several indicated that Aa Corporate Bond Yield would increase or the impact of a pandemic would have less impact on the bond yield as compared to the other asset classes under study. The reasoning for this among the respondents was inconsistent. One individual discussed the impact of a pandemic would be larger on equity markets than high quality spreads since a pandemic will impact top line growth (influencing equity markets) more than short term bottom profits which affects corporate bonds. Another individual discussed that in the short term there will be an increase in investing in bonds as there will be a flight from stocks to bonds offset by a drop in short term interest rates.
9. An individual commented that pandemics would impact lower grade companies more than Aa grade companies.

#### **Question 4: Factors Influencing Estimates**

The final question in each survey round asked participants for their thoughts on future developments that might influence their estimated values. The responses from both rounds are listed below.

Moderate Scenario (209,000 deaths):

1. Rapid development and distribution of effective vaccine or effective containment measures of virus
2. Overreaction of government of shutting borders and closing trade
3. Overreaction by media influencing public perceptions and panic ensues
4. Consumer spending overreacts out of fear
5. Fed fails to provide sufficient liquidity to markets.

6. Government bailout of various industries (Aviation, tourism)
7. Flight to quality could drive up values of AAA and government bonds
8. A market correction of 30% which has not been corrected
9. A jump in inflation
10. Meltdown of geopolitical stability
11. Public perception of other diseases that desensitizes the public perception of pandemic's virulence
12. Market forces that cannot be controlled by this study, mainly outside foreseen macroeconomic factors
13. The occurrence of a Katrina type Hurricane or other extreme weather event, natural disaster or major terrorist attack at same time as flu outbreak

Severe Scenario (1.9 million deaths):

1. Rapid development and distribution of effective vaccine or effective containment measures of virus
2. Governmental financial/bailout relief for companies and industries
3. Change in political/geopolitical landscape
4. Fed fails to provide sufficient liquidity to markets.
5. Consumer spending grinds to a halt as preventive measures are not available in sufficient quantities
6. Flight to quality could drive up values of AAA and government bonds
7. Efficient subsidized programs to train and develop new workers.
8. Rapid and efficient implementation of Business Continuity Programs
9. A large jump in inflation
10. A sustained market correction
11. Mutation of virus around available anti-virals and secondary infections against antibiotics
12. Supply chain disaster
13. State of unrest and general disorder develops
14. Other diseases of greater magnitude desensitizing public
15. Changes in asset correlations among asset classes
16. The occurrence of a Katrina type Hurricane or other extreme weather event, natural disaster or major terrorist attack at same time as flu outbreak.

## **APPENDIX A**

### **Study Participants**

For recruiting participants for the study, invitation e-mails were sent to members of the SOA's Investment and Risk Management Sections. Invitations were also sent to external researchers studying pandemic influenza. This process garnered 12 participants with the overwhelming majority being practicing actuaries. The Project Oversight Group would like to thank the following individuals for their contribution to this study:

1. Larry Carson
2. Daniel Craine
3. Katy Curry
4. Vera Dolan
5. Jason Jump
6. Robert Lamarche
7. Howell Pugh
8. Frank Reynolds
9. Max Rudolph
10. Bill Sayre
11. Manet Schuman
12. Steven Weisbart

## **APPENDIX B**

### **FIRST ROUND QUESTIONNAIRE**



SOCIETY OF ACTUARIES

## ***Study of the Effect of a Flu Pandemic on Economic Values Using the Delphi Method***

The Society of Actuaries is seeking your expertise to help inform a research project in progress to examine the potential economic effect of pandemic influenza in North America. Historical data from past pandemics exists but the applicability of the results from these analyses to today's economic environment is unclear. Thus, varying viewpoints exist as to how a pandemic might impact asset values and other macro economic factors.

The researcher and Project Oversight Group for the flu pandemic study are investigating how asset values might behave as a result of a flu pandemic and invite you to participate in this project by offering your knowledge, expertise, and judgments on this subject. Please complete the enclosed questionnaire and return by Friday, October 6 to: Ronora Stryker, SOA Research Actuary at [researchprojects@soa.org](mailto:researchprojects@soa.org).

Responses will be analyzed and reported back to you for consideration in completing a second round questionnaire which will be sent to you in two weeks.

Research results will be summarized and included in the overall SOA pandemic research report made available to the membership. Your responses will be kept confidential. No attributions will be made, but respondents will be listed as participants in the final report which will, as appropriate, be widely disseminated in the professional literature.

In developing the survey, it has been assumed that North American countries will experience similar economic effects from a flu pandemic to that of the U.S. While the questionnaire has a U.S. focus, individuals from outside of the U.S. are encouraged to participate.

Please contact us with any questions and remember to return your responses in time to arrive at the SOA by October 6. Questions may also be directed to Ronora at [researchprojects@soa.org](mailto:researchprojects@soa.org) or 847-706-3614.

Thank you for participating in this initiative.

Sincerely,

Tom Edwalds, FSA, ACAS, MAAA  
Chairperson of the SOA's Pandemic Study Project Oversight Group

475 N. Martingale Rd., Ste. 600  
Schaumburg, IL 60173  
847.706.3500 main  
847.706.3599 fax  
[www.soa.org](http://www.soa.org)

# Round 1 Questionnaire

## OVERVIEW OF QUESTIONNAIRE

Please complete the portions of this questionnaire in which you are knowledgeable and interested. You may omit any of these questions without affecting the analysis planned for this study.

This first round questionnaire asks for your judgments and underlying analysis and reasoning on how a flu pandemic might affect U.S. asset values. Background information for consideration in responding to the questions is provided after the questionnaire.

In responding to the following questions please assume that a flu pandemic has already occurred in the U.S. and medical technology and air transportation patterns at time of occurrence are similar to today.

## QUESTIONNAIRE

### QUESTION 1:

The table below shows U.S. governmental projections for the number of U.S. deaths for two flu pandemic scenarios. Assuming these estimates are accurate for each scenario, please provide your judgment for the values for each of the asset classes shown below. Values can be positive or negative.

Examples to help you complete the grid:

- An example of the percentage change in S&P 500 index: If starting value before the flu pandemic occurs in the U.S. is 1330 and the index changes to 1197 after the pandemic occurs, the % change is -10%.
- An example of the change in Corporate Bond Yield and Federal Funds Rate: If starting value before the pandemic occurs in the U.S. is 6.0% and the yield or rate changes to 6.6% after the pandemic occurs, the change is 60 basis points.

Virulence Level Scenario	Maximum % Change in S&P 500 Index within 180 days from the onset of the flu pandemic in the U.S.	Maximum Change in Aa Corporate Bond Yield within 180 days from the onset of the flu pandemic in the U.S.*	Maximum Change in the Federal Funds Rate within 180 days from the onset of the flu pandemic in the U.S.*
Moderate (209,000 deaths)			
Severe (1.9 million deaths)			

\*Express maximum change in basis points

**QUESTION 2:**

For each of your answers above, how long would you anticipate before asset values, return to the levels experienced before the onset of the pandemic?

Virulence Level Scenario	Recovery Time for S&P 500 Index	Recovery Time for Aa Corporate Bond Yield	Recovery Time for Federal Funds Rate
Moderate (209,000 deaths)			
Severe (1.9 million deaths)			

**QUESTION 3:**

For each of your answers above, please provide your reasoning and assumptions for your views.

Moderate Scenario Reasons:

Severe Scenario Reasons:

**QUESTION 4:**

Please list plausible future developments that you believe could impact the values of your responses in questions 1 and 2, should they occur:

Moderate Scenario

- 1.
- 2.
- 3.

Severe Scenario

- 1.
- 2.
- 3.

## **BACKGROUND INFORMATION:**

Definitions for pandemic flu and seasonal flu follow.

Pandemic flu is virulent human flu that causes a global outbreak, or pandemic, of serious illness. Because there is little natural immunity, the disease can spread easily from person to person. Currently, there is no pandemic flu.

Seasonal (or common) flu is a respiratory illness that can be transmitted person to person. Most people have some immunity, and a vaccine is available.

Source: <http://www.pandemicflu.gov/>

In the U.S., three flu pandemics occurred in the 20<sup>th</sup> century with differing degrees of virulence, its ability to produce severe illness causing hospitalization or death

1. 1918 is considered a severe pandemic with 675,000+ excess U.S. deaths
2. 1957 is considered a moderate pandemic with 70,000+ excess U.S. deaths
3. 1968 is considered a mild pandemic with 34,000+ excess U.S. deaths

Source: <http://www.pandemicflu.gov/general>

By applying past pandemic mortality rates to current population figures and assuming no control measures such as vaccination, the U.S. government has produced mortality estimates for the general population. Under a moderate scenario similar to the 1957 pandemic, the estimate of the number of excess U.S. deaths is 209,000 (Approximately .7 excess deaths per 1000). For a severe pandemic scenario using mortality rates similar to 1918, the projected excess deaths are approximately 1.9 million (Approximately 6.5 excess deaths per 1000).

Source: <http://www.pandemicflu.gov/plan/pandplan.html>.

The Congressional Budget Office has prepared an assessment of the possible macroeconomic effects of an avian flu pandemic. Per the Dec. 2005 report, the CBO estimates:

Virulence Level Scenario	Change in GDP
Mild/Moderate (Approx. 100,000 deaths)	Real GDP would be about 1.5% lower relative to what would have happened without a pandemic
Severe (Approx. 2 million deaths)	Real GDP would be about 5% lower over the subsequent year

Source: A Potential Influenza Pandemic: Possible Effects and Policy Issues, December 2005 <http://www.cbo.gov/>

## **APPENDIX C**

### **SECOND ROUND QUESTIONNAIRE**



SOCIETY OF ACTUARIES

***Study of the Effect of a Flu Pandemic on Economic Values  
Using the Delphi Method  
ROUND TWO***

The Society of Actuaries is seeking your expertise to help inform a research project in progress to examine the potential economic effect of pandemic influenza in North America. Historical data from past pandemics exists but the applicability of the results from these analyses to today's economic environment is unclear. Thus, varying viewpoints exist as to how a pandemic might impact asset values and other macro economic factors.

The first round survey was recently completed involving 12 participants from varied backgrounds who provided judgments about the values of the S&P 500 Index, Aa Corporate Bond yield and the Federal Funds rate should a pandemic occur and the reasons for their views. The responses have been very insightful. In Round Two results from the first round are provided for consideration in responding to the enclosed questionnaire which will ask for your reassessments of your responses to the Round One questions. **You need not have participated in Round One to participate in Round Two.**

Responses will be analyzed and reported back to you. They will also be included in the overall SOA pandemic research report made available to the membership. Your responses will be kept confidential. No attributions will be made, but respondents will be listed as participants in the final report which will, as appropriate, be widely disseminated in the professional literature.

In developing the survey, it has been assumed that North American countries will experience similar economic effects from a flu pandemic to that of the U.S. While the questionnaire has a U.S. focus, individuals from outside of the U.S. are encouraged to participate.

Please complete the enclosed questionnaire and return by **Wednesday, November 22** to: Ronora Stryker, SOA Research Actuary at [researchprojects@soa.org](mailto:researchprojects@soa.org). Questions may also be directed to Ronora at [researchprojects@soa.org](mailto:researchprojects@soa.org) or 847-706-3614.

Thank you for participating in this initiative.

Sincerely,

Tom Edwalds, FSA, ACAS, MAAA

Chairperson of the SOA's Pandemic Study Project Oversight Group

475 N. Martingale Rd., Ste. 600  
Schaumburg, IL 60173  
847.706.3500 main  
847.706.3599 fax  
[www.soa.org](http://www.soa.org)

# ROUND TWO QUESTIONNAIRE

## OVERVIEW OF QUESTIONNAIRE

Please complete the portions of this questionnaire in which you are knowledgeable and interested. You may omit any of these questions without affecting the analysis planned for this study.

This 2nd Round questionnaire asks for your judgments and underlying analysis and reasoning on how a flu pandemic might affect U.S. asset values. Background information for consideration in responding to the questions is provided after the questionnaire. In addition, Round One results are provided for each question in Appendix 1.

In responding to the following questions please assume that a flu pandemic has already occurred in the U.S. and medical technology and air transportation patterns at time of occurrence are similar to today.

## QUESTIONNAIRE

### QUESTION 1:

The table below shows U.S. governmental projections for the number of U.S. deaths for two flu pandemic scenarios. Assuming these estimates are accurate for each scenario, please provide your judgment for the values for each of the asset classes shown below. Values can be positive or negative.

Examples to help you complete the grid:

- An example of the percentage change in S&P 500 index: If starting value before the flu pandemic occurs in the U.S. is 1330 and the index changes to 1197 after the pandemic occurs, the % change is -10%.
- An example of the change in Corporate Bond Yield and Federal Funds Rate: If starting value before the pandemic occurs in the U.S. is 6.0% and the yield or rate changes to 6.6% after the pandemic occurs, the change is 60 basis points.

Virulence Level Scenario	Maximum % Change in S&P 500 Index within 180 days from the onset of the flu pandemic in the U.S.	Maximum Change in Aa Corporate Bond Yield within 180 days from the onset of the flu pandemic in the U.S.*	Maximum Change in the Federal Funds Rate within 180 days from the onset of the flu pandemic in the U.S.*
Moderate (209,000 deaths)			
Severe (1.9 million deaths)			

\*Express maximum change in basis points

**QUESTION 2:**

For each of your answers above, how long would you anticipate before asset values, return to the levels experienced before the onset of the pandemic?

Virulence Level Scenario	Recovery Time for S&P 500 Index	Recovery Time for Aa Corporate Bond Yield	Recovery Time for Federal Funds Rate
Moderate (209,000 deaths)			
Severe (1.9 million deaths)			

**QUESTION 3:**

For each of your answers above, please provide your reasoning and assumptions for your views.

Moderate Scenario Reasons:

Severe Scenario Reasons:

**QUESTION 4:**

Please list plausible future developments that you believe could impact the values of your responses in questions 1 and 2, should they occur:

Moderate Scenario

- 1.
- 2.
- 3.

Severe Scenario

- 1.
- 2.
- 3.

## **BACKGROUND INFORMATION:**

Definitions for pandemic flu and seasonal flu follow.

Pandemic flu is virulent human flu that causes a global outbreak, or pandemic, of serious illness. Because there is little natural immunity, the disease can spread easily from person to person. Currently, there is no pandemic flu.

Seasonal (or common) flu is a respiratory illness that can be transmitted person to person. Most people have some immunity, and a vaccine is available.

Source: <http://www.pandemicflu.gov/>

In the U.S., three flu pandemics occurred in the 20<sup>th</sup> century with differing degrees of virulence, its ability to produce severe illness causing hospitalization or death

4. 1918 is considered a severe pandemic with 675,000+ excess U.S. deaths
5. 1957 is considered a moderate pandemic with 70,000+ excess U.S. deaths
6. 1968 is considered a mild pandemic with 34,000+ excess U.S. deaths

Source: <http://www.pandemicflu.gov/general>

By applying past pandemic mortality rates to current population figures and assuming no control measures such as vaccination, the U.S. government has produced mortality estimates for the general population. Under a moderate scenario similar to the 1957 pandemic, the estimate of the number of excess U.S. deaths is 209,000 (Approximately .7 excess deaths per 1000). For a severe pandemic scenario using mortality rates similar to 1918, the projected excess deaths are approximately 1.9 million (Approximately 6.5 excess deaths per 1000).

Source: <http://www.pandemicflu.gov/plan/pandplan.html>.

The Congressional Budget Office has prepared an assessment of the possible macroeconomic effects of an avian flu pandemic. Per the Dec. 2005 report, the CBO estimates:

Virulence Level Scenario	Change in GDP
Mild/Moderate (Approx. 100,000 deaths)	Real GDP would be about 1.5% lower relative to what would have happened without a pandemic
Severe (Approx. 2 million deaths)	Real GDP would be about 5% lower over the subsequent year

Source: A Potential Influenza Pandemic: Possible Effects and Policy Issues, December 2005  
<http://www.cbo.gov/>

## APPENDIX D INDIVIDUAL RESPONSES TO ROUND ONE

### **RESPONSE 1**

#### **QUESTION 1:**

The table below shows U.S. governmental projections for the number of U.S. deaths for two flu pandemic scenarios. **Assuming these estimates are accurate for each scenario, please provide your judgment for the values for each of the asset classes shown below.** Values can be positive or negative. Examples to help you complete the grid:

Virulence Level Scenario	Maximum % Change in S&P 500 Index within 180 days from the onset of the flu pandemic in the U.S.	Maximum Change in Aa Corporate Bond Yield within 180 days from the onset of the flu pandemic in the U.S.*	Maximum Change in the Federal Funds Rate within 180 days from the onset of the flu pandemic in the U.S.*
Moderate (209,000 deaths)	-7%	-30 basis points	-25 basis points
Severe (1.9 million deaths)	-25%	-120 bp	-100 bp

\*Express maximum change in basis points

#### **QUESTION 2:**

For each of your answers above, how long would you anticipate before asset values, return to the levels experienced before the onset of the pandemic?

Virulence Level Scenario	Recovery Time for S&P 500 Index	Recovery Time for Aa Corporate Bond Yield	Recovery Time for Federal Funds Rate
Moderate (209,000 deaths)	4 months	5 months	6 months
Severe (1.9 million deaths)	2 years	1.5 years	2 years

#### **QUESTION 3:**

For each of your answers above, please provide your reasoning and assumptions for your views.

##### Moderate Scenario Reasons:

Assume a moderate outbreak will be perceived as such. Therefore, there will be little or no panic. Economic activity will certainly slow in each area when the flu hits, but this won't be at the exact same time in cities across the nation. The stock market will initially drop over the course of a month but will level off for two more months and, seeing the outbreak waning, will begin a climb back to its pre-flu level. The corporate bond yield will initially drift down about 30 bp as economic activity slows with the onset of the flu, but will more slowly recover as the country perceives the outbreak ending. The Fed will quickly drop the Fed Funds rate at the onset of the outbreak but, relying for evidence of recovery on data that appear only with a lag, will be the slowest of actors, restoring the original rate after six months.

##### Severe Scenario Reasons:

## APPENDIX D

### INDIVIDUAL RESPONSES TO ROUND ONE

Assume a severe outbreak will be perceived as such. The stock market won't wait for data showing the impact on economic activity, but will panic and drop 15% in two weeks, then drift lower to a total loss of 25% as data on the outbreak continue to arrive. As economic activity slows, durable inventory will pile up and nondurable inventory will spoil. Corporate bond yields will drop because businesses will be loath to continue investing in expansion and/or start new plans. The Fed, too, will begin a steady downward slide with the Fed Funds rate until the rate is 150 bp below the pre-outbreak level. Although the flu will be over within 5-6 months, the lasting effect of lost workers, diminished demand, and lingering health concerns will persist for about another year and a half.

#### QUESTION 4:

Please list plausible future developments that you believe could impact the values of your responses in questions 1 and 2, should they occur:

##### Moderate Scenario

1. Development and widespread distribution of an effective influenza vaccine
2. The occurrence of a Katrina-type hurricane or other extreme weather event, or a major earthquake, at the same time as a flu outbreak
3. The occurrence of a major terrorist attack at the same time as a flu outbreak

##### Severe Scenario

1. Development and widespread distribution of an effective influenza vaccine
2. The occurrence of a Katrina-type hurricane or other extreme weather, or a major earthquake at the same time as a flu outbreak
3. The occurrence of a major terrorist attack at the same time as a flu outbreak

## **RESPONSE 2**

#### QUESTION 1:

The table below shows U.S. governmental projections for the number of U.S. deaths for two flu pandemic scenarios. Assuming these estimates are accurate for each scenario, please provide your judgment for the values for each of the asset classes shown below. Values can be positive or negative.

Virulence Level Scenario	Maximum % Change in S&P 500 Index within 180 days from the onset of the flu pandemic in the U.S.	Maximum Change in Aa Corporate Bond Yield within 180 days from the onset of the flu pandemic in the U.S.*	Maximum Change in the Federal Funds Rate within 180 days from the onset of the flu pandemic in the U.S.*
Moderate (209,000 deaths)	-2%	50 basis points	50 basis points
Severe (1.9 million deaths)	-10 %	100 basis points	100 basis points

\*Express maximum change in basis points

#### QUESTION 2:

## APPENDIX D INDIVIDUAL RESPONSES TO ROUND ONE

For each of your answers above, how long would you anticipate before asset values, return to the levels experienced before the onset of the pandemic?

Virulence Level Scenario	Recovery Time for S&P 500 Index	Recovery Time for Aa Corporate Bond Yield	Recovery Time for Federal Funds Rate
Moderate (209,000 deaths)	6 months	6 months	3 months
Severe (1.9 million deaths)	2 years	1 year	1 year

### QUESTION 3:

For each of your answers above, please provide your reasoning and assumptions for your views.

Moderate Scenario Reasons:

#### GENERAL OVERALL PERCEPTION

Short memory of investor public

Investor perception fickle

Other diseases could be more prevalent

Past history of reactions to diseases, I specifically did not look at the historical data for asset returns during the study time that you gave me, the reason is I wanted this to be of independent thought that future expectations of our world is not necessarily indicative of the past. It should be a forward thinking question of the 21<sup>st</sup> century kind. What I do recall, is that in general there have been spikes in interest rate flows in the economy after 1968, when interest rates were high and then monetary controls had to be put in. I do not think it a direct result of the virulence that took place in 68, or prior. The 68 outbreak was small and in today's insensitivities of the world (some economic communities just don't care), 200,000 might be considered small by some practitioners across the economy

On individual basis

1. S& P 500 based on conglomerate stocks, in the future will not know the composition of medical and impact on the economy – 6 months just in general for any change. If any impact is made, I believe it takes ½ year to come back. I closely watch individual stocks, as my personal portfolio is made of the entire s and p and individual stocks made up of the s and p
2. Aa corporate bond yields is close to excellent but not triple A, again gambling on little impact except for when perception hits of any event, what is the bounce back time. Corporations tend to be insensitive to economic downturn, if the individual corporate stock company is flying high
3. Federal Reserve and federal funds rate is the gatekeeper of our economy, operates independently from the stock market, I believe that the bounce back time is going to be less, since the Federal Funds “centurians” do have control over the economy and in general if damage has been done, I think it would take about 3 months to bounce back versus the other times.

## APPENDIX D

### INDIVIDUAL RESPONSES TO ROUND ONE

**Severe Scenario Reasons:**

1. Severe is almost 2 million deaths. It is not just the magnitude but the implication of who would die. In today's sociological microcosm, you could have a movie star or a political figure die, and then 1.9 really is 6 in people's eyes. The 2 million is assumed to hit in the United States and with it spreading quickly Fear would overtake.
2. When Aids was around, people did not pay as much attention, when a virulence that affects everybody, then when people think across the board, it can affect them that translates to all facets of the economy. People do not seem to care about mad cow disease either etc.
3. My ranking was that in general stocks are slower to react than a corporate bond yield. The federal funds rates control the economy and the individual participants in setting the funds rate would see a need to step in.
4. I am not looking at the mathematics of this but the perception, the magnitude and the individual people who take the hit of virulence. The mathematics is based on the magnitude of the death, the embodying force (s & p 500 vs individual stock vs controller of economic policy)

**QUESTION 4:**

Please list plausible future developments that you believe could impact the values of your responses in questions 1 and 2, should they occur:

**Moderate Scenario**

1. Public perception of other diseases that water down the virulence. Again this is specifically designed as something you can catch. I have seen other diseases in China that have done nothing to the foreign market equivalency rates at all.
2. New technologies of course, in today's modern health world and of course now with the Bill Gates Foundation and Warren Buffet, also Dell building a medical center in Austin  
To deny that some of the greatest money makers, even those in the stock market like Warren Buffet who could blow things out of the water. Have decided to put their money into medical research. That says something about our economic outlook. To deny it, is just plain dumb. Medical technology is accelerating.  
That type of capital infusion, you cannot deny will mean something in our lifetimes
3. Market forces that cannot be controlled by this study, mainly outside foreseen macroeconomic factors

**Severe Scenario**

1. Other diseases of greater magnitude, whether in the United States or abroad, once something has happened there is a desensitization to things happening again
2. Changes in asset correlations among asset classes,
3. Significant change in our political landscape, including a terrorist attack of greater significant proportion. If things spiral, then rates can plummet so much. There are controls in the economy that place things too low or too high.

**RESPONSE 3**

**QUESTION 1:**

The table below shows U.S. governmental projections for the number of U.S. deaths for two flu pandemic scenarios. Assuming these estimates are accurate for each scenario, please provide your judgment for the values for each of the asset classes shown below. Values can be positive or negative.

	Maximum % Change	Maximum Change	Maximum Change in the
--	------------------	----------------	-----------------------

**APPENDIX D**  
**INDIVIDUAL RESPONSES TO ROUND ONE**

Virulence Level Scenario	in S&P 500 Index within 180 days from the onset of the flu pandemic in the U.S.	in Aa Corporate Bond Yield within 180 days from the onset of the flu pandemic in the U.S.*	Federal Funds Rate within 180 days from the onset of the flu pandemic in the U.S.*
Moderate (209,000 deaths)	-10%	0 bps	-50 bps
Severe (1.9 million deaths)	-30%	-100 bps	-250 bps

\*Express maximum change in basis points

**QUESTION 2:**

For each of your answers above, how long would you anticipate before asset values, return to the levels experienced before the onset of the pandemic?

Virulence Level Scenario	Recovery Time for S&P 500 Index	Recovery Time for Aa Corporate Bond Yield	Recovery Time for Federal Funds Rate
Moderate (209,000 deaths)	3 mos	3 mos	3 mos
Severe (1.9 million deaths)	2 yrs	5 yrs	5 yrs

**QUESTION 3:**

For each of your answers above, please provide your reasoning and assumptions for your views.

Moderate Scenario Reasons:

I believe the impact will be small and short lived as I think there will be an initial overreaction (pundits mapping out “end of the world” scenarios, followed by rebound once it becomes clear that the severity is overblown

Severe Scenario Reasons:

I extrapolated from the reactions to 9/11 in the year following the event, since I think it took some time for the reality to take hold. A severe pandemic would be significantly worse but I think some amount of severe event expectation is already factored into the market.

**QUESTION 4:**

Please list plausible future developments that you believe could impact the values of your responses in questions 1 and 2, should they occur:

Moderate Scenario

1. Media far plays up the impact and panic ensues

**APPENDIX D**  
**INDIVIDUAL RESPONSES TO ROUND ONE**

Severe Scenario

1. Vaccine is quickly developed, produced, and disseminated
2. State of unrest and general disorder develops

**RESPONSE 4**

**QUESTION 1:**

The table below shows U.S. governmental projections for the number of U.S. deaths for two flu pandemic scenarios. Assuming these estimates are accurate for each scenario, please provide your judgment for the values for each of the asset classes shown below. Values can be positive or negative.

Virulence Level Scenario	Maximum % Change in S&P 500 Index within 180 days from the onset of the flu pandemic in the U.S.	Maximum Change in Aa Corporate Bond Yield within 180 days from the onset of the flu pandemic in the U.S.*	Maximum Change in the Federal Funds Rate within 180 days from the onset of the flu pandemic in the U.S.*
Moderate (209,000 deaths)	-5%	-10 bps	-50
Severe (1.9 million deaths)	-15%	+50 bps	-100

\*Express maximum change in basis points

**QUESTION 2:**

For each of your answers above, how long would you anticipate before asset values, return to the levels experienced before the onset of the pandemic?

Virulence Level Scenario	Recovery Time for S&P 500 Index	Recovery Time for Aa Corporate Bond Yield	Recovery Time for Federal Funds Rate
Moderate (209,000 deaths)	90 days	Minimal impact, 90 days	12 months, increased inflation risk
Severe (1.9 million deaths)	2 years	3 years	30 months

**QUESTION 3:**

For each of your answers above, please provide your reasoning and assumptions for your views.

Moderate Scenario Reasons:

I expect that the pandemic will spread around the world very quickly and that this is the first wave. I assumed that a moderate scenario would have very limited long term implications, but that there would be a “fear factor” that would go through the both the bond and equity markets and require the fed to

## APPENDIX D

### INDIVIDUAL RESPONSES TO ROUND ONE

respond by adding liquidity. I think that this would steepen the yield curve for Treasuries, so the 5 and 10 year points on the curve would not change by the full amount (perhaps 20 bps down). The typical Aa bonds would have a higher perceived default risk that would partially offset this, resulting in a 10 bps reduction.

#### Severe Scenario Reasons:

I assume that the pandemic hits worldwide within a very short period of time and that the first wave is severe. I expect vaccines to be available in the US before a second wave hits 9 months later, providing additional protection. I expect a severe pandemic to have longer lasting impact on the world economy. The equity drop will be longer lasting as there is not a built in recovery like casualty risks have. I think the fed would add liquidity in two 50 bps increments to calm the markets. It's possible that more would be needed. The curve would immediately invert with the fed actions flattening it out. I think the curve at the 5/10 year points would be down about 75 bps and default risk up 125 bps for a net increase of 50 bps. I also assume with the default risk that the return to base spread applies only to new issues since many of the earlier bonds would have been downgraded.

#### QUESTION 4:

Please list plausible future developments that you believe could impact the values of your responses in questions 1 and 2, should they occur:

##### Moderate Scenario

1. meltdown of geopolitical stability
2. vaccine effectiveness
3. overreaction by US government by shutting borders or closing trade between states

##### Severe Scenario

1. supply chain disaster
2. successful vaccine
3. mutations of virus around available anti-virals and secondary infections against antibiotics

### **RESPONSE 5**

#### **QUESTION 1:**

The table below shows U.S. governmental projections for the number of U.S. deaths for two flu pandemic scenarios. Assuming these estimates are accurate for each scenario, please provide your judgment for the values for each of the asset classes shown below. Values can be positive or negative.

Virulence Level Scenario	Maximum % Change in S&P 500 Index within 180 days from the onset of the flu pandemic in the U.S.	Maximum Change in Aa Corporate Bond Yield within 180 days from the onset of the flu pandemic in the U.S.*	Maximum Change in the Federal Funds Rate within 180 days from the onset of the flu pandemic in the U.S.*
Moderate (209,000 deaths)	-25	+100	-50
Severe (1.9 million deaths)	-50	+200	-100

## APPENDIX D INDIVIDUAL RESPONSES TO ROUND ONE

\*Express maximum change in basis points

### QUESTION 2:

For each of your answers above, how long would you anticipate before asset values, return to the levels experienced before the onset of the pandemic?

Virulence Level Scenario	Recovery Time for S&P 500 Index	Recovery Time for Aa Corporate Bond Yield	Recovery Time for Federal Funds Rate
Moderate (209,000 deaths)	2 years	18 months	12 months
Severe (1.9 million deaths)	5 years	4 years	48 months

### QUESTION 3:

For each of your answers above, please provide your reasoning and assumptions for your views.

Moderate Scenario Reasons:

The economy will take a while to understand the effect In the short term there will be a flight to bonds offset by a drop in short term rates

Severe Scenario Reasons:

There will be near panic and people will flee to bonds. To stimulate the economy the Fed will reduce short term interest rates. It will take the restoration of confidence and at least two subsequent years of earnings growth to offset the loss in the S&P

### QUESTION 4:

Please list plausible future developments that you believe could impact the values of your responses in questions 1 and 2, should they occur:

Moderate Scenario

1. Development of a vaccine
2. A market correction of 30% which has not been corrected
3. A jump in inflation

Severe Scenario

1. A large jump in inflation
2. A sustained market correction
3. Spreading trouble in the Middle east

## **RESPONSE 6**

### QUESTION 1:

## APPENDIX D INDIVIDUAL RESPONSES TO ROUND ONE

The table below shows U.S. governmental projections for the number of U.S. deaths for two flu pandemic scenarios. Assuming these estimates are accurate for each scenario, please provide your judgment for the values for each of the asset classes shown below. Values can be positive or negative.

Virulence Level Scenario	Maximum % Change in S&P 500 Index within 180 days from the onset of the flu pandemic in the U.S.	Maximum Change in Aa Corporate Bond Yield within 180 days from the onset of the flu pandemic in the U.S.*	Maximum Change in the Federal Funds Rate within 180 days from the onset of the flu pandemic in the U.S.*
Moderate (209,000 deaths)	-5%	50bp	
Severe (1.9 million deaths)	-25%	100bp	200 bp

\*Express maximum change in basis points

### QUESTION 2:

For each of your answers above, how long would you anticipate before asset values, return to the levels experienced before the onset of the pandemic?

Virulence Level Scenario	Recovery Time for S&P 500 Index	Recovery Time for Aa Corporate Bond Yield	Recovery Time for Federal Funds Rate
Moderate (209,000 deaths)	6-9 months		
Severe (1.9 million deaths)	12 months	12 months	24 months

### QUESTION 3:

For each of your answers above, please provide your reasoning and assumptions for your views.

Moderate Scenario Reasons:

Severe Scenario Reasons:

I am assuming the onset of a recession with a drop in GDP of 6%-8%. This would cause the stock market to fall by the 25% and bond yields to drop by 1 %.

### QUESTION 4:

Please list plausible future developments that you believe could impact the values of your responses in questions 1 and 2, should they occur:

Severe Scenario

1. early development of a vaccine

**APPENDIX D**  
**INDIVIDUAL RESPONSES TO ROUND ONE**

**RESPONSE 7**

**QUESTION 1:**

The table below shows U.S. governmental projections for the number of U.S. deaths for two flu pandemic scenarios. Assuming these estimates are accurate for each scenario, please provide your judgment for the values for each of the asset classes shown below. Values can be positive or negative.

Virulence Level Scenario	Maximum % Change in S&P 500 Index within 180 days from the onset of the flu pandemic in the U.S.	Maximum Change in Aa Corporate Bond Yield within 180 days from the onset of the flu pandemic in the U.S.*	Maximum Change in the Federal Funds Rate within 180 days from the onset of the flu pandemic in the U.S.*
Moderate (209,000 deaths)	-20%	-25bp	-100 bp
Severe (1.9 million deaths)	-40%	0 bp	-250 bp

\*Express maximum change in basis points

**QUESTION 2:**

For each of your answers above, how long would you anticipate before asset values, return to the levels experienced before the onset of the pandemic?

Virulence Level Scenario	Recovery Time for S&P 500 Index	Recovery Time for Aa Corporate Bond Yield	Recovery Time for Federal Funds Rate
Moderate (209,000 deaths)	1.5 years	0 year	1 year
Severe (1.9 million deaths)	3.5 years	0 year	2.5 years

**QUESTION 3:**

For each of your answers above, please provide your reasoning and assumptions for your views.

Moderate Scenario Reasons:

Chances are that the elderly, the very young and the sick will be the ones most affected by the 209,000 deaths. The work force should remain fairly stable in general and I do not anticipate companies closing because of the lack labor available. People will get scared and will miss a few days of work (they will be afraid to get sick from being exposed to the public). Some business continuity plans will be implemented, new measures will be implemented to reduce the risk of contamination in the workplace. Shopping malls will be deserted and sales will suffer. This will put pressure on the economy, the feds will ease the interest rate to release some of this pressure. After a few months, things will come back to

## **APPENDIX D**

### **INDIVIDUAL RESPONSES TO ROUND ONE**

normal but some damage would have been done, some balance sheets would have weakened, the feds will need to keep interest rates low for a while to jump start the economy again.

The S&P will go down by less than 20% (mainly because people will not go to the mall for a while but will start going back once they feel safe again) and should be back to the current level within 1- 1.5 years.

The Feds will bring rate down but not more than 100 bp as most industries should not suffer too much. AA bonds are mainly financial institutions papers and spreads from this industry should not widen by much more than 25 to 50 bp. The yield curve will most likely go down because of the Feds rate going down but it will not be a full parallel shift where no more than 50 to 75 bp will affect 5 to 15 years part of the curve. The net impact on the AA bonds will therefore be a tightening of 0 to 25 bp. These bonds will not need any time to recover.

#### **Severe Scenario Reasons:**

More than half a percent of the US population dies, business is severely disrupted, people will not show up for work for days or even weeks because of the severity of the pandemics. Many workers, especially in major metropolitan areas will be part of the casualties, and firms will start feeling the loss of “brain” capital. The Feds will need to be very accommodative very quickly as many companies will need help to pay their debts. I would not be surprised to see the Feds rate go down by 250 bp over a 6 months period. Prices of stocks will plummet, as the markets will be disrupted and confidence will go down. It is hard to say how much market values firms will loose but I would not be surprised to see the values of companies going down by as much as 40% as the scared public will not go out, supplies will be difficult to get, inventories will increase and additional financing will be necessary. The resilient US economy will eventually get back up, rebuild its “brain and expertise” capital, people will start shopping again and the economy will return to the current levels within 2.5 to 3.5 years.

Spreads on AA bonds will most likely widen by 30 to 60 bp but the yield curve will go down by a similar amount, leaving the gross yields for AA bonds at the same levels.

#### **QUESTION 4:**

Please list plausible future developments that you believe could impact the values of your responses in questions 1 and 2, should they occur:

##### **Moderate Scenario**

- 1.A rapid containment of the pandemics (within one week for example) or the development of a vaccine readily available to the general population would mitigate the impact of the pandemics and will not give enough time for the Feds to reduce rates or to the markets to be materially affected.
- 2.Creating a safer environment for workers.

##### **Severe Scenario**

- 1.Special relief for companies to help them cope with liquidity problems.
- 2.Efficient subsidized programs to train and develop new workers.
- 3.Rapid and efficient implementation of Business Continuity Programs.

## **RESPONSE 8**

### **QUESTION 1:**

## APPENDIX D INDIVIDUAL RESPONSES TO ROUND ONE

The table below shows U.S. governmental projections for the number of U.S. deaths for two flu pandemic scenarios. Assuming these estimates are accurate for each scenario, please provide your judgment for the values for each of the asset classes shown below. Values can be positive or negative.

Virulence Level Scenario	Maximum % Change in S&P 500 Index within 180 days from the onset of the flu pandemic in the U.S.	Maximum Change in Aa Corporate Bond Yield within 180 days from the onset of the flu pandemic in the U.S.*	Maximum Change in the Federal Funds Rate within 180 days from the onset of the flu pandemic in the U.S.*
Moderate (209,000 deaths)	-10%	+10 BP	Flat
Severe (1.9 million deaths)	-20%	+35 BP	Flat

We estimated the credit deterioration (using a Merton Model) in a typical bond and the spread required to make up for that change; not the change in spread for a constant rating

\*Express maximum change in basis points

### QUESTION 2:

For each of your answers above, how long would you anticipate before asset values, return to the levels experienced before the onset of the pandemic?

Virulence Level Scenario	Recovery Time for S&P 500 Index	Recovery Time for Aa Corporate Bond Yield	Recovery Time for Federal Funds Rate
Moderate (209,000 deaths)	3 years	3 years	NA
Severe (1.9 million deaths)	5 years	5 years	NA

### QUESTION 3:

For each of your answers above, please provide your reasoning and assumptions for your views.

Moderate Scenario Reasons:

Historical pandemics have actually been followed by periods of market growth. To be conservative, we assumed a 10% drop in our estimation. This was assumed to happen over the course of a year, followed by normal market growth (5%) thereafter. Hence, one year of decline plus two to recover = 3 years. Impact on bonds were a function of equity declines (using Merton model) and therefore track the same timeline. No assumption was made regarding Fed Funds.

## APPENDIX D INDIVIDUAL RESPONSES TO ROUND ONE

Severe Scenario Reasons:

Assumed double the loss in the moderate scenario, happening immediately and lasting one year. After that, normal growth requiring a total of 5 years to recover. Other assumptions were the same as in the Moderate Scenario

### QUESTION 4:

Please list plausible future developments that you believe could impact the values of your responses in questions 1 and 2, should they occur:

Moderate Scenario

1. Flight to quality could drive up values of AAA and government bonds

Severe Scenario

1. Same as above.

### **RESPONSE 9**

#### **QUESTION 1:**

The table below shows U.S. governmental projections for the number of U.S. deaths for two flu pandemic scenarios. Assuming these estimates are accurate for each scenario, please provide your judgment for the values for each of the asset classes shown below. Values can be positive or negative.

Virulence Level Scenario	Maximum % Change in S&P 500 Index within 180 days from the onset of the flu pandemic in the U.S.	Maximum Change in Aa Corporate Bond Yield within 180 days from the onset of the flu pandemic in the U.S.*	Maximum Change in the Federal Funds Rate within 180 days from the onset of the flu pandemic in the U.S.*
Moderate (209,000 deaths)	-30%	100	100
Severe (1.9 million deaths)	-30%	100	100

\*Express maximum change in basis points

#### **QUESTION 2:**

For each of your answers above, how long would you anticipate before asset values, return to the levels experienced before the onset of the pandemic?

Virulence Level Scenario	Recovery Time for S&P 500 Index	Recovery Time for Aa Corporate Bond Yield	Recovery Time for Federal Funds Rate
Moderate (209,000 deaths)	1 year	1 year	1 year
Severe (1.9 million deaths)	2 years	2 years	2 years

## APPENDIX D

### INDIVIDUAL RESPONSES TO ROUND ONE

#### QUESTION 3:

For each of your answers above, please provide your reasoning and assumptions for your views.

#### Moderate and Severe Scenario Reasons:

For Question 1, no one will know within only 6 months (180 days) if the pandemic is moderate or severe – it will be appallingly awful and traumatic to the market even if “only” 10,000 deaths occur. The market will not be able to distinguish between the two in such a short time, so I believe all indexes and metrics will take the same kind of hit, no matter what the scenario. The magnitude of the hit will vary depending on the confidence of the market. Estimating confidence at this point will be tricky – we don’t know if the pandemic flu is all that we will face, or if other parties (Islamic extremists, for example) will take advantage of the opportunity to further destabilize our economy and infrastructure. The greater the mess and confusion, the worse the market confidence will be.

For Question 2, by the time the market recovers, it will be apparent if the U.S. experienced a moderate or severe pandemic, which is why the estimated recovery time will be different for the two. I used years as the basis from what I saw from the 9/11 disaster; it took a very long time for the market to recover after that, and “only” several thousand people in very few places died. The pandemic flu will be harder to withstand and recover from; 1 or 2 years might be fairly optimistic, depending on the mess and confusion caused.

#### QUESTION 4:

Please list plausible future developments that you believe could impact the values of your responses in questions 1 and 2, should they occur:

#### Moderate Scenario

1. Very rapid development and distribution of effective vaccine
2. Effective quarantine of affected geographic areas to reduce spread
3. Effective identification and treatment of flu cases to reduce mortality

#### Severe Scenario

1. Very rapid development and distribution of effective vaccine
2. Effective quarantine of affected geographic areas to reduce spread
3. Effective identification and treatment of flu cases to reduce mortality

### **RESPONSE 10**

#### QUESTION 1:

The table below shows U.S. governmental projections for the number of U.S. deaths for two flu pandemic scenarios. Assuming these estimates are accurate for each scenario, please provide your judgment for the values for each of the asset classes shown below. Values can be positive or negative.

Virulence Level Scenario	Maximum % Change in S&P 500 Index within 180 days from	Maximum Change in Aa Corporate Bond Yield within	Maximum Change in the Federal Funds Rate within 180 days from the

**APPENDIX D**  
**INDIVIDUAL RESPONSES TO ROUND ONE**

	the onset of the flu pandemic in the U.S.	180 days from the onset of the flu pandemic in the U.S.*	onset of the flu pandemic in the U.S.*
Moderate (209,000 deaths)	-5%		-25bp
Severe (1.9 million deaths)	-10%		-75bp

\*Express maximum change in basis points

**QUESTION 2:**

For each of your answers above, how long would you anticipate before asset values, return to the levels experienced before the onset of the pandemic?

Virulence Level Scenario	Recovery Time for S&P 500 Index	Recovery Time for Aa Corporate Bond Yield	Recovery Time for Federal Funds Rate
Moderate (209,000 deaths)	6 months		12 months
Severe (1.9 million deaths)	12 months		24 months

**QUESTION 3:**

For each of your answers above, please provide your reasoning and assumptions for your views.

Moderate Scenario Reasons:

- S&P: Panic will cause a noticeable but short term disruption in the market. The pandemic is seen as a temporary state by the market, and correction (recovery) will follow within 6 months.
- Fed Funds: The government response will be very measured. My response reflects the additional change attributable directly to the economic effects of the pandemic. Recovery will be somewhat slower than the capital market (12 months) as the federal funds rate generally reacts more slowly.

Severe Scenario Reasons:

- S&P: Panic will cause a noticeable but short term disruption in the market. The pandemic is seen as a temporary state by the market, and correction (recovery) will follow within 12 months. Recovery will take longer than in the moderate scenario due to the more severe corporate operational distress.

## APPENDIX D INDIVIDUAL RESPONSES TO ROUND ONE

- Fed Funds: The government response will be very measured, but will act more aggressively than in the moderate scenario to maintain economic stability. My response reflects the additional change attributable directly to the economic effects of the pandemic. Recovery will be somewhat slower than the capital market (24 months) as the federal funds rate generally reacts more slowly.

### QUESTION 4:

Please list plausible future developments that you believe could impact the values of your responses in questions 1 and 2, should they occur:

#### Moderate Scenario

1. Government bailout of various industries (aviation, tourism).
2. Government enforcement of travel quarantines.

#### Severe Scenario

1. Government bailout of various industries (aviation, tourism).
2. Government enforcement of travel quarantines.

## RESPONSE 11

### QUESTION 1:

The table below shows U.S. governmental projections for the number of U.S. deaths for two flu pandemic scenarios. Assuming these estimates are accurate for each scenario, please provide your judgment for the values for each of the asset classes shown below. Values can be positive or negative.

Virulence Level Scenario	Maximum % Change in S&P 500 Index within 180 days from the onset of the flu pandemic in the U.S.	Maximum Change in Aa Corporate Bond Yield within 180 days from the onset of the flu pandemic in the U.S.*	Maximum Change in the Federal Funds Rate within 180 days from the onset of the flu pandemic in the U.S.*
Moderate (209,000 deaths)	-5%	+10bps	-100bps
Severe (1.9 million deaths)	-20%	+20bps	-200 bps

\*Express maximum change in basis points

### QUESTION 2:

For each of your answers above, how long would you anticipate before asset values, return to the levels experienced before the onset of the pandemic?

Virulence Level Scenario	Recovery Time for S&P 500 Index	Recovery Time for Aa Corporate Bond Yield	Recovery Time for Federal Funds Rate

**APPENDIX D**  
**INDIVIDUAL RESPONSES TO ROUND ONE**

Moderate (209,000 deaths)	6 months	6 months	12 months
Severe (1.9 million deaths)	3 years	1 year	3 years

**QUESTION 3:**

For each of your answers above, please provide your reasoning and assumptions for your views.

Moderate Scenario Reasons:

1. In both moderate and sever scenarios impact on equity markets will be larger, with lesser impact on (high quality) spreads. This is because a pandemic will impact principally top line growth (which effects equity returns) more than short term bottom line profits (which effects corporate bonds).
2. There would be a greater impact for lower grade corporate bonds.
3. Under moderate scenario, the recovery will be swift and complete once it is understood that the more sever scenario did not occur – because the severe risk did not materialize, there is little permanent damage to the economy
4. Under both scenarios. The Fed will provide significant economic stimulus.

Severe Scenario Reasons:

**QUESTION 4:**

Please list plausible future developments that you believe could impact the values of your responses in questions 1 and 2, should they occur:

No Response

**RESPONSE 12**

**QUESTION 1:**

The table below shows U.S. governmental projections for the number of U.S. deaths for two flu pandemic scenarios. Assuming these estimates are accurate for each scenario, please provide your judgment for the values for each of the asset classes shown below. Values can be positive or negative.

Virulence Level Scenario	Maximum % Change in S&P 500 Index within 180 days from the onset of the flu pandemic in the U.S.	Maximum Change in Aa Corporate Bond Yield within 180 days from the onset of the flu pandemic in the U.S.*	Maximum Change in the Federal Funds Rate within 180 days from the onset of the flu pandemic in the U.S.*
Moderate (209,000 deaths)	- 5%	+ 50bp	- 50bp
Severe (1.9 million deaths)	- 10%	No change	- 250bp

\*Express maximum change in basis points

## APPENDIX D INDIVIDUAL RESPONSES TO ROUND ONE

### QUESTION 2:

For each of your answers above, how long would you anticipate before asset values, return to the levels experienced before the onset of the pandemic?

Virulence Level Scenario	Recovery Time for S&P 500 Index	Recovery Time for Aa Corporate Bond Yield	Recovery Time for Federal Funds Rate
Moderate (209,000 deaths)	½ year	½ year	½ year
Severe (1.9 million deaths)	1 year	1 year	2 years

### QUESTION 3:

For each of your answers above, please provide your reasoning and assumptions for your views.

Moderate Scenario Reasons:

S&P 500 – mild shock to the system, offset somewhat by Fed action.

Yields—50bp reduction in risk-free rates offset by 100bp increase in spreads. Note that neither change to the Aa bond yield takes into account that a number of issuers would be downgraded away from Aa in either scenario.

Severe Scenario Reasons:

S&P 500 – shock to the system, offset by Fed loosening and by changes in consumer behavior (e.g., traditional retailers see their stock prices fall, while those with robust Internet presences see their stock prices rise or at least tread water).

Yields – 250bp reduction in risk-free rates offset by massive increase in spreads as bond market overreacts.

### QUESTION 4:

Please list plausible future developments that you believe could impact the values of your responses in questions 1 and 2, should they occur:

Moderate Scenario

1. Fed fails to provide sufficient liquidity to markets.
2. Consumer spending over-reacts out of fear.

Severe Scenario

1. Fed fails to provide sufficient liquidity to markets.
2. Consumer spending grinds to a halt as preventive measures are not available in sufficient quantities.

## APPENDIX E INDIVIDUAL RESPONSES TO ROUND TWO

### RESPONSE 1

#### QUESTION 1:

The table below shows U.S. governmental projections for the number of U.S. deaths for two flu pandemic scenarios. Assuming these estimates are accurate for each scenario, please provide your judgment for the values for each of the asset classes shown below. Values can be positive or negative.

Virulence Level Scenario	Maximum % Change in S&P 500 Index within 180 days from the onset of the flu pandemic in the U.S.	Maximum Change in Aa Corporate Bond Yield within 180 days from the onset of the flu pandemic in the U.S.*	Maximum Change in the Federal Funds Rate within 180 days from the onset of the flu pandemic in the U.S.*
Moderate (209,000 deaths)	-5%	-50 basis points	-50 bp
Severe (1.9 million deaths)	-35%	-200 bp	-150 bp

\*Express maximum change in basis points

#### QUESTION 2:

For each of your answers above, how long would you anticipate before asset values, return to the levels experienced before the onset of the pandemic?

Virulence Level Scenario	Recovery Time for S&P 500 Index	Recovery Time for Aa Corporate Bond Yield	Recovery Time for Federal Funds Rate
Moderate (209,000 deaths)	5 months	6 months	6 months
Severe (1.9 million deaths)	3 years	2 years	2 years

#### QUESTION 3:

For each of your answers above, please provide your reasoning and assumptions for your views.

##### Moderate Scenario Reasons:

Much depends on how the media play what happens. Even if the pandemic is moderate (as defined for the survey), if the media play up clusters of sick and dead as though it were a severe pandemic, the reaction of the investment markets (and economic behavior in general) could take on the characteristics of panic. However, I'm assuming that this

## **APPENDIX E**

### **INDIVIDUAL RESPONSES TO ROUND TWO**

will not be the case. Instead, I assume that, in the moderate scenario, the main victims will be those at the extreme ages, and that the media will quickly conclude that this isn't a 1918-style Biblical-dimension plague. News stories will quickly focus on identification, prevention, treatment, and other helpful aspects to coping with the pandemic. Some lingering uncertainty will prevail, both because there will be no vaccine for at least the first wave and because people will be waiting for a second (and maybe a third) wave after the first one passes.

#### Severe Scenario Reasons:

Much depends on how the media play what happens. I assume that in the severe scenario some prominent people in the "prime of life" will die from the flu – possibly athletes, entertainers, and/or senior government officials – and that the media will make much of these developments. This will not only heighten fear of what the disease can do, but will further destabilize society. (In *The Great Influenza*, John Barry strongly hints that in 1919 Woodrow Wilson was a flu victim, and that the treaty that ended World War I would have been quite different if Wilson hadn't been struck by the disease.) Barry and other writers also indicate that the severe flu produced a substantial amount of long-term disability in addition to unprecedented death, and I assume this would happen again under a "severe" scenario. I believe that the combination of death and disability would depress economic activity for at least a few years.

#### **QUESTION 4:**

Please list plausible future developments that you believe could impact the values of your responses in questions 1 and 2, should they occur:

#### Moderate Scenario

1. As noted in my answer to question 3, if the media play the moderate scenario as though it's a "severe-level" pandemic, the economic impact could be many times worse. This might happen if, for example, half of the U.S. Supreme Court dies within a short span from the flu or its complications – which is plausible under a "moderate" scenario in which the flu strikes primarily people at the extreme ages and/or with medical conditions that make them unusually vulnerable to the flu.
2. As the response to the Katrina hurricane demonstrated, government is capable of making the situation worse than it would be otherwise. The moderate scenario could be worse than I've assumed if the government agencies involved so badly bungle their role (or are at least perceived to do so) that people lose confidence in society's ability to manage the pandemic. If that happens, economic activity would slow more than otherwise.
- 3.

#### Severe Scenario

1. The development/discovery/application of techniques for minimizing the spread of the disease, such as masks (if they're effective against the flu), latex gloves, sanitizing sprays, or other common devices could not only lessen the number of people infected (spread out the timing of infection) but also could maintain (or restore) public confidence

## APPENDIX E

### INDIVIDUAL RESPONSES TO ROUND TWO

in our ability to cope with the pandemic. Under these conditions, the economic effects might be milder and shorter-lived than otherwise.

2. One aspect of pandemic preparedness that hasn't been discussed is the role of organized religion. Religious leaders are not listed among those who, like police and medical personnel, are to be vaccinated first so that they can serve others, but in a time of severe social stress such as could be caused by a severe pandemic, many people would turn to their religious leaders for comfort, for "explanations," and for hope. It is reasonable to imagine that, at least for a short time, religious gatherings might be banned in order to prevent spread of the disease among a congregation, but it is unclear whether this will help or hurt the situation in the long run.

#### **RESPONSE 4**

##### **QUESTION 1:**

The table below shows U.S. governmental projections for the number of U.S. deaths for two flu pandemic scenarios. Assuming these estimates are accurate for each scenario, please provide your judgment for the values for each of the asset classes shown below. Values can be positive or negative.

Examples to help you complete the grid:

- An example of the percentage change in S&P 500 index: If starting value before the flu pandemic occurs in the U.S. is 1330 and the index changes to 1197 after the pandemic occurs, the % change is -10%.
- An example of the change in Corporate Bond Yield and Federal Funds Rate: If starting value before the pandemic occurs in the U.S. is 6.0% and the yield or rate changes to 6.6% after the pandemic occurs, the change is 60 basis points.

Virulence Level Scenario	Maximum % Change in S&P 500 Index within 180 days from the onset of the flu pandemic in the U.S.	Maximum Change in Aa Corporate Bond Yield within 180 days from the onset of the flu pandemic in the U.S.*	Maximum Change in the Federal Funds Rate within 180 days from the onset of the flu pandemic in the U.S.*
Moderate (209,000 deaths)	-5%	-10 bps	-50 bps
Severe (1.9 million deaths)	-15%	+50 bps	-100 bps

\*Express maximum change in basis points

##### **QUESTION 2:**

## APPENDIX E

### INDIVIDUAL RESPONSES TO ROUND TWO

For each of your answers above, how long would you anticipate before asset values, return to the levels experienced before the onset of the pandemic?

Virulence Level Scenario	Recovery Time for S&P 500 Index	Recovery Time for Aa Corporate Bond Yield	Recovery Time for Federal Funds Rate
Moderate (209,000 deaths)	90 days	Minimal impact, 90 days	12 months, increased inflation risk
Severe (1.9 million deaths)	2 years	3 years	30 months

#### QUESTION 3:

For each of your answers above, please provide your reasoning and assumptions for your views.

##### Moderate Scenario Reasons:

I expect that the pandemic will spread around the world very quickly and that this is the first wave. I assumed that a moderate scenario would have very limited long term implications, but that there would be a “fear factor” that would go through the both the bond and equity markets and require the fed to respond by adding liquidity. I think that this would steepen the yield curve for Treasuries, so the 5 and 10 year points on the curve would not change by the full amount (perhaps 20 bps down). The typical Aa bonds would have a higher perceived default risk that would partially offset this, resulting in a 10 bps reduction.

##### Severe Scenario Reasons:

I assume that the pandemic hits worldwide within a very short period of time and that the first wave is severe. I expect vaccines to be available in the US before a second wave hits 9 months later, providing additional protection. I assume that the markets are not already at extreme levels such as 1973 or 1999. I expect a severe pandemic to have longer lasting impact on the world economy. The equity drop will be longer lasting as there is not a built in recovery like casualty risks have. I think the fed would add liquidity in two 50 bps increments to calm the markets. It’s possible that more would be needed. The curve would immediately invert with the fed actions flattening it out. I think the curve at the 5/10 year points would be down about 75 bps and default risk up 125 bps for a net increase of 50 bps. I also assume with the default risk that the return to base spread applies only to new issues since many of the earlier bonds would have been downgraded.

#### QUESTION 4:

Please list plausible future developments that you believe could impact the values of your responses in questions 1 and 2, should they occur:

## APPENDIX E

### INDIVIDUAL RESPONSES TO ROUND TWO

#### Moderate Scenario

1. major catastrophic event like earthquake/flooding at same time
2. vaccine effectiveness
3. overreaction by US government by shutting borders or closing trade between states

#### Severe Scenario

1. supply chain disaster
2. successful vaccine
3. mutations of virus around available anti-virals and secondary infections against antibiotics
4. meltdown of geopolitical stability
5. poor harvest with limited workers leads to mass starvation
6. stagflation

## **RESPONSE 6**

### **QUESTION 1:**

The table below shows U.S. governmental projections for the number of U.S. deaths for two flu pandemic scenarios. Assuming these estimates are accurate for each scenario, please provide your judgment for the values for each of the asset classes shown below. Values can be positive or negative.

Examples to help you complete the grid:

- An example of the percentage change in S&P 500 index: If starting value before the flu pandemic occurs in the U.S. is 1330 and the index changes to 1197 after the pandemic occurs, the % change is -10%.
- An example of the change in Corporate Bond Yield and Federal Funds Rate: If starting value before the pandemic occurs in the U.S. is 6.0% and the yield or rate changes to 6.6% after the pandemic occurs, the change is 60 basis points.

Virulence Level Scenario	Maximum % Change in S&P 500 Index within 180 days from the onset of the flu pandemic in the U.S.	Maximum Change in Aa Corporate Bond Yield within 180 days from the onset of the flu pandemic in the U.S.*	Maximum Change in the Federal Funds Rate within 180 days from the onset of the flu pandemic in the U.S.*
Moderate (209,000 deaths)	-5%	+50bp	-100bp
Severe (1.9 million deaths)	-10%	+100bp	-200bp

## APPENDIX E INDIVIDUAL RESPONSES TO ROUND TWO

\*Express maximum change in basis points

### QUESTION 2:

For each of your answers above, how long would you anticipate before asset values, return to the levels experienced before the onset of the pandemic?

Virulence Level Scenario	Recovery Time for S&P 500 Index	Recovery Time for Aa Corporate Bond Yield	Recovery Time for Federal Funds Rate
Moderate (209,000 deaths)	6-9 mo	9 mo	12 mo
Severe (1.9 million deaths)	12mo	12mo	24mo

### QUESTION 3:

For each of your answers above, please provide your reasoning and assumptions for your views.

Moderate Scenario Reasons:

Severe Scenario Reasons:

### QUESTION 4:

Please list plausible future developments that you believe could impact the values of your responses in questions 1 and 2, should they occur:

Moderate Scenario

- 1.
- 2.
- 3.

Severe Scenario

- 1.
- 2.

## APPENDIX E INDIVIDUAL RESPONSES TO ROUND TWO

### RESPONSE 7

#### QUESTION 1:

The table below shows U.S. governmental projections for the number of U.S. deaths for two flu pandemic scenarios. Assuming these estimates are accurate for each scenario, please provide your judgment for the values for each of the asset classes shown below. Values can be positive or negative.

Virulence Level Scenario	Maximum % Change in S&P 500 Index within 180 days from the onset of the flu pandemic in the U.S.	Maximum Change in Aa Corporate Bond Yield within 180 days from the onset of the flu pandemic in the U.S.*	Maximum Change in the Federal Funds Rate within 180 days from the onset of the flu pandemic in the U.S.*
Moderate (209,000 deaths)	-10%	-25 bp	-75 bp
Severe (1.9 million deaths)	-25%	-25 bp	-150 bp

\*Express maximum change in basis points

#### QUESTION 2:

For each of your answers above, how long would you anticipate before asset values, return to the levels experienced before the onset of the pandemic?

Virulence Level Scenario	Recovery Time for S&P 500 Index	Recovery Time for Aa Corporate Bond Yield	Recovery Time for Federal Funds Rate
Moderate (209,000 deaths)	1.5 years	0 year	1.5 year
Severe (1.9 million deaths)	3.5 years	0 year	2.5 years

#### QUESTION 3:

For each of your answers above, please provide your reasoning and assumptions for your views.

Moderate Scenario Reasons:

- S&P 500

## **APPENDIX E**

### **INDIVIDUAL RESPONSES TO ROUND TWO**

- Work force not materially affected by excess deaths.
- Small reduction in sales as malls are temporarily deserted.
- It may take a couple of months for the reality to kick in and to understand the extent of the pandemic.
- Within a 6 months period, the prices should stabilize and the pressure on some industries will reduce stock prices by about 10%.
- Prices should come back to original values within the next year as the pandemic is contained.
  
- Aa corporate bonds
  - Spreads on highly rated bonds should not widen excessively during a moderate pandemic.
  - It will take a few weeks for any investors to react to the pandemic; a most likely reaction is a swap to treasuries and highly rated bonds. This should raise the price for AA bonds and reduce the overall yield.
  - AA companies should have strong enough balance sheets to stomach a moderate pandemic, spreads may widen by 25 bp because of increased concerns on the future of the economy but excess demand for high quality bonds may reduce the risk free rates by 50 bp.
  - Since most AA bonds are in the 5 - 15 year maturity range, the fed's rate will not impact the price of these bonds.
  
- Feds
  - Once the feds realizes the importance of the pandemic, they will start reducing their rates to take some pressure off.
  - Within the first 2 months, rates may go down 75 bp. Another 25 bp reduction will occur until they realize that the pandemic is not as bad as expected.
  - The rates will stay at that level until the pandemic is contained (after one year). When everything goes back to normal, the feds will start bringing the rate up over a 6 month period.

#### Severe Scenario Reasons:

- S&P 500
  - At the beginning, the pandemic may not be clearly identified, and the market will have a minor negative reaction.
  - After a couple of months, the economy slows down because of disruption in the work force and the stock market goes down again.
  - As the economy adjusts to the new reality, the stock market stabilizes after suffering a 25% loss in 6 months.
  - This level will stabilize until the pandemic is contained (after one year) and the S&P starts growing back at 10% per year, getting back to the original level 3.5 years after the pandemic onset.
  
- AA Bonds
  - Fundamentals on AA companies should remain strong but spreads will most likely increase because of the uncertainty of the markets.

## **APPENDIX E**

### **INDIVIDUAL RESPONSES TO ROUND TWO**

- Increases in spreads by 50 to 75 bp will be possible and not unheard of for this asset class.
- Bond holders will want to hold more secure bonds, which should increase the price of highly rated bonds and decrease the prices of junk bonds. The yield curve for the 5 to 15 year maturity may decrease by 50 to 75 bp.
- The net impact on the AA bonds would practically be null.
- Feds
  - The Feds will be very accommodative very quickly, reducing their rates three times by 50 bp over the first 4 months and by 25 bp over the next 2 months.
  - They will most likely decrease them by another 100 bp over the following 6 months.
  - After the pandemic is contained (after one year), it will take them at least 1.5 year to bring it back to the original levels.

#### **QUESTION 4:**

Please list plausible future developments that you believe could impact the values of your responses in questions 1 and 2, should they occur:

##### Moderate Scenario

1. A rapid containment of the pandemic (within one week for example) or the development of a vaccine readily available to the general population would mitigate the impact of the pandemic and will not give enough time for the Feds to reduce rates or to the markets to be materially affected.
2. Creating a safer environment for workers.
3. Any other shock that would affect the economy; natural disaster, terrorist attack, recession, etc.

##### Severe Scenario

1. Special relief for companies to help them cope with liquidity problems.
2. Efficient subsidized programs to train and develop new workers.
3. Rapid and efficient implementation of Business Continuity Programs.
4. Disruptions in the financial markets (banks failing, liquidity crisis, etc.)

## **RESPONSE 8**

#### **QUESTION 1:**

The table below shows U.S. governmental projections for the number of U.S. deaths for two flu pandemic scenarios. Assuming these estimates are accurate for each scenario, please provide your judgment for the values for each of the asset classes shown below. Values can be positive or negative.

Examples to help you complete the grid:

## APPENDIX E

### INDIVIDUAL RESPONSES TO ROUND TWO

- An example of the percentage change in S&P 500 index: If starting value before the flu pandemic occurs in the U.S. is 1330 and the index changes to 1197 after the pandemic occurs, the % change is -10%.
- An example of the change in Corporate Bond Yield and Federal Funds Rate: If starting value before the pandemic occurs in the U.S. is 6.0% and the yield or rate changes to 6.6% after the pandemic occurs, the change is 60 basis points.

Virulence Level Scenario	Maximum % Change in S&P 500 Index within 180 days from the onset of the flu pandemic in the U.S.	Maximum Change in Aa Corporate Bond Yield within 180 days from the onset of the flu pandemic in the U.S.*	Maximum Change in the Federal Funds Rate within 180 days from the onset of the flu pandemic in the U.S.*
Moderate (209,000 deaths)	10%	10BP	50BP
Severe (1.9 million deaths)	20%	35BP	200BP

\*Express maximum change in basis points

#### QUESTION 2:

For each of your answers above, how long would you anticipate before asset values, return to the levels experienced before the onset of the pandemic?

Virulence Level Scenario	Recovery Time for S&P 500 Index	Recovery Time for Aa Corporate Bond Yield	Recovery Time for Federal Funds Rate
Moderate (209,000 deaths)	9 months	9 months	12 months
Severe (1.9 million deaths)	18 months	18 months	30 months

We estimated the credit deterioration (using a Merton Model) in a typical As bond given the presumed drop in equity values and the spread required to make up for that change; not the change in spread for a constant rating *per se*

#### QUESTION 3:

For each of your answers above, please provide your reasoning and assumptions for your views.

Moderate Scenario Reasons:

As stated in round 1, historical pandemics have actually been followed by periods of market growth. To be conservative, we assumed a 10% drop in our estimation. Upon reflection, I believe the market would recover faster than stated in round 1, hence 9

**APPENDIX E**  
**INDIVIDUAL RESPONSES TO ROUND TWO**

months for a moderate scenario. Impact on bonds was a function of equity declines (using a Merton model) and therefore tracks the same timeline. Assuming the Fed drops interest rates to spur recovery, they would likely leave them low till the market shows significant positive movement (say six months) then raise them 25 BP per quarter thereafter. Therefore 12 months for a moderate scenario.

**Severe Scenario Reasons:**

We assumed double the loss in the moderate scenario – 20% drop in equities with its commensurate impact on bond spreads. These would take approximately six months to show significant recovery, and a further twelve to recover fully. After the six months of recovery, it would take the Fed an additional 24 months to raise rates back to pre-infection levels.

**QUESTION 4:**

Please list plausible future developments that you believe could impact the values of your responses in questions 1 and 2, should they occur:

**Moderate Scenario**

1. Extent of pandemic in other countries
2. Degree of certainty that extent will be limited
3. Impact on other world markets that might fuel panic

**Severe Scenario**

1. Same as above
2. Willingness of hedge funds to ride out disruption or force liquidity crisis.

**RESPONSE 11**

**QUESTION 1:**

The table below shows U.S. governmental projections for the number of U.S. deaths for two flu pandemic scenarios. Assuming these estimates are accurate for each scenario, please provide your judgment for the values for each of the asset classes shown below. Values can be positive or negative.

Virulence Level Scenario	Maximum % Change in S&P 500 Index within 180 days from the onset of the flu pandemic in the U.S.	Maximum Change in Aa Corporate Bond Yield within 180 days from the onset of the flu pandemic in the	Maximum Change in the Federal Funds Rate within 180 days from the onset of the flu pandemic in the U.S.*
--------------------------	--	---	--

## APPENDIX E INDIVIDUAL RESPONSES TO ROUND TWO

		U.S.*	
Moderate (209,000 deaths)	-25%	100bpts	0bpts
Severe (1.9 million deaths)	-40%	150bpts	-50bpts

\*Express maximum change in basis points

### QUESTION 2:

For each of your answers above, how long would you anticipate before asset values, return to the levels experienced before the onset of the pandemic?

Virulence Level Scenario	Recovery Time for S&P 500 Index	Recovery Time for Aa Corporate Bond Yield	Recovery Time for Federal Funds Rate
Moderate (209,000 deaths)	6mths	3mths	0
Severe (1.9 million deaths)	18mths	6mths	24mths

### QUESTION 3:

For each of your answers above, please provide your reasoning and assumptions for your views.

Moderate Scenario Reasons:

Initial 'Shock Effect' would be just as large as with Severe Scenario. However, 'Relief' effect that worst is over would come sooner. Classic flight to quality response followed by bottom fishing value seekers driving the market back up.

Severe Scenario Reasons:

More potential for financial market disruption to impinge on real economy, hence time line for recovery is longer. Also, potential for market 'second round' effects to emerge as initial fears of an economic impact actually get realized and investors then overshoot further on the downside. Longevity of GDP effects will depend upon the demographic composition of mortality.

### QUESTION 4:

Please list plausible future developments that you believe could impact the values of your responses in questions 1 and 2, should they occur:

Moderate Scenario

1. Was it terrorist generated? Even speculation of this could change the market response dramatically.
2. Will the virus mutate or has potential to mutate?

**APPENDIX E**  
**INDIVIDUAL RESPONSES TO ROUND TWO**

3. Is the pandemic 'localized' in terms of either demography or geography within the US?

**Severe Scenario**

1. Was it terrorist generated? Even speculation of this could change the market response dramatically.

2. Will the virus mutate or has potential to mutate?

3. Is the pandemic 'localized' in terms of either demography or geography within the US?