Open Letter to the Stern Review of the Economics of Climate Change

Thank you for the opportunity to present ideas to this review of the economics of climate change. This open letter addresses the key points relating to what the under signed authors consider to be the two critical issues concerning the catastrophic risks associated with the extreme aspects of global climate change, namely:

- The ability of financial markets to correctly value the risks associated with environmental change.
- How can the insurance industry – which provides the overwhelming majority of protection against the risks associated with environmental change - minimise the likelihood of financial crises as environmental disasters occur with increasing frequency.

This letter deals with each question in turn. In the first section, the deficiencies of existing environmental risk valuation methods are briefly analysed and possible solutions suggested. The second section examines the current ability of the insurance industry to absorb future environmental disasters without being either the cause of or being overwhelmed by systemic financial crisis, also suggesting possible changes to current approaches that would improve the robustness of the insurance industry for coping with catastrophes without fundamentally compromising future risk bearing capacity. Our conclusions offer some recommendations on possible guidelines for the implementation of practical policies.

Issue 1: Current risk valuation techniques are inadequate to deal with increased environmental risks arising from climate change

There are three critical problems with existing risk valuation techniques:

i. ***Assumed distributions of environmental risks are breaking down***: Sustained and substantial changes in weather patterns are causing large increases in the probability of occurrence of anomalous climatic events. This changing behaviour is not reflected in current risk valuation models, causing many existing models to severely under-predict (and therefore incorrectly value) the likelihood of occurrence, size of impact and risk of future catastrophic events. Data from the insurance industry show that the estimated damage from catastrophes has doubled every year since 2002, while claim volume has increased steadily since 2000. Significantly, twelve catastrophes on the PCS's "Top 20" list have occurred over the past five-years. A dramatic increase in the number and value of exposed properties in high-risk areas is a major contributor to increasing catastrophe losses. At the micro level, according to the daily publication Credit Sights, the Tropical Meteorology Project at Colorado State University now estimates that for 2006 there is a 64% probability that a major hurricane (category 3 or higher on the Saffir-Simpson scale) will hit the East Coast of the United States during 2006 – which is more than twice the average over the past 100 years. Should such an event occur, the total value of insured property in the Tri-State area alone is $2.7trillion*. The inability of a model to deal with variability in the underlying inputs (such as the distribution of the underlying events) is a classic indicator that the underlying model is neither robust nor stable.

ii. ***Inadequacy of existing risk models***: In common with many markets, models used in the insurance industry result in valuations for risks that are just sufficient to clear supply and demand for that part of the risk being considered. However, it is far from clear that such valuations reflect the full economic costs of bearing the associated risks. Evidence that this is so can be seen in facts such as the mismatching of the location of risks and insured losses. For example, according to Sigma 2005, 92% of fatalities occurred in Asia, but 87% of insured losses were located in North America in 2005. This leads to myopic models that concentrate on capturing factors that affect the financial risk of catastrophes but ignore the potential loss of life and long-term environmental risks. Once again, un-modelled variables are a further indicator of a lack of model robustness. The problem is further compounded by the inherent measurement uncertainty surrounding many of the aspects of measuring the weather variables that form a cornerstone of the inputs to existing models.

iii. ***Unfavourable macro-economic climate***: A combination of higher claims, lower returns on invested premia (attributable to the lower returns earned by insurers from equity and bond markets) have combined to exert even greater pressure on primary insurers as well as re-insurers, thereby exposing and further exacerbating the inadequacies of existing structural, capital-based risk models as insurers and re-insurers take on more risk in an attempt to reach for higher returns. Finally, stressing a model with known shortcomings increases the likelihood of producing non-robust valuations.

Proposed Solution for Issue 1: develop a new modelling approach

i. ***Incorporate feedback into models to make them more robust to uncertainty and change***: Any proposed solution to the above model based problems must address the underlying causes of those problems, namely, the intrinsic lack of model robustness. By this we mean that new robust modelling approaches are needed to produce valuations for the increasingly frequent extreme climatic events, such that the new models are not tied irrevocably to the presently endemic (non-robust) stochastic calculus approach to valuation. The single feature required for model robustness and stability is the incorporation of feedback directly into the risk valuation model. Recent papers by Salmon and Weston (2006) explain the detailed theory behind this concept. However, the intuition can be easily understood by posing the environmental risk valuation problem as an option-pricing problem set in a game theoretic framework, the solution to which employs non-linear control techniques familiar to engineers.

ii. ***Employ robust risk valuation and measurement techniques***: Such a robust approach provides a massive advantage over existing models, namely, the avoidance of the otherwise difficult issue of parameterisation of the behaviour of the underlying (usually weather) variables. This occurs because in order to value extreme risks, robust models require no knowledge of either the identity of the parameters or the moments of their distribution. They merely require a description of a set of feasible trajectories for the underlying process – typically weather, either in the form of wind, rainfall or temperature. Critically, this lack of reliance on estimated distributions, is based on a far more flexible and robust approach that is capable of incorporating known non-linear dynamics inherent in the problem structure. The result is a valuation approach that incorporates feedback into the model as a means of dealing with the uncertainty, thereby producing valuations of extreme event risks that are both more stable and robust.

Issue 2: current risk bearing capacity is insufficient to deal with increased environmental and financial risks arising from climate change

The insurance industry currently provides protection for the overwhelming majority of environmental risks, yet its capacity to absorb losses associated with catastrophic events is severely limited by the risk bearing capacity within the industry, to the point where there are severe doubts about the capacity of the industry to absorb the rising tide of losses resulting from the increased frequency and scale of catastrophic events. The problem manifests itself in the following three ways:

i. ***Aggregate losses rising faster than industry risk bearing capacity:*** The aggregate value of catastrophic losses have increased every year since 1970, with both the number and aggregate value of losses having doubled in the past 5 years alone. Insured losses rose significantly from $48bn in 2004, such that in 2005, catastrophes caused directly attributable, global financial losses of more than $230bn, of which, $220bn is directly attributable to natural catastrophes. Hurricanes Katrina, Wilma and Rita accounted for losses of $170bn of the 2005 losses. Katrina alone absorbed over 7.5% of US non-life premium income. Global insured losses accounted for $83bn of the $230bn total, with $78bn of the $83bn stemming from natural catastrophes. Re-insurers bore the brunt of Katrina, Wilma and Rita, with many of Bermuda based syndicates needing to dip into their equity in order to meet their liabilities, but over one third of the exposure was still left with US primary insurers. The net loss for the Lloyds of London insurance market as a result of hurricane Katrina is estimated at $3.42bn. To put this in context for the UK insurance market, Lloyd's expects to have the capacity to write approximately ($27bn) of risk business in 2006, an increase of 7% on 2005.This contrasts with the position before the hurricanes, with rates softening, when it was expected that Lloyd's capacity would reduce by around 7% next year. The US capital markets alone are worth $26 trillion - 75 times more than property / casualty industry's net worth. Risk bearing capacity: according to the 2005 Sigma review, with losses of $45bn the hurricane season of 2005 was the most expensive year for property insurers since the San Francisco earthquake of 1906.

ii. **R*isk transference is inefficient**:* To date, there has been a very low degree of risk transference from the under-capitalised and illiquid insurance sector, into the deep and highly liquid international capital markets. The transference has predominantly been in the form of the securitisation of the better-understood (and therefore intrinsically more tradable) assets such as life insurance policies – being pioneered by the NPI securitisation in the UK in 1998 and in the

USA by the 2001 Prudential Corporation $1.75bn issue. This latter issue was a landmark transaction as it was arguably the first structure that explicitly brought together the two sectors through both the securitisation and through the inclusion of the credit default protection that was subsequently traded through the capital markets. However, in reality, catastrophic risk transference has remained extremely small in terms of both volume (annual issuance as well as total historical issuance) and total amount of outstanding securities currently in existence. For example, there is less than $5bn of catastrophe bonds currently outstanding, with the total historical issuance being under $10bn.

iii. ***Risk spreading is inadequate:*** At the level of the insurance industry, the overwhelming proportion of catastrophic risk remains within the industry (despite the known and acknowledged risk bearing limitations) – having been recycled between the insurers and re-insurers. This is fundamentally attributable to the fact that until very recently, large investment banks were substantially unwilling to undertake catastrophic risk, as there was little or no prospect of being able to manage their exposures through hedging in a secondary market. At the transaction level, there have been relatively few significant transactions that have truly performed risk spreading outside of the insurance industry. As explained above, although securitisation has occurred, it has been almost entirely limited to non-catastrophic risks, with the result that existing instrument issuance is insufficient to free up enough capital to deal with increased frequency and cost of catastrophes. There is a real prospect that insurance will be withdrawn and unavailable to cater for catastrophic events.

Proposed Solution for Issue 2:

The insurance industry is well aware of its lack of risk capital to cope with catastrophic events. So, how have the major players in the industry responded so far to the increasing gap between risk bearing capacity on the one hand, versus the increased number and cost of catastrophic risk events on the other hand? Beyond inadequate increases in risk bearing capital, the principal response by the insurance industry has been to securitise the most marketable assets within its risk portfolios to free up risk bearing capacity. However, whilst this approach is rational it is far from adequate, because the freed capacity represents only a fraction of the catastrophic liabilities that the industry faces from events such as Katrina. So, what strategy should the insurance industry follow in order to achieve a substantial improvement in its risk bearing capacity? An effective strategy is simple to identify in theory, but may be difficult to implement in practice. However, it is easy to see that it should be comprised of three distinct though inter-related and mutually reinforcing components:

i. ***Clear, consistent identification and quantification of the future hazards and risks***: Inconsistencies between the capital markets and insurance markets make it difficult for institutions to measure and manage risk in consistent ways. To overcome this problem, changes to the supervisory/regulatory environment for both the insurance and capital markets are required if inter-industry solutions are to be achieved. In the capital markets, international banks are already beginning changes required to their risk-capital regulatory environment as part of the Basel II framework. This revised framework will, when fully operational in 2007/2008, have a significant impact on capital requirements (as expressed in a capital adequacy ratio) for financial institutions in two ways. First, changes in the assets eligible for inclusion as Tier 1 and Tier 2 capital (in particular, certain forms of catastrophe-linked securities will become eligible for inclusion in Tier 2 capital, subject to a 15% limit), will affect the numerator of the risk-asset ratio. Second, the development of both weather and credit derivatives markets has made it possible for financial institutions to hedge a substantial part of the risk associated with catastrophic derivatives within their normal risk-capital process. This has a double benefit as it allows financial institutions to achieve trading book treatment of catastrophe-linked securities (thereby vastly reducing risk-capital requirements), whilst simultaneously providing risk measures that financial institutions are comfortable measuring and controlling

ii. ***Reduction of those risks that can be reduced*****:** Catastrophe bonds are a known mechanism for the financial markets to absorb and spread natural hazards risk. Indeed, reinsurance companies are one of the most frequent issuers and facilitators of catastrophe-linked bonds. These securities are typically sold by insurance companies and trade infrequently, consequently paying a much higher coupon than debt with similar credit ratings in exchange for investors taking the risk that they may lose their invested capital. Catastrophe bonds issued on behalf of countries such as Mexico and Taiwan covering earthquake risk, have been used to insure public finances against potential costs related to natural disasters. The bonds are an alternative to reinsurance offered by industry giants such as Swiss Re, Munich Re and other companies, which raised policy prices

after the damage caused by Hurricane Katrina. Yet, hurricane and other natural disaster catastrophe bonds are currently in limited use. According to a Marsh McLennan Corporation (MMC) Securities Corp. 2005 report, total cat bond issuance in 2004 was only $1.14 billion, a decline from 2003. The report notes that since 1997, when cat bonds first were issued, the total number of transactions has only been 59 with total issuance limits of $8.66 billion of which only $4.04 billion is outstanding. This is a very small amount in comparison to the industry's catastrophe exposure. Although many in the industry had hoped the cat bond market would provide significant additional capacity for natural disasters, it simply has not. Factors such as cost, complexity, regulatory and accounting issues, high risks, lack of analytical capacity and liquidity concerns are often cited as reasons the catastrophe bond market has not developed further. Although a number of these issues are being addressed gradually, far more needs to be accomplished more quickly if such catastrophe bonds are to become a viable means of transferring risk between the two industries.

iii. ***Transfer of those risks that cannot be eliminated or reduced through risk sharing mechanisms or risk financing mechanisms such as insurance*:** Catastrophe based securities and their derivatives, clearly have a key role to perform in helping to efficiently and effectively transfer risks between the two industries. However, the real challenge is for the endemically innovative capital markets to create hybrid instruments that offer a wider range of methods of bridging the gap between the two industries, thereby appealing the widest possible base or investors and hedgers, thereby maximising the risk transfer. Due in large part to the recent developments in the credit derivatives market, several of the large international banks are now beginning to offer products that will, in addition to facilitating inter-industry risk transfer, also enable market participants to effectively hedge exposures associated with catastrophe linked securities. Arguably the most contemporaneous example of such a product is a type of default swap with a binary payout based on an accumulated catastrophic loss level and whose underlying is one of a range of catastrophe loss indexes. This product has the joint advantage of monetising the catastrophe risk, but in a form that is familiar to a highly developed sector of the capital markets currently awash with hedge fund investment money. The cat-CDS (as it is known) will be traded based on specific types of underlying such as US wind, thereby also helping to broaden and deepen the risk transference capability offered by the standard weather derivatives markets. Cat-CDS has real potential to succeed as it offers yield-hungry investors an opportunity to tap into a highly liquid and rapidly expanding sector of the capital markets.

Conclusions and recommendations

In this letter we have highlighted risk identification, risk reduction and risk transference are the three key areas that taken together will enable the design and implementation of an effective policy framework to deal with the catastrophic risks associated with environmental change. We believe that there are three key areas involved in developing an effective disaster risk management strategy:

- Hazard and risk identification
- Risk reduction through either avoiding the hazard or creating market products and structures capable of withstanding the impact of catastrophic events.
- Transferring the risks that cannot be eliminated or reduced through risk sharing mechanisms or risk financing mechanisms.

We firmly believe that these three components are inter-related and mutually reinforcing. The important point is that there is a need to accelerate the development of new financial products to help the process of risk spreading and to deal with the increased occurrence of extreme climatic events such as Katrina. Clearly, one possible drawback is that markets may just turn out to be providers of market-clearing prices between willing buyers and sellers, but fail to adequately provide mechanisms that internalise the externalities. Either way, it is probably safe to state that take-up of novel financial instruments will help to improve the speed of risk spreading and transfer, such that if they are priced correctly they will help to produce pricing models that are more robust and more fully and correctly incorporate the externalities.

Should you require further detail on any of the above issues that we have raised, please feel free to contact us and we will be happy to discuss any aspect of the contents of this letter.

Yours sincerely

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References

Sigma, (2005), "Report on Natural catastrophes and man-made disasters for 2005", Published in volume No. 2, 2006 by Swiss Re.

http://www.lloyds.com/News_Centre/Press_releases/Hurricane_update_and_Capacity_2006.htm

https://www.creditsights.com/corp/_hpc/_57/040513.htm

Bank for International Settlements, (2006), "International Convergence of Capital Measurement Standards – A Revised Framework, Comprehensive Version", Basel Committee on Banking Supervision.

Salmon, M. and Weston, S.P., (2006), "Robust pricing of catastrophic derivatives", Warwick Business School, Working Paper Series.