Arrangement Infringement Possibility Approach: Some Economic Features of Large-Scale Events

Alexander Harin (email at: www.Harin.net)
September 15, 2004

Abstract

The definition of arrangement infringement has been given. Several characteristics of hurricanes as large-scale events and objectives for the first stages of insurance data analysis have been sketched out. Scale hypotheses, insurance and investment problems have been formulated.

Contents

Introduction

This working paper[1] constitutes a concise, preliminary draft of part of the research conducted on the arrangement infringement possibility approach. It elaborates on one of the topics mentioned in the preceding article (Harin 2004) of this series.

0.1. Arrangement infringement possibility approach

Arrangement infringement will refer to the infringement of an arrangement that took place after a decision to fulfill this arrangement was made. Here the arrangement will refer to an arrangement, agreement, assumption, contract, etc. Infringement will refer to an infringement, breach, modification, alteration, etc. The risk of arrangement infringement is a widespread phenomenon.

The arrangement infringement possibility approach will be given systematically in the following articles. Current information on research on the arrangement infringement possibility approach is presented on the website: www.harin.net

Arrangement infringements may be studied in various fields. Examples of these fields are large-scale events, insurance and investment.

0.2. Large-scale events and corresponding risks

Here the large-scale events will refer to such events as global climate changes, wars, windstorms, hurricanes, floods, droughts, hailstorms, tornadoes, earthquakes etc. Apropos, the risks related to such events are studied and managed particularly in the field of insurance: see e.g. Cummins, Lalonde and Phillips (2004); Grace, Klein and Kleindorfer (2002).

0.3. Hurricanes as an example of large-scale events

Hurricanes may be referred to as large-scale events. Using the example given in Harin (2004), hurricanes can be studied as examples of large-scale events.

1. Some characteristics of hurricanes

1.1. Some characteristics of hurricanes, as large-scale events, and their economic consequences

Within the context of this paper, five general and manifest characteristics and consequences of hurricanes as large-scale events can be pointed out.

---

1. Most of this working paper was written in July 2004 however, its completion was delayed for technical reasons. I would like to offer my deepest condolences to all the victims of hurricanes Charley, Frances and Ivan, their relatives and their friends. I hope this paper will assist in reducing the problems caused by future hurricanes.

1. Large total losses and losses incurred through arrangement infringements.

2. Hurricanes cause many types of arrangement infringements.

3. A great many arrangement infringement incidences are hurricane-related.

An internet search on Yahoo for “Hurricane Isabel” gave 352,000 search results. Consequently:

4. A wealth of information on hurricanes is widely available.

These four characteristics make hurricanes appealing to analysis.

5. When studying a single case of arrangement infringement, other arrangement infringements and the causes for these infringements are a strong influencing factor.

This characteristic of hurricanes makes them somewhat complex for analysis.

1.2. Some specific characteristics and consequences of hurricanes

1) Hurricanes are not global but local events.

2) Hurricanes are recurrent events.

This characteristic of hurricanes offers a possibility for perfect research, making hurricanes an even more appealing subject for analysis.

The amount of time available to give hurricane warnings can range from a day to a week. Consequently:

3) Hurricanes usually cause infringements of those arrangements that last longer than a week.

Many arrangement infringements caused by hurricanes do not depend on the quality of work of a company’s staff. Accordingly, in many cases information on the aftermath of hurricanes does not worsen the company’s image. Consequently:

4) In many cases information on the aftermath of hurricanes is not confidential.

2. Comparison of hurricanes information

The comparison of various pieces of information on hurricanes requires a single point of view and a singe scale or, at least, clear correlations between the scales used.

2.1. Saffir-Simpson hurricane scale

According to National Oceanic & Atmospheric Administration (NOAA), U.S. Department of Commerce (2004-1) “The Saffir-Simpson Hurricane Scale is a 1-5 rating based on the hurricane's present intensity. This is used to give an estimate of the potential property damage and flooding expected along the coast from a hurricane landfall. Wind speed is the determining factor in the scale, as storm surge values are highly dependent on the slope of the continental shelf in the landfall region.”

“Category One Hurricane:

Winds 74-95 mph. Storm surge generally 4-5 ft above normal. No real damage to building structures. Damage primarily to unanchored mobile homes, shrubbery, and trees. Some damage to poorly constructed signs.

Category Two Hurricane:

Winds 96-110 mph. Storm surge generally 6-8 feet above normal. Some roofing material, door, and window damage of buildings. Considerable damage to shrubbery and trees with some trees blown down. Considerable damage to mobile homes, poorly constructed signs, and piers. Coastal and low-lying escape routes flood 2-4 hours before arrival of the hurricane center. Small craft in unprotected anchorages break moorings.

Category Three Hurricane:

Winds 111-130 mph. Storm surge generally 9-12 ft above normal. Some structural damage to small residences and utility buildings with a minor amount of curtainwall failures. Damage to shrubbery and trees with foliage blown off trees and large trees blown down. Mobile homes and poorly constructed signs are destroyed. Low-lying escape routes are cut by rising water 3-5 hours before arrival of the center of the hurricane. Flooding near the coast destroys smaller structures with larger structures damaged by battering from floating debris. Terrain continuously lower than 5 ft above mean sea level may be flooded inland 8 miles (13 km) or more. Evacuation of low-lying residences with several blocks of the shoreline may be required.

Category Four Hurricane:

Winds 131-155 mph. Storm surge generally 13-18 ft above normal. More extensive curtainwall failures with some complete roof structure failures on small residences. Shrubs, trees, and all signs are blown down. Complete destruction of mobile homes. Extensive damage to doors and windows. Low-lying escape routes may be cut by rising water 3-5 hours before arrival of the center of the hurricane. Major damage to lower floors of structures near the shore. Terrain lower than 10 ft above sea level may be flooded requiring massive evacuation of residential areas as far inland as 6 miles (10 km).

Category Five Hurricane:

Winds greater than 155 mph. Storm surge generally greater than 18 ft above normal. Complete roof failure on many residences and industrial buildings. Some complete building failures with small utility buildings blown over or away. All shrubs, trees, and signs blown down. Complete destruction of mobile homes. Severe and extensive window and door damage. Low-lying escape routes are cut by rising water 3-5 hours before arrival of the center of the hurricane. Major damage to lower floors of all structures located less than 15 ft above sea level and within 500 yards of the shoreline. Massive evacuation of residential areas on low ground within 5-10 miles (8-16 km) of the shoreline may be required.”

2.2. Damage/costs hurricane scale

By definition, the damage/costs hurricane scale represents costs of damages caused by hurricanes.

2.3. 1980-2003 Billion Dollar Events

Some aspects attributed to hurricanes can be compared. According to National Oceanic & Atmospheric Administration (NOAA), U.S. Department of Commerce (2004-2) these are:

The hurricane's category in accordance with the Saffir-Simpson Hurricane Scale (with a rating of 1-5)

Damage costs incurred by the hurricane (in billions).

Results of a Yahoo search (in thousands) serve as a complement to these two aspects. The Yahoo search was done by Harin in July 2004. The search words were "hurricane Isabel," "hurricane Floyd," and so on.

Table I. Comparison of some aspects attributed to hurricanes.

Name of hurricane	Year	Category	Damage /costs (in $ billions)	Results of a Yahoo search (in thousands)
Isabel	2003	2 (5?)	4	352
Floyd	1999	2	6	270
Georges	1998	2	6	105
Bonnie	1998	3	1	126
Fran	1996	3	5	76
Opal	1995	3	3	50
Marilyn	1995	2	2	119
Iniki	1992	4	2	13
Andrew	1992	5	27	395
Bob	1991	2	2	739
Hugo	1989	4	7	134
Juan	1985	1	2	253
Elena	1985	3	1	28
Alicia	1983	3	3	61

2.4. Miscorrelations

It is apparent that the presented data does not give an explicit correlation between aspects:

category,
amount of damage,
search engine results.

The only slight correlation that can be observed is found between the years and search engine results.

In the context of economic characteristics, the most significant inconsistencies are those between categories and damage amounts. They are shown in table II.

Table II. Comparison of categories and damage amounts.

Name	Category	Damage /costs ($ billions)
Bonnie	3	1
Elena	3	1
Marilyn	2	2
Iniki	4	2
Bob	2	2
Juan	1	2
Opal	3	3
Alicia	3	3
Isabel	2 (5?)	4
Fran	3	5
Floyd	2	6
Georges	2	6
Hugo	4	7
Andrew	5	27

2.5. Two-scale hypothesis

Complex and comprehensive risk models and databases (e.g. Risk Management Solutions 2004) have been designed to solve complex problems. However, simple questions need simple answers. To improve correlations between categories and damage amounts scales, the "two-scale hypothesis" can be proposed:

The correlations between two scales, category and damage costs, may be improved mainly by taking into account values of property and population on territories suffered from hurricanes. More officially:

A monotonically increasing (on any of the arguments) function of category, value of property and population size in the area that should suffer the most damage, may exist which gives a qualitative approximation of damage costs.

In the simplest form, damage costs can be roughly approximated by

$$V_{Damage} \sim K_{gener} * (C_{cat} + N_{Categ}) * (V_{Prop} + V_{Popul} * K_{pop}) \qquad (1)$$

where

V_{Damage} – damage costs;

K_{gener} - general coefficient;

C_{cat} - constant (for all categories);

N_{Categ} - hurricane category number;

V_{Prop} - total value of property on a 10-mile stretch of seashore (or land less that 10ft above sea level) and 5-mile stretch of riverside, where hurricane intensity was (or will be) higher than certain fixed level;

V_{Popul} - total value of population on a 10-mile stretch of seashore (or land less that 10ft above sea level) and 5-mile stretch of riverside, where hurricane intensity was (or will be) higher than certain fixed level;

K_{pop} - population coefficient.

Thus, the two-scale hypothesis may be able to explain the qualitative relationship between the Saffir-Simpson and damage/cost scales for past hurricanes and qualitatively predict the damage costs of future hurricanes.

2.6. Saffir-Simpson scale addition hypothesis

The Saffir-Simpson scale shows the peak strength of a hurricane. Saffir-Simpson scale addition hypothesis proposes an addition to Saffir-Simpson scale. This addition may present some characteristic of overall hurricane energy.

This energy characteristic may be expressed in terms of hurricane energy or dimensions, effective area for example. Effective diameter appears to be the most convenient parameter. A hurricane's effective diameter may be half-peak diameter, or a hurricane's diameter at certain minimal hurricane strength: winds 50 or 100 or 150 mph for example, or another convenient parameter.

This additional total energy characteristic together with the two-scale hypothesis may improve the correlations between these two scales.

2.7. Density maps

If the category, effective diameter and path of the hurricane are known and property and population density maps are available, one can visualize a qualitative picture of the size of the hurricane's impact.

3. Insurance analysis

Insurance is possibly one of the fields most suitable for arrangement infringement analysis as well as the analysis of hurricanes and other large-scale events and their economic consequences. So, according to Doherty (1997) "Catastrophic events such as hurricane and earthquakes are the dominant source of risk for many property casualty insurers."

The insurance analysis may be carried out in two ways:

1. an analysis of insurance data or/and
2. an analysis of insurance itself.

3.1. Insurance data analysis and objectives for its first stages

While beginning insurance data analysis in the context of this paper, a number of difficulties may be encountered, such as:

1. The aforementioned influence of other arrangement infringements and arrangement infringement causes on the type being studied.
2. As of yet undeveloped special and generalized characteristics responsible for arrangement infringements.

The first stage of insurance data analysis may be the determination of data types which might be related to arrangements infringements. The second stage may be the study and comparison of correlations between various types of insurance data to identify information on arrangements infringements contained in them.

3.2. Insurance strategy analysis

Three general and one specific hurricane characteristics can be rewritten:

High total losses

Many types of losses are caused by hurricanes.

Multitude of incidents of loss is caused by hurricanes.

Hurricanes are local events.

The consequences of combining these characteristics can give rise to a range of problems and issues in analyzing insurance (and investment) strategy:

3.2.1. “The problem of small insurance companies”. Limited (liabilities) insurance.

The local problem (“The problem of small insurance companies”). This occurs when an essential part or whole area of an insurance company’s activity (or one of its few branches) is completely engulfed by hurricane damages. In this case, the small insurance company may run into risk of unconquerable total losses. The ultimate issues lie:

- in the calculation of the maximum allowable capacity of contracts concentrated in one area and
- in the calculation of sufficient reinsurance and other financial support instruments.

So, Doherty (1997) pointed out the need of “… sufficient geographic spread to diversify catastrophe risk.” And also that reinsurance can “… achieve a spatial spread of risk and can therefore bear catastrophe risk that is undiversifiable to the primary. But the transaction costs associated with reinsurance, and therefore premiums, are high.” And the need of “… new instruments that securitize catastrophe risk.”

Another choice may be referred to as e.g. limited (liabilities) insurance. This means insurance except of cases concerned with hurricanes and earthquakes.

3.2.2. “The problem of large insurance companies”

The distributed features (parameters) problem (“The problem of large insurance companies”). Due to the specific characteristic of hurricanes − locality − the area of an insurance company’s activity may be substantially larger than the area of hurricane damage. In this case the problem lies in the optimization of office locations and the territorial distribution of contracts.

3.2.3. Analogies, links and interdependencies between strategy levels.

At least three strategy levels can be noted:

1) The entire U.S. insurance industry
2) Large insurance and reinsurance companies
3) Small insurance companies

This paper’s remarks on middle and lower levels may be added to top-level analysis, see e.g. Cummins, Doherty and Lo (2002). Probably, when developing a general all-level strategy it is desirable to examine the analogies, relationships and interdependencies between levels, from the microeconomic to the macroeconomics and vice versa.

4. Investment and reinsurance portfolio issues

Investment and reinsurance portfolio issues and problems are in a certain way similar to the “problem of large insurance companies”. In this case the problem also lies in optimizing the geographical distribution of portfolios.

4.1. “Don't keep all your egg baskets in one place.”

If we move from investment and reinsurance portfolio questions to statements, we have reached the famous, simplified first level portfolio statement:

> “Don't put all your eggs in one basket.”

Here, in the case of hurricanes and earthquakes, we may formulate the simplified second level portfolio statement:

> “Don't keep all your egg baskets in one place.”

Conclusions

This working paper constitutes a concise, preliminary draft of part of the research conducted on the arrangement infringement possibility approach.

The definition of arrangement infringement has been given. Several general and specific characteristics and economic consequences of hurricanes as large-scale events and objectives for the first stages of insurance data analysis have been sketched out.

The rest consideration is mainly centered around two points:

1. The miscorrelation between the Saffir-Simpson and damage/costs hurricane scales.
2. The consequences of combining the three general and one specific characteristics of hurricanes.

The two-scale hypothesis and the Saffir-Simpson scale additional hypothesis, “problem of small insurance companies”, “problem of large insurance companies”, investment and reinsurance portfolio issues and the simplified second-level portfolio statement have been formulated.

References

1. Cummins, J., Lalonde, D., and Phillips, R. (2004) “The basis risk of catastrophic-loss index securities” *Journal of Financial Economics* 71, 77-111.

2. Cummins, J., Doherty, N., and Lo, A. (2002) “Can insurers pay for the "big one"? Measuring the capacity of the insurance market to respond to catastrophic losses” *Journal of Banking & Finance* 26, 557-583.

3. Doherty, N. (1997) “Financial Innovation in the Management of Catastrophe Risk” Center for Financial Institutions Working Papers from Wharton School Center for Financial Institutions, University of Pennsylvania, 1997-12.

4. Grace, M., Klein, R., and Kleindorfer, P. (2002) “The Demand for Homeowners Insurance with Bundled Catastrophe Coverage” Center for Financial Institutions Working Papers from Wharton School Center for Financial Institutions, University of Pennsylvania, 2002-01.

5. Harin, A. (2004) “On the Possibility of Arrangement Infringement” *Voprosy Economicheskih Nauk [Economic Issues]* no. 2 (2004), 20-21.
Харин А.А., «О возможности нарушения договоренностей» *Вопросы экономических наук* № 2 (2004), 20-21.
Accessible explanations on this matter are presented on the website: http://www.harin.net July 2004.

6. National Oceanic & Atmospheric Administration (NOAA), U.S. Department of Commerce (2004-1) “The Saffir-Simpson Hurricane Scale” http://www.nhc.noaa.gov/aboutsshs.shtml 2004.

7. National Oceanic & Atmospheric Administration (NOAA), U.S. Department of Commerce (2004-2) “Billion Dollar U.S. Weather Disasters, 1980-2003” http://lwf.ncdc.noaa.gov/oa/reports/billionz.html 2004.

8. Risk Management Solutions (2004) “Software Products” http://www.rms.com/Catastrophe/Software/ 2004.