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An Exposure-Based Analysis of Property-Liability Insurer Stock Values Around Hurricane Andrew

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ABSTRACT

It has been estimated that Hurricane Andrew caused more than $20 billion in damage in Florida and Louisiana in August 1992. Property-liability insurers will bear much of the loss payments to insureds. This study classifies the firms in the property-liability industry in terms of loss exposure and no loss exposure to determine if the market discriminated among insurers based on this risk. The results indicate that Hurricane Andrew produced a significant negative stock price reaction on property-liability insurers with direct premiums written in Florida or Louisiana. Unexposed firms sustained no significant price response. Thus, the results support the hypothesis that the market efficiently interpreted the information generated by the hurricane and discriminated among property-liability insurers based on the existence and magnitude of insurance written.

Introduction

Investors hold a set of information that generates expectations concerning risk and earnings. In an efficient market, stock prices quickly reflect all of the relevant information involving a firm. Several studies have examined the type of information investors consider relevant for pricing decisions. Dividend and earnings announcements and stock splits have been extensively covered (Charest, 1978; Aharony and Swary, 1980; Asquith and Mullins, 1983). Other studies have addressed the impact of losses on firm value. Sprecher and Pertl (1983) and Davidson, Chandy, and Cross (1987) found a negative relationship between large losses and firm value. Reilly and Drzycimski (1973) found that stock prices adjust immediately following the announcement of major world events.

Shelor, Anderson, and Cross (1990) examined the effect of the October 17, 1989, California earthquake on the stock value of firms in the real estate industry. They concluded that the earthquake conveyed important new informa-

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tion to the market that was reflected in significant negative stock returns among real estate firms operating around San Francisco (the area sustaining the most damage from the earthquake). Real estate-related firms operating in other areas of California were generally unaffected by the earthquake. The occurrence and timing of the earthquake could not be anticipated and, thus, instantaneously introduced new and relevant information to the marketplace. The large negative returns for the sample indicated that investors viewed the earthquake as a signal of unfavorable financial conditions for the real estate industry in the San Francisco bay area. The market response to the earthquake among other California firms was consistent with that observed for an event that has no impact on market valuation. These results provide evidence that the market may discriminate among firms in relation to their geographic risk exposure. Such behavior is expected in a rational and efficient market.

In a related article, Shelor, Anderson, and Cross (1992) examined the market response of property-liability insurers around the earthquake. In contrast with the real estate-related firms, the property-liability industry demonstrated a significant positive response to the earthquake, indicating that investor expectations of higher demand for insurance (positive effect) may have more than offset the potential earthquake losses (negative effect). Aiuppa, Carney, and Krueger (1993) also explored the impact of the earthquake on property-liability stock values and found a similar positive response. These results suggest that the two industries were affected by the earthquake in different ways; that is, the California earthquake stimulated industry-specific responses. This conclusion, in part, provides the motivation for this study involving the examination of the effect of Hurricane Andrew on property-liability stock values.

Research Question

In August 1992, Hurricane Andrew struck South Florida and Louisiana with sustained winds of 138 miles per hour. The magnitude of this storm's devastation made it the costliest natural disaster in U.S. history. The property-liability insurance industry estimates that Andrew caused more than $20 billion in property damage.[1] This dwarfs the $7 billion in claims paid after Hurricane Hugo (the previous costliest natural disaster) struck North Carolina and South Carolina in September 1989. The effect of catastrophic property damage on the value of property-liability insurers is the subject of this study; specifically, does the market demonstrate an ability to discriminate by the degree of loss exposure of property-liability insurers around significant hurricanes (such as Andrew)?

Although some insurers have heavy loss exposure in certain geographic areas of the country, other firms have little or no business in the affected areas. If the market is rational and efficient, then it would be surprising to find that unexposed or lightly-exposed firms experience a similar hurricane-induced

[1] See *Aide Magazine* (USAA), "1992: A Year of Catastrophes," February 1993, p. 1.

market reaction to that of heavily-exposed firms. Insurers with a large proportion of business in Florida and Louisiana (exposed firms) can thus be expected to have negative reactions significantly greater than those insurers concentrating in other states (unexposed firms). If the returns response to Andrew is uniform across all firms in the industry, regardless of their geographic risk exposure, then a type of contagion effect may have swept through the entire property-liability industry, much like the industry-wide contagion effect around bank failures (Aharony and Swary, 1983; Swary, 1986), the 1986 Chernobyl reactor accident (Fields and Janjigian, 1989; Kalra, Henderson, and Raines, 1993), airline crashes (Barrett et al., 1987), and electric utility firms around the Three Mile Island incident (Hill and Schneeweis, 1983; Bowen, Castanias, and Daley, 1983; Spudeck and Moyer, 1989). To provide additional insight into the behavior of the market around a particular event, this study classifies the firms in the property-liability industry in terms of loss exposure and no loss exposure (as measured by direct premiums written) around Hurricane Andrew to determine if the market discriminated among firms based on this risk. The results will indicate if Hurricane Andrew conveyed important new information to the market that was reflected either across all property-liability insurers (industry) or in only those firms that were expected to be affected directly by the damage (exposed firms).

Data and Methodology

The initial sample of 37 publicly-held property-liability insurers was identified by Standard Industrial Code. Three firms exhibited insufficient trading to calculate reliable parameter estimates and were eliminated from the sample. The firms were then classified as either exposed or unexposed according to their respective business activity in Florida or Louisiana. According to National Underwriters Co. (1992), 17 of the firms in the sample had direct premiums written in at least one of the two states. These firms comprise the exposed sample. The other 17 firms had no direct premiums written in Florida or Louisiana and were classified as unexposed. A list of the exposed and unexposed firms in the samples, and their corresponding proportion of Florida/Louisiana exposure is provided in the Appendix. The relevant dates in the life of the hurricane were collected from the *Wall Street Journal Index* in order to identify the "announcement date" for Hurricane Andrew. Although Andrew was born on August 14, 1992, as Tropical Depression #3, it actually struck the Florida coast in the early morning hours of August 24. The assault continued the following day in Louisiana. The expectation of a hurricane strike thus became a certainty on August 24, and enabled the market to respond directly to the damage produced by Andrew. For this reason, August 24 was identified as the announcement date (Day 0) for this event.

The returns data involving Hurricane Andrew were generated from the Center for Research in Security Prices (CRSP) tape and *Standard & Poor's Daily Stock Price Record.* Both data sources were used for stock prices because the returns for some of the firms in the sample were not available in the

current version of CRSP. Every effort was made to compile consistent pricing information for the sample. The market model was used to calculate the stock price reaction to the hurricane. The existence of significant excess returns (either positive or negative) would provide evidence that the hurricane generated new information to the market. Given the magnitude of the damage produced by Andrew and the responsibility of the affected property-liability firms to meet the claims, it is expected that the overall industry impact will be negative. This expectation is not necessarily inconsistent with the findings by Shelor, Anderson, and Cross (1992) and Aiuppa, Carney, and Krueger (1993) of a positive property-liability response to the 1989 California earthquake, because Hurricane Andrew is a separate and different event. The earthquake results are San Francisco earthquake-specific. The results of this study are Hurricane Andrew-specific. Given the evidence of a reasonably efficient market, however, firms with a larger exposure to the hurricane are expected to sustain a larger negative response.

The expected return for securities with returns following a bivariate normal distribution can be expressed through the market model as

$$R_{j,t} = \alpha_j + \beta_j R_{m,t} + \varepsilon_{j,t}, \quad (1)$$

where $R_{j,t}$ = the raw return of security j on day t
$= \ln[(\text{Price}_{t+1} + \text{Dividend})/\text{Price}_t]$,
$R_{m,t}$ = the natural log of the CRSP equally-weighted market return on day t,
α_j = a coefficient representing the return of security j that is independent of the market,
β_j = a constant representing the market sensitivity of security j, and
$\varepsilon_{j,t}$ = an error term expected to follow normal regression assumptions.

The set of dates from which the parameters are estimated include the 150 trading days ending 10 days prior to August 24, 1992. The estimation period does not include the 10-day period (6 trading days) immediately prior to the hurricane strike to ensure that the results are not contaminated by any anticipation of the imminent hurricane path and level of destruction. The parameters are then used to estimate return performance during the event period.[2] The excess return for security j on day t is the difference between the actual return and the predicted return:

$$ER_{j,t} = R_{j,t} - (\alpha_j + \beta_j R_{m,t}). \quad (2)$$

The average excess return (AER) for day t is calculated as follows:

[2] For further information concerning the methodology of event studies, see Brown and Warner (1985) and Henderson (1990).

$$AER_t = \frac{1}{n}\sum_{j=0}^{n} ER_{j,t}, \tag{3}$$

where n = the number of property-liability insurers in the sample.
Equation (4) presents the test for significance of AER_t as

$$Z_t = \frac{AER_t}{S_t}, \tag{4}$$

where

$$S_t = \sigma \sqrt{1 + \frac{1}{T} + \frac{(R_{m,t} - R_m)^2}{\sum_{-160}^{-11} (R_{m,t} - R_m)^2}}$$

and σ = the standard deviation of the AERs during the estimation period,
T = the number of days in the estimation period,
$R_{m,t}$ = the return on the CRSP index at time t, and
R_m = the average return on the CRSP index during the estimation period.

In addition to testing the individual AER_ts, the cumulative average excess return (CAR) is calculated and tested for a period of two days following the hurricane. The CAR for days t_1 and t_2 (Days 0 and +1) is calculated as

$$CAR(t_1,t_2) = \sum_{t=t_1}^{t_2} AER_t. \tag{5}$$

The test statistic to measure if the CAR is significantly different from zero is calculated as follows:

$$Z_k = \frac{\sum_{t=t_1}^{t_2} \frac{AER_t}{S_t}}{\sqrt{k}}, \tag{6}$$

where k = the number of days in the CAR period, and
S_t = is calculated as above.

Cross-sectional analysis is applied to determine the market response related to the *existence of exposure* each insurer had to the hurricane. Two-day CARs (Days 0 and +1) for each firm (j) are regressed on a dummy variable representing whether the insurer had direct premiums written (DPW) in Florida or Louisiana. Information involving the exposure of each property-liability insurer in each state was obtained from the *National Underwriter Profiles*. The ability of the market to discriminate by the existence of risk exposure of insurers is measured by standard comparative statistical tests:

$$CAR_j(t_1,t_2) = \alpha_j + \beta_j DPW_j + \varepsilon_j, \quad (7)$$

where DPW_j = 0 if firm j has no direct premiums written in Florida or Louisiana and
= 1 if firm j has direct premiums written in Florida or Louisiana.

An additional cross-sectional analysis is performed to measure the market response related to each insurer's *degree of exposure* to the hurricane. Two-day CARs (Days 0 and +1) for each firm (j) are regressed on the proportion (weight) of direct premiums written in Florida and Louisiana to total direct premiums written.

$$CARj(t_1,t_2) = \alpha_j + \beta_j WDPW_j + \varepsilon_j, \quad (8)$$

where $WDPW_j$ = the amount of Florida and Louisiana direct premiums written as a percentage of the total direct premiums written for firm j.

Empirical Results

A significant negative price response around the event date would provide evidence that the hurricane produced unfavorable information that was manifested in depressed stock prices. A significant positive reaction would be translated as favorable information, and no significant reaction indicates that the hurricane did not produce any new information that impacted on stock prices. Table 1 presents the average daily and cumulative excess returns for the exposed and unexposed property-liability insurers in the sample around Hurricane Andrew.

Exposed Property-Liability Insurers' Response to Hurricane Andrew

As expected, for exposed firms, Days 0 and +1 exhibit significant negative returns, indicating that investors considered the information associated with the hurricane as unfavorable to insurers with premium volume in Florida or Louisiana. The market response for these firms is concentrated in Days 0 and +1, and provides evidence that investors were efficient in assessing the information produced by the hurricane, despite the financial press reporting upwardly revised damage estimates for several weeks after the initial strike. The cumulative average excess return for the two-day period is significant at the 0.01 level.[3] The sign of the daily AERs is predominantly negative for the twelve trading days following the hurricane. The significant negative return observed on Day +10 may simply be random as no new substantive information related to the event was announced on that date.[4] Following Day +12, the signs and

[3] The t-statistic for the two-day CAR of the exposed insurers is -3.6738.

[4] Hurricane Iniki struck Hawaii on September 11, 1992, causing $2 billion in damage (*Honolulu Advertiser*, January 22, 1993). Property-liability insurers exhibited no significant price response around the hurricane strike date (Event Date +14), indicating that Iniki did not impact on property-liability stock prices. The estimation period beta for all firms was 0.366. The event period beta for all firms was 0.483. The t-test result for the possibility of a shift in risk between the estimation and event periods as a result of Iniki indicates no significant change in betas. The t-statistic for differences in beta between the periods is 0.931.

Table 1
Reaction to Hurricane Andrew by Exposed and Unexposed Property-Liability Insurers

	Exposed Insurers			*Unexposed Insurers*		
Event Date	*Average Excess Returns*	*t-value (AER)*	*Cumulative Average Excess Returns*	*Average Excess Returns*	*t-value (AER)*	*Cumulative Average Excess Returns*
-10	-0.0017	-0.1672	-0.0017	-0.0018	-0.1079	-0.0018
-9	0.0006	0.0598	-0.0011	-0.0011	-0.0659	-0.0029
-8	0.0018	0.1802	0.0007	0.0043	0.2577	0.0014
-7	-0.0145	-1.4368	-0.0138	-0.0122	-0.7312	-0.0108
-6	0.0068	0.6767	-0.0070	0.0058	0.3476	-0.0050
-5	0.0102	1.016	0.0032	0.0107	0.6413	0.0057
-4	-0.0051	-0.5047	-0.0019	-0.0033	-0.1978	0.0024
-3	-0.0062	-0.6111	-0.0081	0.0083	0.4975	0.0107
-2	-0.0062	-0.6103	-0.0143	-0.0078	-0.4675	0.0029
-1	0.0085	0.8381	-0.0058	0.0057	0.3416	0.0086
0	-0.0172	-1.6752***	-0.0230	-0.0062	-0.3746	0.0024
1	-0.0350	-3.4685*	-0.0580	-0.0071	-0.4227	-0.0047
2	-0.0135	-1.3427	-0.0715	0.0043	0.2597	-0.0004
3	-0.0055	-0.5427	-0.0770	-0.0118	-0.7073	-0.0122
4	-0.0053	-0.5244	-0.0823	0.0019	0.1140	-0.0103
5	0.0058	0.5746	-0.0765	0.0330	1.9767**	0.0227
6	-0.0045	-0.4463	-0.0810	-0.0243	-1.4569	-0.0016
7	0.0076	0.7524	-0.0734	-0.0051	-0.3076	-0.0067
8	-0.0136	-1.3462	-0.0870	-0.0012	-0.0720	-0.0079
9	-0.0048	-0.4710	-0.0918	0.0143	0.8555	0.0064
10	-0.0193	-1.9017***	-0.1110	-0.0206	-1.2353	-0.0142
11	-0.0025	-0.2505	-0.1136	0.0012	0.0722	-0.0130
12	-0.0007	-0.0722	-0.1143	-0.0046	-0.2759	-0.0176
13	0.0008	0.0783	-0.1135	0.0028	0.1665	-0.0148
14	0.0021	0.2078	-0.1114	-0.0139	-0.8321	-0.0287
15	0.0075	0.7373	-0.1039	0.0195	1.1659	-0.0092
16	-0.0102	-1.0081	-0.1141	0.0043	0.2591	-0.0049
17	-0.0063	-0.6208	-0.1203	-0.0003	-0.0159	-0.0052
18	0.0004	0.0408	-0.1199	0.0023	0.1377	-0.0029
19	0.0182	1.7989***	-0.1018	-0.0032	-0.1937	-0.0061
20	-0.0003	-0.0326	-0.1021	-0.0078	-0.4684	-0.0139
21	0.0033	0.3241	-0.0988	-0.0038	-0.2302	-0.0177
22	0.0196	1.9451***	-0.0792	0.0000	0.0005	-0.0177
23	0.0059	0.5807	-0.0733	0.0239	1.4304	0.0062
24	-0.0032	-0.3151	-0.0765	0.0029	0.1729	0.0091
25	0.0087	0.8588	-0.0678	0.0023	0.1367	0.0114
26	0.0055	0.5456	-0.0623	0.0022	0.1293	0.0136
27	0.0126	1.2433	-0.0497	0.0030	0.1787	0.0166
28	-0.0152	-1.4924	-0.0649	-0.0136	-0.8178	0.0030
29	-0.0067	-0.6473	-0.0716	0.0045	0.2709	0.0075
30	-0.0005	-0.0457	-0.0722	0.0014	0.0829	0.0089

* Significant at 0.01 level ** Significant at 0.05 level *** Significant at 0.10 level

magnitudes of the AERs resemble those experienced in the pre-hurricane estimation period.

Unexposed Property-Liability Insurers' Response to Hurricane Andrew

Although the signs on the AERs for the unexposed firms on Days 0 and +1 are negative, the values are not significantly different from zero, thereby indicating that the information produced by the hurricane did not have an impact on the value of property-liability insurers with no direct premium business in Florida or Louisiana. In fact, the only significant AER during the entire 30-day period is on Day +5. No information justifying a price behavior of this magnitude was identified involving this date, and it is thus believed to be a random occurrence. The signs and magnitudes of the AERs during the complete 30-day period are similar to those observed in the estimation period. The CAR during Days 0 and +1 is not significantly different from zero.[5] These results indicate that insurers with no direct exposure in Florida or Louisiana were not significantly impacted by Hurricane Andrew. When compared to the exposed firm reaction, these observations are similar to those experienced by real estate-related firms operating in San Francisco (negative reaction) and in other areas of California (no reaction) around the 1989 California earthquake (Shelor, Anderson, and Cross, 1990; Aiuppa, Carney, and Krueger, 1993).

Response by Property-Liability Insurers Leading up to Hurricane Andrew

None of the AERs for both the exposed and unexposed property-liability insurer samples are significant during the ten-day period immediately preceding the hurricane, indicating that, despite a substantial expectation by the media, government officials, and the general public that a strike by Andrew was forthcoming, the market may not have been sure what the ultimate path and damage would be. A great deal of uncertainty by the market regarding Andrew (and the general unpredictability of the hurricane path and strength) is thus reflected in the pre-strike period. Since a marked difference in returns behavior is observed between Florida/Louisiana exposed and unexposed firms after the hurricane struck, it may be that the sample of exposed and unexposed firms would have been different had the hurricane turned up the coast to strike the Carolinas or Virginia. Or the hurricane could have turned back out to sea and avoided a landfall altogether. The market may have been waiting to see where the hurricane would ultimately hit so that the exposed firms could be accurately identified and the appropriate price reaction could be made.

Figure 1 presents a graphical comparison of the CARs from 10 days prior to the strike date through 30 days after Andrew hit for both exposed and unexposed firms and provides further evidence of a significant difference in the response by the samples. The CAR for the unexposed firms turns positive by Day +23, whereas the CAR for the exposed sample is negative throughout the 30-day period.[6] These results provide further evidence that the market was

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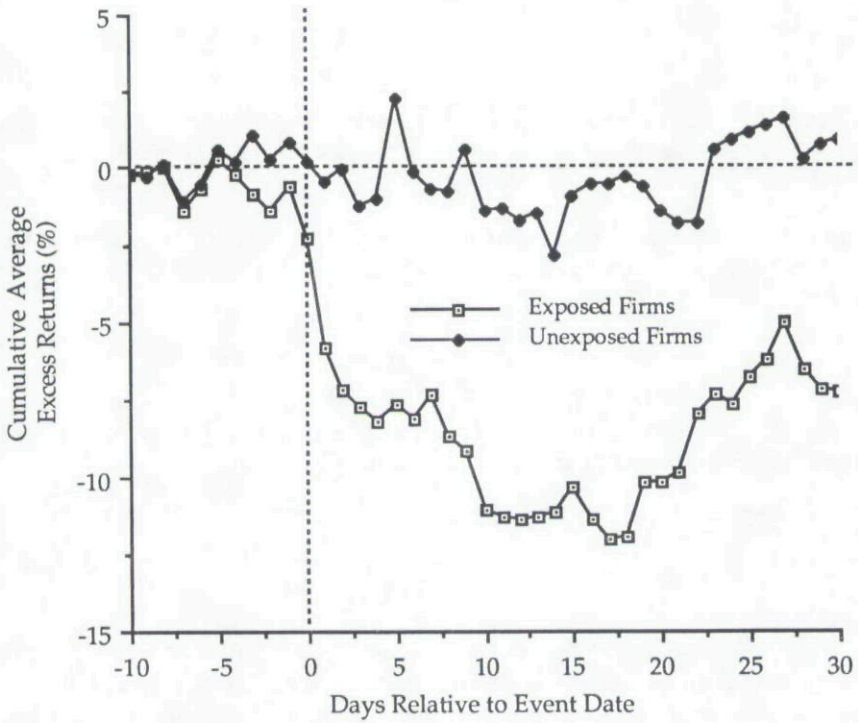
[5] The t-statistic for the two-day CAR of the unexposed insurers is -0.5638.

[6] The t-statistics for the 10-day, 20-day, and 30-day CAR for exposed insurers are -3.0482, -2.3768, and -1.3911, respectively. The corresponding t-statistics for unexposed insurers are -0.4286, -0.1983, and 0.0100.

efficient in interpreting the information produced by the hurricane and discriminated between firms that may and may not have been affected by the associated losses. A significant negative reaction was levied on only those firms with direct premium volume in Florida or Louisiana. Firms with no direct premium business in those states were not significantly impacted by Hurricane Andrew.

Figure 1
Stock Price Reaction to Hurricane Andrew
by Exposed and Unexposed Property-Liability Insurers



Cross-Sectional Results of Market Response to Hurricane Andrew

The results of the cross-sectional analysis are summarized in Table 2 and strengthen the conclusions described above regarding a market response based on firm exposure to hurricane losses. A significant relationship is observed between the response by the market to the hurricane and whether the property-liability insurer had loss exposure in Florida or Louisiana (Panel A). Specifically, a significant negative price response at the 0.10 level is exhibited on firms with direct premiums written in the two states. Panel B examines the magnitude of the market response in relation to the amount of premium volume each firm wrote in Florida and Louisiana. The independent variable is the

weight of Florida and Louisiana direct premiums written to total premium volume.[7] A significant negative relationship at the 0.01 level is observed and indicates that the market reaction to the hurricane was related to the degree of exposure each firm had in the affected states.

Table 2
Cross-Sectional Regression Results of Reaction to
Hurricane Andrew by Exposure of Property-Liability Insurers

Panel A: Results of Exposure to Hurricane Andrew as Measured by the Existence of Direct Premiums Written in Florida or Louisiana

$$CAR_{(0,1)} = \underset{(-0.155)}{-0.368} - \underset{(-1.717)}{5.768}\ DPW_j + \varepsilon_j,$$

where $DPW_j = 0$ if firm $_j$ has no direct premiums written in Florida or Louisiana and = 1 if firm $_j$ has direct premiums written in Florida or Louisiana.
$F = 2.949$ p-value = 0.096 $R^2 = 0.084$

Panel B: Results of Exposure to Hurricane Andrew as Measured by the Proportion of Direct Premiums Written in Florida and Louisiana to Total Direct Premiums Written

$$CAR_{(0,1)} = \underset{(-0.340)}{-0.643} - \underset{(-3.009)}{0.863}\ WDPW_j + \varepsilon_j,$$

where $WDPW_j$ = the amount of Florida and Louisiana direct premiums written as a percentage of the total direct premiums written for firm $_j$.
$F = 9.052$ p-value = 0.005 $R^2 = 0.221$

Note: t-statistics are in parentheses.

Conclusion

Hurricane Andrew produced a significant negative property-liability stock price reaction on insurers with direct premium volume in Florida or Louisiana. Insurers with no exposure in the two states sustained no significant stock price response. The market efficiently interpreted the information generated by the hurricane and discriminated among property-liability insurers based on the existence and magnitude of insurance written.

[7] For insurers with exposure to Hurricane Andrew, the proportion of direct premiums written in Florida and Louisiana to total premium volume ranged from 0.6 percent to 16.3 percent. The average amount was 6.8 percent.

Appendix
Property-Liability Insurers in Sample

Insurers with Exposure in Florida or Louisiana

American General Corporation (15.1)
American Indemnity Financial (11.6)
American International Group (4.7)
American Reliance Group (13.3)
Chubb Corporation (3.6)
Frontier Insurance Group Inc. (15.8)
Geico Corporation (16.3)
Hanover Insurance Company (2.3)
Harleysville Group Inc. (0.6)
Hartford Steam Boiler Inspection (6.2)
Navigators Group Inc. (1.4)
Ohio Casualty Corporation (4.7)
Orion Capital Corporation (2.4)
Pan Atlantic (10.5)
RLI Corporation (3.7)
United Coasts Corporation (1.7)
W.R. Berkley Corporation (1.7)

Insurers with No Exposure in Florida or Louisiana

Alfa Corporation
Argonaut Group Inc.
Berkshire Hathaway Inc.
Capital Transamerica Corporation
Chandler Insurance Company Ltd.
Citizens Security Group Inc.
Condor Services Inc.
Donegal Group Inc.
First Central Financial Corporation
Markel Corporation
Merchants Group Inc.
Meridian Insurance Group Inc.
North East Insurance Company
RE Capital Corporation
Seibels Bruce Group Inc.
Trenwick Group Inc.
Unicare Financial Corporation

Note: Exposure is measured by direct premiums written in Florida and Louisiana as a proportion of total premiums written and is presented in parentheses.

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