The Use of Quantitative Modeling in the Directors & Officers (D&O) Liability Insurance Market

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The art of building models, simplified representations of reality, has become more and more common in almost every sector of the economy, particularly in the financial services industry. With this article we seek to provide the reader with insight about the evolution and limitations of the models in the Directors & Officers (D&O) liability insurance market. We discuss the features of D&O data, the variety of D&O models, their limitations, and provide examples in which the reliance on models is still controversial.

The development of mathematical models has allowed professionals to simulate, make inferences, predict and assess almost any kind of event we can imagine. Perhaps, models used in the financial sector are one of the most familiar applications to us; they have demonstrated their usefulness and importance in the development of this industry supporting the creation, design, and management of complex and innovative products. In the financial services industry, there exists a wide spectrum of quantitative models: models designed to estimate the fair equilibrium price of an asset, market movements, portfolio returns, default probabilities, frequency and severity of claims; assess the performance of a financial asset or a portfolio; predict the return of a project; control the risk level of an investment; categorize events or individuals by level of risk, among many others. In particular, in the D&O liability insurance market, we can find models that seek to predict the frequency and severity of claims. Some of them are inference models designed to identify variables that explain the likelihood of a claim, while others are predictive models used to estimate future companies' behavior and trends.

Difficulties in D&O Risk Estimation

D&O liability insurance has become an essential part of today's corporate world. The basic D&O coverage protects directors and officers of companies, and sometimes the corporation itself, against lawsuits arising from wrongful acts. The creation of this sort of insurance dates back to the 1930´s, but it was not until the 1970´s when the interpretation of the securities laws changed, that a market for this product began to develop.[1]

The initial D&O policy, aimed primarily to offer personal financial protection, has evolved and now offers a wider range of coverages such as fiduciary liability, employment practices liability, and defense costs. Regarding the types of claims, most of the claim costs arise from securities class actions, fraudulent trade practices, and underwriting malpractice. The principal buyers of policies are directors and officers of publicly traded companies, although some private and nonprofit companies also purchase D&O liability protection.

The nature of the Directors and Officers liability exposure imposes difficulties to assess or predict future losses. In contrast with other types of policies, such as auto insurance,

[1] http://library.findlaw.com/2000/Jan/1/241472.html

D&O presents low frequency and high severity claims, some of them ending in "mega settlements" in excess of $100 million dollars. In other words, due to the low frequency and high severity, it is particularly difficult to predict whether an insured company will be presented with a claim, and if so, the amount of the claim. Therefore, the combined effect makes D&O claims extremely complex to forecast and model.

Besides the mentioned drawbacks, the low frequency also makes the collecting of a large and reliable database a hard task. With not enough data there is no opportunity to calibrate and, subsequently, test the soundness of a model; this is exactly what happens to weather models used to price wind-related/hurricane coverage. In D&O insurance, there is trade off between the amount of information and its reliability. If more years of information are taken into account, the dataset becomes larger, and therefore, easier to build and test the models; however, they will fit past market conditions rather than the current period. In the ever-changing corporate world, conditions may change fast and therefore models used to estimate D&O claims cannot rely on old information.

Nevertheless, some brokerage and consulting firms such as NERA, Audit Integrity, Advisen, Guy Carpenter, among others, have overcome some of these difficulties to come up with sound models to estimate the likelihood and severity of potential D&O claims. We will present some of the models used in the D&O market as well as alternative approaches to the problem.

D&O Model Development

As stated at the beginning of the article, our goal is to provide insight about the different models designed for the D&O sector, how they work, and who are the most suitable users. D&O models can be categorized in predictive, classification, and scenario models according to their scope. This section primarily presents the evolution in D&O model development, based on the information released by the companies that provide the models.

In 2004, Guy Carpenter & Company, Inc. in association with Marsh & McLennan Companies subsidiary NERA Economic Consulting developed the **Loss & Exposure Analysis for D&O (LEAD)** model to analyze and forecast the frequency and severity of securities class action suits, which account for the majority of D&O insurers' losses.[2] This is a regression-based model that examines the individual, combines effects of more than 70 variables covering four distinct categories: 1) stock issuer characteristics, 2) financial statement items, 3) stock ownership, and 4) stock trading characteristics; and compares companies that have had Securities Class Action Suits (CAS) with companies that have not in order to estimate the absolute and relative riskiness of them.[3]

"Taking into account the historical difficulties in modeling this line of business, the LEAD model represents a significant step forward in analyzing D&O risks," said Charles

[2] http://www.insurancejournal.com/news/national/2004/02/12/36730.htm
[3] www.casact.org/education/reinsure/2005/handouts/pricing.ppt

B LaLone, principal and head of Guy Carpenter's worldwide D&O practice when the product was launched. In summary, the LEAD model brings together a wide range of publicly available data, including stock issuer characteristics, stock trading information, financial statement metrics and stock ownership breakdown, to calculate the likelihood that a portfolio company will face a future securities class action suit, as well as an estimate of the severity of the class action.[4]

The LEAD model would also be categorized as a classification model. According to the company, as stated in the 2005 CAS Seminar on Reinsurance[5], the LEAD model is "not an underwriting or pricing model, but ideal comparison of exposure relativities between insured companies, prospective companies, and segments of D&O portfolio".

On the other hand, in 2004 Advisen, one of the leading providers of analytics, benchmarking and information for the commercial insurance industry, created a tool: the **Advisen Total Accrual Metric (ATACm)[6],** which predicts D&O risk through examination of accounting information. This model was a very innovative solution because it was the first to incorporate and adjust academic research into aggressive accounting practices applied specifically to the D&O insurance market. Officers from Advisen pointed that the "analytics resulted from this model offer D&O underwriters, brokers and risk managers increased ability to assess management liability risk and predict the frequency of D&O claims"[7].

The ATACm model was essentially a scoring (classification) tool developed to help D&O insurers determine the potential of insureds to encounter a securities class action suit; the model analysis relied on the study of the correlation between growth in accruals[8] and the likelihood of attracting securities class action lawsuits.

According to David K. Bradford, executive vice president of Advisen, "Advisen provides data and analytical tools to support the broad spectrum of risk assessment methodologies used by D&O underwriters today. Now we offer insurance professionals a powerful new formula that puts more science into the art of assessing risk. The correlation between high total accrual scores, indicating overly aggressive accounting, and the increase in the frequency of securities class action suits is very meaningful."[9]

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[4] http://gcportal.guycarp.com/portal/extranet/popup/pdf/Articles/IQ_Spring_D&O.pdf

[5] Guy Carpenter and ACE USA,2005.The D&O Market: Current Issues and Pricing Approaches- CAS Seminar on Reinsurance, available at: www.casact.org/education/reinsure/2005/handouts/pricing.ppt

[6] Summary of the information disclosed in: www.advisen.com, www.allbusiness.com/company-activities-management/management-risk-management/5238729-1.html

[7] Advisen Press Release: Advisen Predicts D&O Risk Through Examination of Accounting, Nov 2004, available at: https://www.advisen.com/HTTPBroker?action=jsp_request&id=articleDetailsNotLogged&resource_id=36216471

[8] Accruals refer to the accounting method whereby revenues and expenses are recognized when they are incurred, regardless when the cash is received or paid out.

[9] See Advisen press release

"ATACm is the latest Advisen analytic, programmed and designed to provide greater insight for insurance professionals assessing risk," said Tom Ruggieri, CEO of Advisen. "Research has proven that overly-aggressive accounting is at the heart of many securities class action lawsuits. Now, with a tool to spot and quantify these dangerous accounting practices, we can better predict future securities litigation and D&O liability".[10]

Later on in 2005, Audit Integrity, one of the leading providers of accounting and governance risk analysis on public companies, focused its efforts on developing the **Audit Integrity Accounting and Governance Risk Rating Model (AGR)**[11]. The AGR model is a classification model with a different approach than Advisen's that appears to be very useful to underwriters. It combines both financial and non-financial risk indicators to assess the quality of corporate governance rather than considering merely accounting metrics. In addition, the AGR methodology encompasses not only accruals, but also recognizes that financial manipulation could take many other forms.

The AGR categorizes companies according to their likelihood to commit fraud, i.e. be involved in a SEC action - manifested as class action litigation or financial restatement. The AGR model measures the corporate governance quality under the premise that accounting restatements and the likelihood to be sued are positively associated with weak governance as it is stated in some state-of-the-art academic papers[12].

The AGR model works as follows: it examines 200 accounting and governance metrics and 3,500 variables from public data to measure the overall risk of potential fraudulent or misleading accounting and governance activity and to determine the risk group for each company. It assigns a rating from 0 to 100 (worst to best) to more than 9,000 publicly-traded companies based on data from reported financial statements and corporate behavior. Audit Integrity assures that what imparts the most insight is not the absolute level of the ratios, but rather its trend and persistency over time.

As stated in the AGR white paper, the rating is able to predict companies' likelihood to face a SEC action, class action litigation and/or financial restatement and the model is able to discriminate between companies by predicting the probability of a company committing fraud.

In brief, the AGR consists of a logit statistical model which seeks to predict the fraud likelihood (a company is considered fraudulent if the SEC successfully sued it). The fraud likelihood is modeled as a function of about 600 ratios, taking into consideration

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[10] https://www.advisen.com/HTTPBroker?action=jsp_request&id=articleDetailsNotLogged&resource_id=36216471

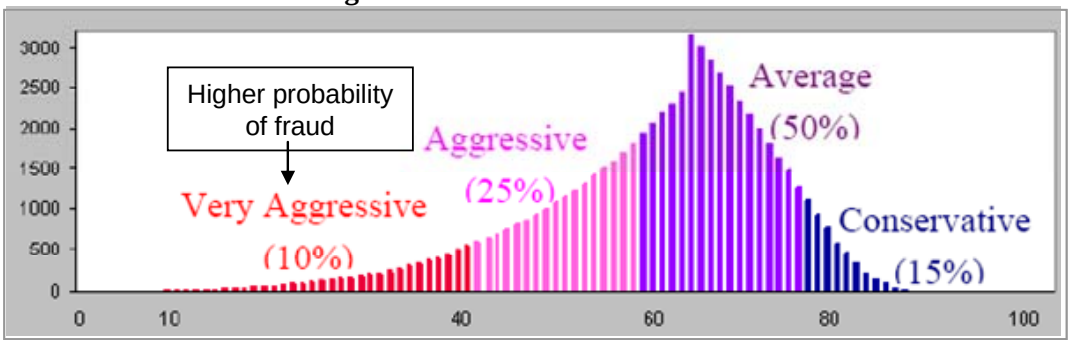
[11] Summary of the information disclosed in the Audit Integrity white paper, The Audit Integrity AGR Model: Measuring Accounting and Governance Risks in Public Companies (June 27, 2005), available at http://www.auditintegrity.com/documents/Audit_Integrity_AGR_White_Paper.pdf

[12] Beasley, M. S., 1996. An empirical analysis of the relation between the board of directors composition and financial statement fraud. The Accounting Review 71.
Farber, D. B., 2005. Restoring trust after fraud: Does corporate governance matter? The Accounting Review 80.
Peng, L., Röell A., 2007. Executive pay and shareholder litigation. Review of Finance.

whether or not the level of each ratio goes beyond regular levels (flagged metrics). The AGR score equals the sum of the flagged metric weights, obtained from the logit regression.

The following graph exhibits the distributions of the scores of all analyzed companies by risk categories. Audit Integrity disclosed that approximately 10% of the companies are very aggressive, 15% are conservative, and the rest are classified as average or aggressive.

Figure 1. AGR Score Distribution



Source: Audit Integrity

Audit Integrity states that its ratings are of great benefit in helping users "avoid companies at a high risk of litigation" anticipating future corporate problems. Therefore, the rating can be useful to investors or insurance companies issuing D&O policies. Furthermore, corporate stakeholders can benefit from timely risk management and insurers can make premium adjustments in case they find a company more likely to be involved in class action suits.

Audit Integrity models have proven their ability to eliminate poor companies from a stock portfolio before the stock drop, thereby enhancing the returns of a stock portfolio. This result does show some degree of effectiveness for the Audit Integrity model.

Regarding corporate governance ratings, there are other models that measure and evaluate the governance quality of public firms, but they are not as suitable as the AGR to explain D&O insurance market risk because they differ in terms of focus. For instance,

- **Corporate Governance Quotient (CGQ)** by RiskMetrics "evaluates the strengths, deficiencies, and overall quality of a company's corporate governance practices and board of directors" and "is designed on the premise that good corporate governance ultimately results in increased shareholder value"[13]. The CGQ releases rankings of the quality of the audit review, firm's board of directors, firm's director compensation and ownership; and firm's level of takeover defense.

[13] RiskMetrics Group presentation: International Practice of Corporate Governance, Corporate Governance Ratings and the Perspective of International Investors , 2007, available at: www.iyisirket.com/Rapor/TKYD_Michael%20Castello%20Vogt%201.ppt

- **Governance Metrics International (GMI)**[14] rating is "founded on the premise that the quality of corporate governance can add significantly to the risk-reward profile of credit and investment portfolios." The GMI releases rankings of board accountability, financial disclosure and internal controls, shareholder rights, remuneration, market for control, and corporate behavior.
- **The Corporate Library's TCL** rating system is based on four specific components: the company's board and succession planning, CEO compensation practices, takeover defenses, and board-level accounting concerns. These ratings measure the impact of a particular board's effectiveness on sustainable shareholder value; they "have been proven to predict losses in shareholder value and the occurrence of securities class action lawsuits" and "have been tested against actual investment returns"[15].

Notice that none of these corporate governance rating models explicitly reveal the likelihood of being involved in a D&O claim. The AGR is the only that addresses this matter, a feature that makes it preferred within the D&O insurance market.

Continuing with Audit Integrity developments, it's very important to mention two more models that both soundly complement the AGR: **The Audit Integrity Multi-Factor Litigation Models (AILM)**[16] and **The Audit Integrity Multi-Factor Restatement Models (AIRM)** [17]. Both models have been widely adopted by insurance firms providing D&O insurance.

Audit Integrity first produced a Litigation Model in 2005. The AILM utilizes AGR scores and other factors to identify firms at high risk of securities-based class action litigation. It includes additional commonly recognized litigation factors such as size of company, industry and stock performance to build a highly effective predictor of shareholder litigation. "Audit Integrity publishes the quarter-by-quarter litigation probabilities on each firm in their database of public corporations. The results of the Litigation Model are expressed as a ranking score from 1 to 5 and as a litigation probability percentage, representing the probability of litigation over the one-year time period after the AGR publication date"[18]. The AIRM model is analogous to the AILM to identify firms at high risk of material financial restatements using variables based on the 2-year mean AGR scores, market capitalization and industry indicator.

On the other hand, in 2008, Advisen complemented its ATACm with a solution called **Value Risk Tools (VRT)**. The initial measure of risk, the accrual accounting, was complemented with four other risk measures as they proved that each have strong

[14] http://www.gmiratings.com
[15] http://www.thecorporatelibrary.com/info.php?id=53.
[16] Audit Integrity white paper: The Audit Integrity Multi-Factor Litigation Model: The Market Leading Indicator of Class Action Lawsuits, May 2008, available at: www.auditintegrity.com/documents/Audit_Integrity_20080515_Litigation_Model_2.0_White_Paper.pdf
[17] Audit Integrity white paper: The Audit Integrity Multi-Factor Restatement Model: The Market Leading Indicator of Financial Restatement, April 2006, available at: www.auditintegrity.com/documents/Audit_Integrity_Restatement_White_Paper.pdf
[18] See white paper: Audit Integrity Multi-Factor Litigation Model.

correlations with the likelihood of attracting securities class action lawsuits. Advisen explained that "the measures are derivatives of the following four underlying value investing techniques: price-to-earnings (P/E) ratio; positive earnings-to-CFO (cash flow from operations); negative earnings-to-CFO; and sales-to-CFO. Each measure represents a useful tool for assessing risk on its own, but together, in conjunctions with ATACm, these Value Risk Tools provide powerful insights into the risk profiles of public companies" [19].

Most of the aforementioned models are conceived to classify companies, except the LEAD model that attempted to assess both severity and frequency of D&O claims. However, there exist several models that seek to price D&O policies. These models have evolved from a deterministic approach to stochastic option pricing methods. For instance, in 2003, Zurich Financial Services Ltd. developed a model for D&O pricing based on the fundamental assumption that selling a D&O policy is equivalent to selling an implied option to the shareholders where the company is the purchaser, the directors and officers are the insureds, and the shareholders are the beneficiaries[20]. The option implies that if the company's stock falls, a shareholder may recover some portion of that loss. The methodology is based on Black-Scholes pricing theory making the model more financial rather then insurance-based.

The model comprises five modules: 1) Volatility of stock determines the distribution of future stock prices, 2) the size of a company along with percent drop in the stock determines the probability of a claim, 3) the amount of market capitalization lost determines the amount of recovery, 4) the probability of financial distress (bankruptcy) affects market capitalization at risk and likelihood of a claim, and 5) the recent history that affects likelihood of a claim.

To finalize our recompilation of models, it's important to recall that there exist other models intended to help insurance purchasers to make decisions, instead of insurance companies. This is the case of McGriff, Seibels & Williams, Inc., an insurance brokerage and risk consulting company that developed a scenario model specially designed to help companies deciding how much D&O insurance to buy. The **D&O Claims Severity (DOCS)** model incorporates many variables known to affect claim sizes to assist the insurance purchaser in his examination of various circumstances that might affect the size of a future claim.

Similarly another insurer brokerage firm, Beecher Carlson has developed a tool that provides a forward-looking view of the insurance purchasers D&O risk profile to alert them to the likelihood and severity of future shareholder class action litigation. This model pinpoints D&O risk drivers, establish the insurance purchasers risk

[19] Advisen document: Using Value Investing Measures as Predictors of Lawsuits: Advisen's Value Risk Tools, September 2008, available at: https://www.advisen.com/downloads/Value%20Risk%20Tools%20-%20September%202008.pdf

[20] The information regarding this model was extracted from: www.casact.org/education/reinsure/2007/handouts/rooney.pdf

profile, generate benchmark analyses, and simulate real-world scenarios to evaluate the impact of a potential business decision on their future D&O risk profile[21].

In the same way, Willis, another insurance brokerage, supports insurance purchasers in the creation, design, implementation and effectiveness of D&O insurance policies through the use of a model. This analytical tool is designed to identify risks, measure D&O exposures, and suggest coverage enhancements to D&O purchasers or policyholders.[22]

Controversy about Use of Models

There are several sources of controversy regarding the accuracy and the predictive power of D&O models. For instance, some experts claim that there is no relationship between corporate governance and some D&O specific type of claims. This is the case mentioned in the academic paper by Larcker (2007)[23], where it is stated that there is no statistical evidence to support the relationship between accounting restatements and quality of corporate governance.

On the other hand, researchers from Stanford University[24] have been examining the ratings produced by four leading corporate governance rating firms (Audit Integrity, Risk Metrics, Governance Metrics, and Corporate Library) concluding that the predictability power of the models is questionable. They stated that there is no significant association between some of these ratings and future firm performance or undesirable outcomes such as accounting restatements and shareholder litigation. They argue that rating models work better for historical data than for forecasts. With respect to future corporate outcomes, both the AGR and the GMI rating models have modest ability[25] to predict accounting restatements and class-action lawsuits compared to the other models. However, the authors run regressions, using 2005 data, to assess the effect of each of the four different ratings on accounting restatements and class-action lawsuits separately, and found that even though AGR and GMI presented significant estimates, the pseudo R^2 weren't as high to conclude that the models are able to explain the variability in the data.

According to these findings, the authors conclude that as ratings are constructed backward-looking, they reflect past firm performance, but are unable to accurately predict litigation, accounting restatements, and future performance. However, among the available rating models, the AGR seems to perform better and is suited to the D&O insurance market needs.

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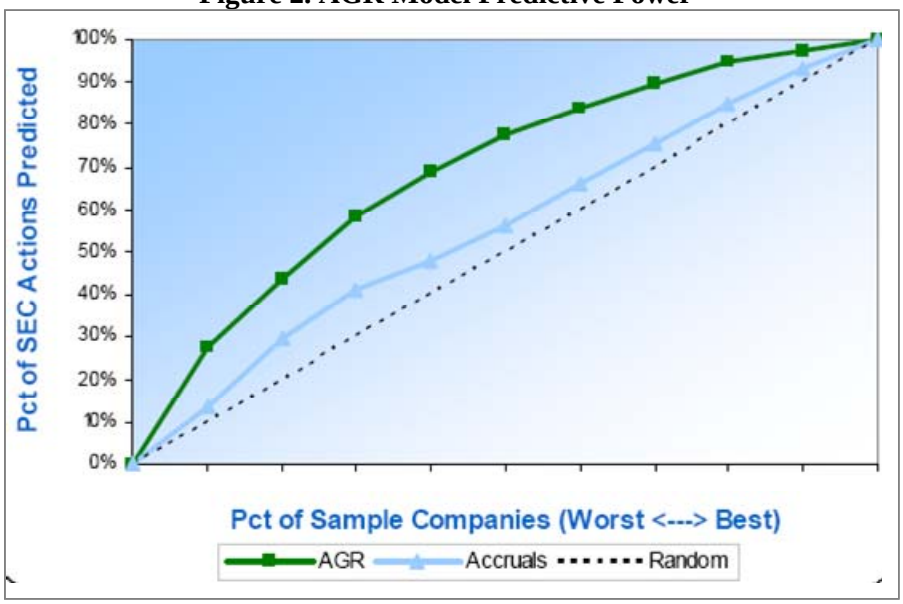
[21] http://www.beechercarlson.com/services-delivered/executive-liability/executive-liability.asp
[22] http://www.willis.com/Client_Solutions/Services/Directors_and_Officers/
[23] Larcker, D., Richardson, S., Tuna, I., 2007. Corporate governance, accounting outcomes, and organizational performance. The Accounting Review 82.
[24] Daines, R., Gow, I., Larcker, D., 2008. Rating the Ratings: How Good Are Commercial Governance Ratings?, available at: http://www.gsb.stanford.edu/cldr/cgrp/documents/dgl6-26-2008.pdf
[25] See Daines and Gow (2008).

As exhibited in Figure 2, having a statistical model is better than having no clue about what determines SEC actions. The area bounded by the diagonal and each curve represents the added predictability power of the AGR model or the accrual-based model over a random model (a model with zero predictive power), respectively.

Figure 2. AGR Model Predictive Power



Source: Audit Integrity

The graph suggests that even results from the most sophisticated models can be inaccurate. This inaccuracy is caused by the set of assumptions which sometimes are very far from reality or by the omission of relevant variables. The model risk exists across the financial industry; however in D&O, it is more difficult due to the low volume of data issue. Regarding predictive models for D&O for individual companies, model-developers recognize that are not very reliable. According to them, Willis is the only company that has drastically overstated the predictive ability of its model.

Concerning the discussion about weather models facing the same features as D&O models, it's important to mention that although they are not expected to have high predictive ability, insurers, brokers and state regulators keep using them. The typical "skill" of these models[26], useful statistic to compare the model effectiveness and reliability, ranges between 20-30%, indicating poor predictive ability. For instance, the renowned hurricane models[27] significantly overestimated losses for 2006-2008; they

[26] The skill of a model measures the predictive ability of a model and can be determined via a cross-validation methodology as used in hurricane forecasting by Dr. William M. Gray and as presented in: Michaelson, J., 1997. Cross-Validation in Statistical Climate Forecast Models, Journal of Climate and Applied Meteorology 26, pp. 1589-1600.

[27] Models developed by three risk-modeling companies: RMS, Air Worlwide, and EQECAT.

predicted losses of $37.2 billion to $42 billion for those years, while the actual losses were only $13.3 for that period.[28]

On the other hand, there are two remarkable cases that illustrate how dangerous it can be over relying or misusing models. The first one is the case of AIG, the insurer that was bailed out by the federal government in September, 2008 as a result of tens of billions of dollars in losses. Despite the fact that AIG had highly sophisticated models to assess its risks, AIG failed when it used a model in a manner that went beyond its intended purpose. The model was designed to gauge risks arising from credit-default swaps and to figure out which swap deals were "safe". Although these models were very accurate regarding the likelihood of default, they didn't attempt to measure the risk of future collateral calls or write-downs. AIG didn't anticipate how market forces and contract terms not weighed by the models would turn the swaps into huge financial liabilities. AIG had to take write-downs and face the downgrade in its corporate-debt rating.

The second is the Lehman Brothers story. In its 2008 Annual Report, Lehman boasted of having a "culture of risk management" at every level of the firm. Its risk management practices were broadly based on the well-known "Value at Risk" (VaR) system invented by JP Morgan Chase & Co. (JPM), a model that makes a number of mathematical assumptions that are probably very far from real life. The problem arises from two sources: first, the model understates the effect of the extreme events (losses) which are more likely to occur in reality; and second, the assessment of volatilities. The excessive leverage level (30 to 1) together with the fact that they were using poor metrics to measure risk led managers to fail to consider how dangerous a 1% probable outcome could be, and consequently leading the firm to be over-exposed.

The modeling failures at AIG and Lehman imply that reliance on modeling undermined good business practices like investment, underwriting, and pricing disciplines. We mention these cases to warn D&O insurers against shifting toward a misuse or over-reliance on models.

Conclusions

There are several key points that we can gather from the use of quantitative models with the D&O liability risk. First, the nature of the D&O business is very different from traditional types of insurance since the volume of claims is relatively low and the severity of the losses can be significantly high, sometimes catastrophic. Therefore, from the mere historical number of claims and loss amounts, there are not enough data points to build robust and confident models. The estimation of D&O aggregate claims has become an difficult and challenging task just as the estimation of weather-related coverage. Weather models face the same challenges regarding scarcity of data and low frequency of events.

Second, due to this complexity, model-developer companies have come up with different and innovative approaches seeking to assess severity and frequency separately, or to identify the liability risk profile of D&O applicants. Some models attempt to estimate the

[28] Advisen, 2008. Insurance Methods for Hurricane Rates Draws Skepticism.

probability of being involved in securities class action suits or the probability of committing fraud, generating scores/classifications depending on the absolute and relative risk position of the company. Some others seek to predict D&O liability or value the price of a particular D&O policy. In general, there exists a wide variety of models; we found models based on financial and non-financial ratios analyses, models that include corporate governance considerations, and models built as applications of financial engineering theory.

Third, the usefulness of these models varies by the user. They are tools that allow D&O underwriters, brokers and risk managers to assess management liability risk and predict the frequency of D&O claims. Corporate stakeholders can benefit from timely risk management and insurers can make premium adjustments. Investors can also use the risk classification generated by some of the models to build their expectations about companies.

Fourth, some researches have not found statistical evidence of the predictive power of these D&O models. It is expected for these models to have poor predictive power. The unexpected element is how people tend to assign more reliability to the results than they should. All models built upon limited data are likely to have poor predictive power; recall the skills measurement of 20% to 30% computed for weather models.

This is why we cannot forget that they are just simplifications of reality and there are some situations which they are not capable of being replicated. Models are an aid in decision-making; they cannot be a substitute for the judgment of the decision-maker. The combination of art and science in modeling is a must. In D&O model analysis the artistic skills is required to explain the gaps that are not explained by the data; the more consistent the quality of data and the greater the ability of models explaining the variations in that data, the less artistic ability required.

Finally, there are plenty of opportunities for model development. Most of the models are targeted to help insurance companies, particularly underwriters. But what about the customers, how do they know how much insurance they should buy or whether they really need a D&O policy? How likely are they to face a D&O lawsuit? How can they be sure that the premium is appropriate? Alternatively, it's important to remark that research on the evolution of weather models could provide some insight on the direction of D&O models to come.

The bottom line of this research is that D&O model development continues to be a challenge for model-developer companies.