NAVIGATING AROUND TURBULENT TIMES, HOW EFFECTIVE ARE THE RISK MODELS?

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Introduction

Formulating credit policies and managing credit is like flying an airplane in low visibility conditions. As the pilot, many times he sees clouds and not much else. So he has to depend on instruments in his cockpit, which are like economic and financial data. The difficulty is half of the reasons are not known and one does not know which half at any given time. Similarly the cockpit of a risk manager includes economic data, anecdotes and opinion from contacts, commercial economic forecasts, historical loss data, etc. Should a pilot only trust what is reflected by the instruments? Similarly should a risk manager trust what risk models predict?

Till the beginning of 2007, financial condition or flying conditions seemed pretty calm and visibility was good, but mid 2007 saw the conditions in global financial markets becoming turbulent. Particularly the debt capital markets made up of so-called structured securitized residential mortgage assets became extremely volatile. Markets plummeted or in some cases stopped. Credit spreads widened. Lenders became wary of counterparties. Investors became suspicious of ratings.

Can risk models provide necessary tools to manage these turbulent times? Recent developments including sub-prime crisis and collapse of large Corporates shed light on this question. Failure to properly evaluate the risk and pricing of collaterised debt obligations and other structured debt products was one of the problems that brought turmoil to the securitization market last year.

This paper attempts to cover the recent market turmoil and the role played by the risk predictability models including Value at Risk (VAR) model, Black Scholes Model and sensitivity analysis tools to predict such failure and to forecast losses.

Apart from analyzing the effectiveness of those models, the paper also assesses effectiveness of Corporate failure predictability models. In the cases such as ENRON and Worldcom, and even many others that we are aware of, although tools like Z-score, EDF, Moody's Risk Assessor, etc were available, losses were still incurred by even the most sophisticated financial institutions, lenders and investors. These institutions have now realized that having a sophisticated model is simply not enough, but what is needed is a "Credit Culture" within the financial institutions, whereby these credit risk tools are "listened to" and evaluated in good times as well as in turbulent times. It is important to note that credit scoring models should not be the only analytical process used in credit decisions. The analysts or lenders need to be motivated to consider or re-evaluate the situation when traditional techniques have not clearly indicated a distressed situation.

Apart from the failure of these models, not giving adequate prominence for risk management has also contributed to the downfall of major Corporates and Investment firms.

Risk management failures have managed to unseat CEOs at the top of the banking industry. October 2007 saw the resignation of Stan O'Neal from Merrill Lynch after he presided over USD 8.4 Bn in write-downs from subprime mortgages, asset backed bonds and secured loans. A month later, Charles Prince quit Citibank, following an USD 8 Bn hit to Citibanks's balance sheet.

As the financial world reels from massive write-downs, Risk Managers are moving out of the back office and emerging into strategic roles. Therefore, the final topic covered in this paper is the role of risk managers in managing financial institutions in turbulent times.

In summary this paper will discuss the recent sub prime crisis and corporate failures, the effectiveness of Risk and Corporate Failure models in predicting such pitfalls and how important the risk managers are becoming nowadays.

The 'Black Swan' Concept

In assessing the events and devising a risk management policy, it is important not to be blinded by their idiosyncratic features. All instances of financial distress have evident episode-specific elements, often linked to the type of financial innovation that precedes them.

Unfolding turmoil that we are seeing today is due to a natural result of a prolonged period of generalized and aggressive risk taking, which happened to have the sub-prime market at its epicenter. In other words it represents the archetypical example of financial instability with potentially serious micro-economic consequences that follows the build-up of financial imbalances in good times and strong economic growth in the form of overstretched balance sheets, marked by buoyant asset prices.

Second half of 2007 and 2008 exposed the flaws of financial measures based on historical prices that securities firms use compulsively and that overlooked a possible disaster, such as the mistaken credit rating on defaulted sub-prime debt.

This is more fully described in 'Black Swan' concept. Nassim Taleb, a research professor at London Business School and former options trader wrote a book in 2007 titled "The Black Swan" (published by Random House). It describes how people underestimate the impact of infrequent occurrences. Just as it was assumed that all swans were white until the first black species was spotted in Australia during the 17th century, historical analysis is an inadequate way to judge risk.

Finance is an area that is dominated by rare events and according to Professor Taleb, "The tools that we have in quantitative finance do not work in a 'Black Swan' domain."

The Financial Turmoil

Present turmoil represents a sharp repricing of credit risk that, given the leverage build up in the system, led to, and was exacerbated by evaporation of liquidity in many markets, including the inter-bank market. The credit repricing which centred around US subprime mortgage market followed a prolonged phase of broad-based aggressive risk taking. It was amplified by the availability of structured credits and distribution of exposures across the system. This led to a crisis of confidence in valuations, triggered by unexpected rating agency downgrades, and to a generalised distrust of counterparties, as market participants wondered about the size and character of their own exposures and of those of others. This crisis of confidence triggered an evaporation of market liquidity for the instruments concerned and of funding liquidity to those institutions suspected of being vulnerable to the market disruption. As the time passed, the underlying asset quality weakness inevitably became more evident.

Banks were affected for a number of reasons. For one, they had actually invested in subprime market securities directly, but more importantly, they had provided back-up credit lines for special purpose vehicles (SPVs) that held those securities. As a result banks became very concerned with the liquidity and capital implications of potential large sale involuntary re-intermediation, causing them to retrench such assets.

Even though the deterioration in the US sub prime market was the key trigger of the financial turmoil; banks in other continents also faced with substantial liquidity pressures due to the fear of being caught up in a whirlpool of uncertainty.

Before proceeding further, it is quite useful to have a basic understanding of the origins of sub-prime crisis which is described in the box article.

Collapse of Subprime Mortgage in the United States. How it Happened

Subprime lending refers to those risky mortgages made to borrowers with blemished or "subprime" credit histories. Reports indicate that as much as 25% of the USD1trillion subprime mortgage market has moved in to default, triggered by rising monthly obligations that many people cannot now afford.

What led to this crisis and lessons for policy makers

As usual, a key player is the Federal Reserve. When influenced by events such as 9/11, Enron and Worldcom, the Federal Reserve moved towards policies of loose money and low interest rates. As a consequence, since 2001, all levels of financial system have been awash with cash. Banks, mortgage companies, institutional investors, including largely unregulated hedge funds developed increased appetite for risk as they felt pressured to chase even higher returns in a weak dollar/low interest rate/cheap asset environment.

Meanwhile, home ownership was promoted aggressively to first time home buyers – many of whom under traditional credit standards would not have qualified for a mortgage. Closing documents containing rate step-up provisions were pushed on to the unsophisticated. Consumers were encouraged to sign and move into their dream home with little understanding of the risks and consequences of an adjustable rate mortgage. Naturally this easy money ramped up pricing and speculation in housing. When faced with subsequently higher monthly mortgage payments when the higher rates kicked in, a vast number of homeowners simply couldn't pay.

While these mortgages were being peddled, aggressive investment bankers on Wall Street moved to package up these higher rate bearing mortgages into what first became known as Collateralized Mortgage Obligations "CMOs" and sold them to institutional investors, such as pension funds. Subsequent iterations were called Collateralized Debt Obligations "CDOs" (these included such things as credit card debt and car loans). To give some semblance of portfolio balance and diversification, such structured fixed income instruments, essentially bonds, were blended together by math wizards with regard to geography and credit type so as to gain not only AAA credit ratings (for which the rating agencies were well paid) but also some insurance coverage – this from firms that specialize in insuring mortgage-related bonds against default (the insurer MBNA recently took a related $2.3 billion hit). The alchemy of these math wizards made the CDOs appear to be a perfect investment, one that had high return, low risk and a nice warm AAA rated security blanket.

The creative use of leverage, layered options (derivatives) and other sophisticated math-driven applications led to an almost unlimited demand for this structured paper – and volumes grew into the hundreds of billions. Under these conditions, investment bankers were more than happy to originate, warehouse, trade and own these investments because of the huge fees associated with such activities, especially origination. The more sanguine in the market such as Goldman Sachs left the party early and avoided the financial havoc other major firms like Bear Sterns have experienced. Other investment bankers and hedge fund managers chose to forget what every undergraduate business student knows – that high return and low risk do not go hand in hand.

Further, given the incentives and pressures institutional investors faced worldwide to perform and justify their lofty fees, such "high return/low risk" paper was sought in great volume. As the game became more profitable and global in scope, some even borrowed against the paper they held, which, in combination with increasingly complex derivatives, freed-up investors' cash to demand even more CDOs. As part of this frenzy, Citigroup et al created and funded a further permutation called Structured Investment Vehicles "SIVs" as a basis to issue their own commercial paper and thus chase further profits. Citicorp's subsequent inability to meet short-term obligations as the value of its supporting leveraged assets collapsed led to devastating hits to their balance sheet. The same impact has been experienced by European banks including the previously venerable UBS.

All this started to unravel (surprise, surprise) when the subprime borrowers began to miss their mortgage payments. As the meltdown began, holders of CMOs/CDOs/SIVs realized they couldn't measure the true value of this supposedly low-risk paper and quickly found their assets and liabilities mismatched with billions lost in the squeeze. As we've said, high return and low risk do not go hand in hand and it may be timely to remind ourselves of the Enron days- when too few analysts studied the fundamentals driving the market and few were brave enough to say, "the emperor has no clothes." One also recalls the adage attributed to Warren Buffett, "You don't know who's swimming naked until the tide goes out".

So where are we today? Well, regulatory accounting requirements mandate that publicly owned investment banks write down assets of questionable value. CMOs/CDOs/SIVs do come to mind. Massive write-downs have wiped out huge-chunks of capital and crippled investment banks' ability to act as financing institutions – and there is more carnage to come. This is important as there is real risk that if the flow of credit from the impacted financial houses tightens further – those that supply vital credit to both consumers and companies – the downturn we're moving into will be deep and long.

(Extracted from Wall Street Journal article "Quants Gone Wild – The Subprime Crisis" Commentary by A W Bodine and C J Nagel, Faculty at Concordia College – New York March 26, 2008,) The role of credit structured products has been so prominent that the recent turmoil is turning out to be the first major test of the resilience of the new credit risk transfer instruments. Three inter-related specific characteristics of these products may have contributed to the turbulence itself.

First, their pay-offs can be highly non-linear, producing steady streams of returns in good times, but can result in heavy losses in bad times, i.e. their sensitivity to more systematic aspects of the business cycle such as asset prices and income can be high, but cannot be perceived by investors. Second, for similar reasons, risk profile of structured products can be quite different from that of traditional bonds. It is common for tranches of structured products with same expected (average) loss as a bond to be exposed to a much higher probability of large losses (i.e. to have a higher unexpected loss). Since credit rating only captures expected losses, it can be highly misleading for investors to extrapolate the credit risk profile of the structured products from the ratings. Finally and most importantly, the modeling deficiencies in predicting future default and the risk profile of these instruments. This reflects both the limitations of current models and difficulty in estimating key model parameters with any degree of confidence, especially given the short history of these products.

These characteristics have likely played a role both during the build up of risk taking and during the turmoil. During the buildup they may have contributed to participants getting into a false sense of security. During the turmoil such features contributed to loss of confidence and evaporation of market liquidity triggered by unexpected downgrades and unexpected losses incurred on the instruments. The evaporation in the market liquidity in turn forced firms to increase their reliance on marking-to-model, further amplifying the uncertainty surrounding the value of the instruments in stressful market conditions. In fact, in addition to being forced to rely more on marking-to-model, firms may have had an incentive to do so opportunistically, so as not to recognize the distressed prices prevailing in the markets.

With this background, let's now turn in to some of these models, and their performance during turbulent times.

Value at Risk Model's failure

Value at Risk (VaR), the measure banks used to calculate the maximum their trades can lose each day, failed to detect the scope of sub-prime mortgage market's collapse as it triggered securities firms led by Citigroup Inc, Merrill Lynch, Morgan Stanley and UBS AG to capsize.

The difficulty of properly measuring the credit and counterparty exposure of Collaterised Debt Obligations (CDOs) created doubt among investors. That in turn led to a sell-off of securities that pushed spreads wider, thus forcing more asset sales.

Increased availability of data, modern portfolio theory and the application of advanced mathematical techniques have combined to make Value At Risk Models, which gave investment firms, a false sense of security. In reality, such probability based models are derived from past norms. These models based on VaR became so technically advanced, many of the principals running investment firms simply did not understand the underlying risk model.

In the case of Risk models, it should be noted that there wasn't a lack of data regarding underlying assets of CDOs such as sub-prime mortgage loans, but the models used to predict their performance were based on incorrect assumptions. Though there were plenty of data, it was incorrectly used and the new environment of home price depreciation made a lot of the historical data and behavior relationships irrelevant.

It is astonishing to see that VAR model, the risk taking model that emboldened Wall Street to trade with impunity is broken and all major investment firms including Merrill Lynch & Co, Morgan Stanley, etc are coming to realize that no algorithm or a triple 'A' rating can substitute the old fashioned due diligence. Executives in these firms were forced to take steps to overhaul their risk management techniques after internal models failed to foresee the first annual decline in house prices since great depression that eroded five years of trading gains.

Goldman Sachs Inc, the firm with the highest nominal VAR was the sole investment bank to report record earnings in the 4th quarter 2007, whilst Merrill Lynch, which had the second lowest VAR of the five biggest US Securities firms posted USD9.8Bn loss for the 4th quarter 2007, the biggest in its 94 year history. This itself is a testimony to the failure of VAR model in a black swan situation.

Banks and securities firms increased their trade sizes (bet sizes) during the past decade on interest rates, stocks, commodities and credit. Trading volumes for the top five securities firms in the USA, namely Goldman, Morgan Stanley, Merrill Lynch, Lehman Brothers and Bear Stearns climbed to a combined USD71Bn by 2006 from USD29Bn in 2002. Third quarter 2007 daily average VAR of Goldman was USD139Mn as compared to Morgan Stanley's USD87Mn, Lehman's 96Mn, Merrill's USD76Mn and Bear Stearns USD32Mn.

All these firms based their calculations at confidence interval of 95 percent, meaning they did not expect one day drops to exceed the reported amount more than 5 percent of the time. However, the amounts differed in part due to different methodology and data used by these firms. For instance, Lehman Brothers used four years of historical data to calculate VAR, with higher weighting given to more recent times, while Morgan Stanley provided VAR calculations using both 4 years and one year of market data. However, a comparison of VAR versus their losses in the 3rd or 4th quarter 2007 was astounding. Many instances where VAR model would have trivial losses at 95 percent of the time or even 99 percent of the time ended in having huge losses. In the case of mortgage defaults, Merrill's highest one-day VAR in the 3rd quarter 2007 was USD92Mn, indicating that the firm's maximum expected cost during 63 trading period would have been USD5.8Bn. However, the firm wrote down USD8.4Bn from the value of collateralized debt obligations, sub-prime mortgages and leveraged finance commitments, i.e. 45% more than the worst case scenario.

All of the risk management tools failed to prepare Merrill for the unforeseen declines in triple 'A' rated securities, backed by sub-prime mortgages. In fact, Merrill in its 3rd quarter filing with the US Securities and Exchange Commission admitted "VAR, stress tests and other risk measures significantly underestimated the magnitude of actual loss from unprecedented credit market environment" and that "in the past, these AAA ABS CDO Securities had never experienced significant loss in value".

In analyzing the reason for failure of VAR model, one can learn lessons from 1998 Russian bond defaults and related market stress.

Market Stress and Risk Measurement Tools

Securities firms developed VAR models and statistical models in early 1990s to better quantify risks on the trading of bonds, stocks, currencies and derivatives increased. However, by late 1998, Russia's bond defaults demonstrated drawbacks in using statistical analysis based on historic market movement to measure risk. Russia's default risk was underestimated because Value-at-Risk computations used by investment banks depended on market events of the preceding two to three years, when nothing similar had occurred.

In addition, several firms which amplified their risks by relying on borrowed money for most of their trading bets, blew up since they did not anticipate that investor panic after the Russian default would cut the value of any risky debt, whether it was issued by a country, sold by a company or backed by mortgages This is known as market stress and in such a market stress situation, some individual sectors that previously appeared unrelated do move together and as a result, the organization would take losses on both of them or even on positions that were previously deemed to be hedged. This was the principal cause for the failure of VAR model in the recent turmoil.

Stress Testing/Scenario Analysis

Other risk measurement tools commonly used by securities firms, known as stress testing or scenario analysis, also failed to prepare the industry from the plummeting value of AAA-rated securities that had previously been deemed the most credit worthy. Risk management teams in major financial institutions use complex computers to guide the banks away from financial danger. These risk models obsessively run through scary scenarios such as, what if there is recession, what if interest rates fall too far or rise too fast or say, the Central Bank of Argentina collapses, etc. Those who study many scenarios every day, will try to figure out how likely for a bank to lose a lot of money. However, such software completely failed to predict the current mortgage crisis.

To understand why scenario analysis software failed, one has to understand the basic mathematics of risk management, and to do that, one has to go somewhere unexpected; a botanical garden!!.

These models are based on a theory discovered in 1827 by the Scottish botanist, Robert Brown. He collected pollen and put it with some water under a microscope and observed that the tiny pollen grains bounced around completely randomly. This is due to grains being buffeted by constantly moving water molecules.

It turns out that what Brown discovered, later called "Brownian Motion" is useful in studying all sorts of random phenomena, including financial risk. It is a useful model but not foolproof. Though financial models based on Brownian Motion have done a great deal of good, have made the world far richer and have been very helpful in managing risk, at least for sometime, they are not perfect.

Brownian Motion works best with truly random samples, like little bits of pollen that bounce around with no rhythm or reason. However, financial markets are not random. They are linked and risk management software based on Brownian Motion are not always good at figuring out how those global links work.

Stress tests are good at predicting, based on scenarios used and in many cases, scenarios used are more severe than people anticipated. However, these scenarios assumed were not adequate and going forward, these stress testing models needs to have broader perspective covering more scenarios. History has proven that "worst case scenario" was not in fact the worst case.

These models can also be referred to as GPS devices used in a car. It's helpful as a guide, but the driver still needs to look out the window. Some banks with a better understanding of Brownian Motion and the vulnerabilities of the software planned correctly, and are doing well. Other banks never looked at the window and they crashed. It should be noted that at Credit Suisse, one of the firms that have so far skirted the worst sub-prime declines, Value-at-Risk played no role in helping the risk managers navigating the market turmoil. In such situations, Credit Suisse's risk managers sat down with traders, talked about varying specific issues and scenarios and arrived at critical decisions, which helped them successfully to manage the turmoil.

However, this article does not suggest in any way that risk managers should do away with VAR models or stress testing. VaR provides a service if it is used every day because it can pick up variations in the risk that the firm is taking. It is important that risk managers complement VAR model and stress testing with practical experience and market sentiments to arrive at a conclusive decision.

Deficiencies in Black Scholes Model

For years investors have relied on complex formulas in Black Scholes Model to manage risk. Over relying on this model has also highlighted its deficiencies. Investors and the banks underestimated the likelihood of an unlikely event, a financial panic.

A relatively smart strategy known as "Portfolio Insurance" invented by a pair of finance professors in early eighties at the University of California had been taken up in a big way by the supposedly savvy investors. Portfolio Insurance evolved from the most influential idea on Wall Street, an option pricing model based on Black – Scholes. Model is based on the assumption that a trader can suck all the risk out of the market by taking a short position and increasing that position as the market falls.

Good in theory, but the glitch was discovered only after the fall. When a market is crashing, no one is willing to buy more of that security and it's impossible to sell short. If too many investors are trying to unload stocks, as a market falls, they create a disaster, they themselves are seeking to avoid. Their desire to sell further drives down the market, triggering an even greater desire to sell and ultimately sending the market into a bottomless free fall. That is what happened in October 1987 (black Monday stock market crash), when logic of Black – Scholes was shown to be irrelevant in the real world of crashes and panics. Even the biggest Portfolio Insurance firm, Leland O'Brian Rubinstan Associates (co-founded and run by the same finance professors who invented portfolio insurance) tried to sell short as the market crashed and couldn't.

However, this failure of financial theory did not lead to questioning Black-Scholes in general because the maths was too advanced and the theorists were too smart to be challenged by anyone without a degree in mathematics. However, overall after the 1987 crash, the market adjusted to these eventualities through a rise in prices. Though it was obvious that huge price jumps were more probable and likely to be more extreme than what Black-Scholes model assumed, market realized that one cannot manufacture an option on the market by selling and buying the market itself.

Though few smart traders abandoned the theory, the market itself didn't and infact its influence mushroomed. As at end 2006, as per BIS (Bank for International Settlements) there were USD 415 Trillion in derivatives. In addition, there are trillions more in exchange – traded options, employee stock options, mortgage bond, etc most of which presumably are still priced using some versions of Black – Scholes.

Investors need to believe that there is an equitable price for what they buy, even if it requires a leap of faith. Hence the model created markets and markets follow models. So the markets sprang up and investors figured out that, at least for some of it, Black-Scholes does not work. For certain kinds of risk, the risk of rare, extreme events, the model is very wrong.

The reason that markets sprang up was the belief that Black – Scholes could price it fairly but in extreme cases Black – Scholes did not work; trillions of dollars worth of securities would have been priced without regard to the possibility of crashes and panics. But until recently, no one has moaned about this problem too loudly. However, with the sub prime market unravelling, the revolt against the model has begun.

As per Taleb, author of the "Black Swan", one of the major critic of Black - Scholes, the model has a pernicious effect; by leading investors to think they understand complicated financial risk, Black - Scholes encourages them to take more chances than they rationally should. However, there is very little public outcry against failure of Black – Scholes model. May be this was due to main losers being broker-dealers themselves rather than human beings.

The collapse of sub-prime mortgage bond market involves millions of oblivious people who have never heard of Black – Scholes options pricing model. Nevertheless, it was Black – Scholes that gave them and the rest of financial system, the excuse to risk the roof over their head. They were followed by the mortgage brokers who lent them money and the banks that funded the brokers. Black – Scholes is no longer just a model, it has evolved into a climate of opinion about a certain kind of financial risk. It wasn't only big firms but lot of small real estate speculations (home owners) who in effect sold put options too cheaply against the risk of extreme rare events. That many people live inside the investment that they have speculated on, sharpens the pain.

Financial panic has become almost a common place and events that are meant to occur once in a millennium now are seen to occur every few years. Is this because the financial system was built on an idea that badly underestimates the risk of catastrophe? This is the question now being raised among Wall Street investment bankers.

At this juncture it is appropriate to cover "Model Risk" in general terms, before discussing Corporate failure models and their effectiveness during turbulent times.

Model Risk

The investors and the lenders expect good performance of their investment at an acceptable level of risk by utilizing available "risk budget" or funding. In fact, measured risk taking is a key part of active investment and credit management. Similarly, the clients expect fund managers to know and be able to articulate the risk that they are running with their portfolio. Hence risk measurement is important and it should be forward looking (ex-ante) based on the portfolio of assets. To assess ex-ante risk, generally a model is needed to predict how the future might evolve, which describes how assets or liabilities might move. Typically these models are applied to current asset (or liability) mix and provide decomposition of risk and permit risk budgeting.

The models are typically constructed using one or more of the following approaches;

- pure extrapolation from historic data (eg. As derived from past daily/weekly/monthly data)
- inclusion of fundamental factors (eg. Derived from company accounts)
- inclusion of macro-economic factors (eg. Interest rates, inflation, oil price)
- statistical models (eg. Using principal components analysis)

Risk models are typically derived from statistical analysis of some observed data set and are characterized mathematically by a multivariate probability distribution describing the likelihood of different outcomes. Therefore as with any statistical analysis, there is an uncertainty in the answers, and in this case it would be in the modeled distribution form.

Hence the "Model Risk" is the risk that the model is inherently misspecified rather than the risk that the particular outcome just coming out (or that has just occurred) is at one extreme of the modeled distribution. An example of a model risk is the fat tails in a probability distribution where extreme outcomes seem to occur more often than would be the case.

In the traditional risk management paradigm, a risk model is developed or brought from a third party and used to measure whether the portfolio is running too much or too little risk and accordingly portfolio positioning is adjusted. Portfolio construction includes an explicit optimization stage since risk forecasts as well as return forecasts explicitly influence portfolio construction.

If the risk model is misspecified, then it is very likely that one ends up with a wrong portfolio. It can be due to either misspecification of overall risk distribution or misspecification of the decomposition of the risk.

Having discussed the "Model Risk" and the potential failure of risk models assessing complex products in the macro environment, let us turn to micro assessment through corporate failure prediction models.

Corporate Failure Prediction Models

With the turn of the new millennium, credit scoring models have been given unprecedented significance and with Basel 2 advantages under Internal Ratings (IRB) approaches, shift towards model based credit decision has accelerated. Banks in particular and most financial institutions worldwide, are currently developing internal credit risk systems to assess probability of default (PD), loss-given default (LGD) on credit assets of all types.

Almost all the statistical credit scoring models that are in use are variations on a similar theme and coming under various brands, eg, KMV, Z-score, Moody's Risk Assessor (MRA), Moody's Risk Calc (R), Credit-sights Bond Score etc. They involve a combination of a set of quantifiable financial indicators of firm performance with a small number of additional variables, that attempt to capture some qualitative elements of the credit process.

The detection of a company operating with financial difficulties is a subject which has been particularly amenable to analysis with financial ratios. Professionally concentrated studies in the area of ratio analysis and bankruptcy classification were initially performed by Beaver in 1967. Beaver studied the performance of various ratios as bankruptcy predictors and concluded that the cashflow to debt ratio was the single best predictor. These semi variate analysis of a number of bankruptcy predictors set the stage for multivariate attempts such as Z-score model developed by Edward Altman (1968).

The critical breakthrough in bankruptcy prediction came when Altman decided to abandon the search for a single best ratio and built a comprehensive statistical model using a technique called multiple discriminant analysis (MDA). MDA allows a researcher to group observations into several pre-determined categories based on several characteristics of an observation. He selected a sample of 33 manufacturing companies filed for bankruptcy in 1946-1965 and matched with another randomly selected 33 firms and started with 22 ratios that seemed to be intentively plausible as bankruptcy predictions. After each run, the ratio that contributed least to the explanatory power of the model was eliminated and eventually he came up with a model with only 5 ratios. The original Altman model, which is limited to manufacturing firms was;

$$Z = 0.012X_1 + 0.014X_2 + 0.033X_3 + 0.006X_4 + 0.999X_5$$

Where X_1 = working capital / total assets
X_2 = retained earnings / total assets
X_3 = earnings before interest on tax / total assets
X_4 = market value of equity / book value of total liabilities
X_5 = sales / total assets

In the initial 1968 study, cut off Z-score of 2.675 was used (if the score was below, company was classified as bankrupt). After conducting subsequent tests (86 companies gone bankrupt in 1969-75, 110 in 1976-95 and 120 in 1997-99) Altman himself recommended a lower cut-off score of 1.81 in year 2000.

In general, ratios measuring profitability, liquidity, leverage and solvency are considered as most significant indicators to assess probability of default (PD). Though the order of their importance depends from case to case, overall it provides several measures in a meaningful predictive model. The combined model is based on following factors.

a) which ratios are most important in detecting credit risk problems
b) what weights should be attracted to those selected ratios
c) how should the weights be objectively established

Almost all corporate failure prediction models in a sense are static in nature as they can be applied at any point in time, regardless of the current or expected performance of the economy and the economy's impact on the key risk measures, PD and LGDs. Aggregate PDs vary over time so that a firm with a certain set of variables will fail more frequently in poor economic times and vice versa in good periods. This systemic factor is not incorporated directly in the establishment of scoring models in most cases.

Several other studies have criticized MDA analysis as used in Altman's Z-score model, due to statistical procedures employed. Application of linear MDA was not preceded by tests to determine optimality in most financial studies and it has been found that MDA procedure would be optimal only if the normality conditions are met. Furthermore, a "time bias" might have been incorporated into these classic business failure models, most of which were developed between late 1960s and the 1980s. Research has confirmed that models are inappropriate for time frames different from those in which the model was developed. Some models have attempted to experiment with variables which can capture economic factors such as GDP growth to overcome this factor.

In the case of estimating LGD, most modern credit risk models assume independence between PD and the recovery rate on defaulted debt. However, studies show that this is an incorrect assumption. In particular, in periods of high default rates, the recovery rates are low relative to average and losses can be greater.

KMV model owned by Moodys uses the proposition that when the market value of a firm drops below a certain liability level, the firm will default on its obligations. The value of the firm, projected to a given future date has a probability distribution characterized by it's expected value and standard deviation (volatility).

The area under the distribution that is below the book liabilities of the firm is the PD, called EDF. In three steps, the model determines the EDF for a company. In the first step market value and volatility is determined from the market value of stock, volatility of the stock and the book value of the liabilities. In the second step, firm's default point is calculated relative to firm's liabilities coming due over time. Finally, a mapping is determined between a firm's distance to default and the default rate probability based on the historical default experience of companies with similar distance to default values. In the case of private companies, where stock price and default data are unavailable, KMV estimates the value and volatility of the private firm directly from its observed characteristics and values based on market comparables. It is assumed that a firm would default when its total market value falls below the book value of its liabilities. A key assumption of the KMV approach is that all the relevant information for determining relative default risk is contained in the expected market value of assets, the default point and the asset volatility. Difference due to industry, national location, size, etc are assumed to be included in these measures.

It should be noted that in both Enron and Worldcom failures, both KMV and Z-score models were issuing warnings long before the bad news hit the market. Though neither actually predicted the bankruptcy, these tools certainly could have provided an unambiguous early warning that the rating agencies were not providing for. However, true liabilities of a firm is a basic ingredient and both models were using under-estimate of the true liabilities. If true liabilities were utilized, both models would have predicted severe distress.

Predictability of these models when accounting books are cooked is another challenge. However, an interesting feature of the Z-score model is its ability to withstand certain types of accounting irregularities.

An objective model, based solely on public available accounting and market information is not constrained in that the analyst is free to follow the signal or be motivated to dig deeper.

However, in the case of bankers (lenders), the situation is more advantageous since lenders are privy to management accounts, stock statements, profitability forecasts and business plans of borrowers. In addition, bankers exercise their right to carry out factory inspections and other fact finding visits. Therefore lenders need not restrict their decisions to the information thrown by risk model but use their experience and judgement.

To repeat an important point, credit scoring models should not be the only analytical process used in credit decisions. The analyst will, however, when indications warrant, should, be motivated to consider or re-evaluate the situation when traditional techniques have not clearly indicated a distressed situation.

Given the foregoing background, we should now move on to the next important area of Risk Management using common sense as our guide.

Emergence of Risk Managers

With the sub-prime crisis and other economic melt-downs, Risk Managers are gradually moving out of the back office to function strategic roles. Coming fresh from the global fallout from the sub-prime lending crisis, the Societe Generale scandal where a young trader cost them USD7.2Bn raises stark questions about risk management systems and how critical risk information is shared across an organization. This trader cost Societe General by betting frequently on European stock index futures and using knowledge of the bank's risk controls to conceal the trading.

Traditionally, risk managers have been assigned a more advisory role, essentially functioning as referees rather than as players in the game of wealth creation. However, it is very difficult to be the voice that says 'stop' when a strategy is making money. Though in the latest sub-crime crisis, the risks were apparent to many across the industry, investment managers ignored warnings by risk managers because of massive profits being generated.

However, now the staggering writedowns have prompted banks to reconsider this stance and strengthen risk management areas.

There had been a surge in demand now for qualified risk managers. Some of the banks posting biggest losses have become most visible advocates of an emboldened risk manager. In the recent past, banks have spent billions to comply with the new international banking accords, the Sarbanes-Oxley Act, etc and tightened money laundering rules. Banks have historically been designed into organizational structures that group risk in silos and it is generally accepted now that risk management has not kept pace with financial innovation on Wall Street.

Going forward, successful risk management necessitates a genuine partnership between traders on the business lines and the risk managers where information is traded candidly and acted on. Risk managers depend on accurate information from business lines in order to build models that predict losses or take credit decisions that are best for the institution. Most financial institutions have now realized that the recipe for successful risk management involves equality between risk managers and business lines. The best organizations create a healthy tension of checks and balances between these two functions. For example, Goldman Sachs group which emerged relatively unscathed from the mortgage mess rotates employees between jobs on the front line or trading floor with those managing risk. Goldman has emerged on top, in part because of its insistence on emboldened risk management.

However, only time will tell whether, in this new era, risk managers will be given real power they need.

Conclusion

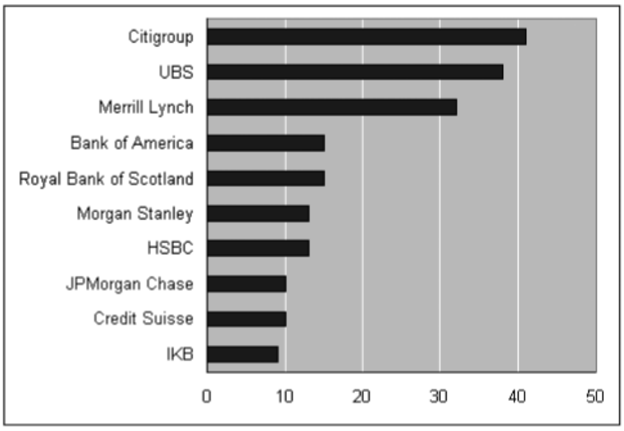
Current credit crunch that we are experiencing is not solely the responsibility of the bank. Banks come in all shapes and sizes, large and small, conservative and risk hungry. Beyond the banks, host of other institutions must take some of the blame. The credit rating agencies have rose-tinted expectations about the default rates for subprime mortgages. Some institutions took the ill-fated decision to start insuring structured credit. Unregulated entities issued many of the dodgiest mortgages in America. On the other hand, global glut of liquidity played a role in the "reach for yield" phenomenon where most of the funds came from Asia and oil producing countries which were looking for high returns in a world of low interest rates. On the other hand, there were Central Banks who should take part of the responsibility. Tougher monetary policy would have encouraged investors to steer towards more liquid products. The investors themselves are part of the problem, many of whom relied on AAA ratings without questioning why they were delivering such high yields.

It should be noted that other industries have also gone through similar turbulent times. Airlines in the wake of terrorist attacks on September 11, 2001, Technology firms where dotcom bubble burst. However, banks are special due to 3 main reasons.

i) Inherent fragility of the business model (eg. possibility of bank run due to loss of customer confidence)
ii) Banks do lots of business with each other (collapse of one institution sends a ripple of fear through all the others)
iii) Role the banks play in the economy, allocating credit and flowing capital to productive sources

Therefore it is vital that banks tread carefully in turbulent times with common sense. The following graph extracted from "The Economist" May 17, 2008 issue depicts the write-offs so far in the main banks.

Hall of Shame



Source: Bloomberg ***To April 28th 2008**

There is a clear gap between the top 3 losers and the others, mainly attributed to the quantum of risk been taken.

Whatever the type of institution, it is clear that the quality of risk management can make a big difference to its performance.

In a market where most banks are drawing up lists of people to sack, risk managers are in heavy demand. Yet those risk managers are also aware that they have to base their decisions on imperfect information, ie. the instruments in the cockpit that a pilot has to use. The crisis has underlined not just their (instruments) importance, but also their weakness.

We discussed the failures of these risk models in extreme cases. Most models estimate how bad things could get using data from preceding three or four years, so it gets more sanguine the longer things go smoothly. Yet common sense suggests that the risk of a blow-up will increase, not diminish, the farther away one gets from the last one.

The unfolding financial turmoil in mature economies has darkened the outlook for the global economy and prompted the official and private sectors to reconsider policies, business models and risk management practices.

However, models still have their place; optimists expect them to be greatly improved now that a big crisis has helpfully provided loads of new data / default data on stressed markets. However, going forward it is likely to have more emphasis on non-statistical ways of thinking about risk. That means more rigorous about imagining what could go wrong and thinking through the effects. Hence, risk managers' role is becoming important along with their skill level.

The silver lining is that industry has now realized that market participants should not rely exclusively on mathematical models but should also use the social sciences to understand behavior. Time has come to put aside full reliance on mathematics and somehow find the right balance between qualitative, quantitative and sensitive risk management.

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NAVIGATING THROUGH TURBULENT TIMES Remarks by Dr. Patrick Njoroge Governor, Central Bank of Kenya December 2, 2016.Â The outlook for the global economy is confounded by uncertainties around the impact of Brexit and political developments in the U.S. Given these risks, and in line with the theme of this forum, I would like to provide some highlights on the outlook for Kenyaâ€™s economy, and to outline some of the measures we are implementing to mitigate the risks.Â Nevertheless, risks to the economy remain largely with regard to the uncertaintyÂ Before I conclude, I would like to reiterate that the CBK is strengthening the banking sector to ensure greater transparency and stronger governance, and also to promote effective business models and innovation. Interested in how to adopt a wide range of virtual recruiting tactics? Here is Rakuna's guide to virtual recruiting with best practices.Â How to Organize Effective Online Assessment? If you are considering implementing virtual assessment or finding the way to upgrade your online tools in the following months, here are some tips and best practices: 1. Choosing The Right Tools.Â If the onboarding time happens at the office, the new hires can reach out to their supervisors or teammates easily to sort things out. However, challenging times require adaptive measures, and this is an opportunity for the rise of online learning hubs. Utilizing these tools ensure that your new employees can have the proper training to perform productively despite the lack of in-person communications and guidances. The greatest danger in times of turbulence is not the turbulence. It is to act with yesterdayâ€™s logic.8.Â effective, they need hierarchical power and direct control over a specific set of resources which they can deploy to achieve results (Botelho et al. 2017).Â The formation of a mental model in a personâ€™s mind is the result of both biology, i.e., an ability inherent to the human mind, and learning (Jones et al. 2011). The discipline starts with self-reflection, learning to discover our own internal pictures of the world, and then to bring them to the surface and scrutinise them rigourously. It also includes the ability to carry on what Senge (1990) calls â€œlearningful conversationsâ€ where people expose their own thinking effectively and make that thinking open to the influence of others. Risk premiums rise not only because the absolute level of risk increases but also because lenders require higher rates of return when they are unsure about how companies will performâ€"that is, when they lack deep famili-arity with the specific risks individual companies face. An investor who can acquire distinctive knowledge about particular B-rated credits and discern where the risk premiums are "too high" can create a bond portfolio with superior returns relative to the risks taken.Â Statisticians call this approach a search for "asymmetric" risk. Oddsmakers might call it "loading the dice," and it is the opportunity to capture this effect that makes a portfolio-of-initiatives approach so appealing today. Turbulent times exacerbate many existing information risks and create new security management challenges. Discussions and interviews with chief information security officers from a broad range of large firms about how they addressed the challenges of the economic downturn provide both actionable ideas and clues for future research.Â Purpose: To argue that in the case of quantitative security risk assessment individuals do not estimate probabilities as a measure of likelihood of event occurrence .Â Research limitations/implications: The ALE model used in security risk assessment, although it is presented in the literature as quantitative is in fact qualitative being influenced by bias.