



Measuring and Managing Risk in Innovative Financial Instruments

Stuart M. Turnbull

Bauer College of Business

University of Houston

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Outline of Presentation





2 Pricing – the starting point

1. To be concrete, we consider some form of Collateralized Debt Obligation.
2. Modeling the individual assets in the collateral pool – a bottom-up approach.
3. A top-down approach
4. Implications for new financial products

Note that many of the same issues that arise for pricing also arise for risk management.



2 Pricing – bottom-up approach

At the individual asset level (an asset may be a mortgage or a ABS) we need to model the probability of default and the loss given default over the horizon of the CDO.

To model the cash flows generated by the assets in the collateral pool, it is necessary to consider how default affects the remaining assets – default dependence.

Default may be beneficial for the remaining assets – less competition, or it may signal a particular sector or the whole economy is in trouble.

How do we model default dependence?



2 Pricing – default dependence

One approach is to assume that the probability of default for a particular asset depends on set of macro-factors.

What are these factors?

How do we estimate the functional dependence?

An alternative approach is to assume that we know the marginal distributions of default for each asset and link them together.

The link function is called a copula function – first used in CreditMetrics.

Which function do we use and how do we estimate the parameters of the copula function?

The loss given default varies over the credit cycle, so in both cases we must model the LGD.



2 Pricing – top-down approach

This approach directly models the cash flows generated by the assets in the collateral pool.

It avoids having to explicitly model the default dependency and the loss given default for individual assets.

The number of parameters that must be estimated or calibrated is relatively small.



2 Pricing – implications for new financial products

1. For new products there is a real trade-off between model complexity and data availability.

For either the bottom-up or the top-down approaches the issue is how to estimate or calibrate the parameters.

Usual procedure is to calibrate to a subset of extant prices.

2. The limited liquidity of prices and the deficiencies of the model are impounded into the model parameters. This increases parameter instability.
3. This also implies that there is uncertainty with respect to the accuracy of posted model prices, especially for highly illiquid assets.
4. For a new product, there is little, if any empirical evidence about the accuracy of the model or its hedging ability in different market conditions.



3 Design Characteristics

The design of an instrument affects its appeal to different clienteles of potential users and defines its risk sharing characteristics:

1. the ability to use other instruments for hedging;
2. the need to identify the risk characteristics of the instrument, given its design features.



3 Design Characteristics – hedging features

The factors that drive the risk of the innovation dictate the instruments that will be used for hedging.

The ease of hedging will depend on how the features of the innovation mesh with the features of the extant instruments used for hedging.

Example

The roll dates for credit default swap indices match the International Monetary Market dates. This matching of maturities helps if LIBOR futures are used as a hedging tool.



3 Design Characteristics – Factor Sensitivity

The design of an innovation directly affects its risk characteristics.

The challenge is to identify these features.

For example, perhaps one of the biggest failing in the current credit crisis was the failure to understand the binary (zero-one) nature of subprime mortgage backed CDOs.

Why? The initial low level of subordination and narrow tranches.
(See Crouhy, Jarrow and Turnbull (2008) for a full explanation.)



3 Design Characteristics – Example market disruptions

Certain features in the design of an innovation may make it sensitive to market disruptions.

Example SIVs

Special investment vehicles invested in long term assets and financed their purchase issuing asset backed commercial paper (ABCP).

With the fall in house prices and increased uncertainty about the value of the underlying collateral, vehicles had to reduce the amount of ABCP, forcing them to sell assets in order to meet claims.

This put more pressure on asset values – “wrong-way” feedback.

Due to increasing uncertainty about the valuation of collateral, investors eventually refused to purchase new ABCP.

The ABCP did not have an option to extend its maturity in the event of a market disruption.



4 Liquidity

Liquidity for an innovation depends on many factors:

1. the ability to grow both the supply and demand – educating end users about the innovation, its risk-return characteristics and identifying accounting and regulatory issues;
2. the ease of pricing the innovation and the transparency of pricing;
3. the existence of hedging tools and the ease of hedging.



4 Liquidity - ease of pricing

If a product is relatively easy to price, this aids investors understand of the role different factors have upon price.

Understanding the risk drivers, goes a long way in increasing investors' confidence in posted prices and hence liquidity.

The ease of pricing depends on the complexity of the innovation.

CDS is relatively straight forward.

The structure of a CDO is complex and data requirements are formidable. This greatly increases both the data and analytic skills needed for pricing.

The greater the complexity of the pricing process, the more uncertainty there is about model prices, adversely affecting liquidity.



4 Liquidity - ease of hedging

The existence of a secondary market provides investors with ability to exit a position.

For a new product there is limited liquidity. This increases the risks in entering a position and the costs of exiting the position.

Institutions know this and often agree to make a market for investors. However, bid/ask spreads may be large.

The ability to hedge provides a mechanism to alter the risk profile. It also increases the attractiveness of investing in the innovation.

For a new innovation, we need to find appropriate hedging instruments.

The costs associated with hedging will be reduced if the design characteristics of the innovation synchronize with the institutional features of the hedging instruments.



4 Liquidity - transparency

Dealers in the fall of 2002 introduced an index on a portfolio of 125 credit default swaps and agreed to post bid/ask quotes daily on a third party screen.

The index was successful because of the relatively simplicity of the design. The components (individual CDSs) were simple.

This greatly increased the liquidity of the credit default swap market. Investors could see the view of the whole market. It also allowed them to calibrate their models.



5 Counterparty Risk

Counterparty risk is the risk that a party to a contract might fail to perform, when called upon to honor its contractual commitments.

It exposes the other party to the contract to a mark-to-market risk.

For an innovation:

1. How can we reduce counterparty risk?
2. Is there wrong way dependence?



5 Counterparty Risk – reducing counterparty risk

For a new product, the **back office** facilities need to be developed in order to record the trades and to keep track of the counterparties.

A **master agreement** reduce counterparty exposure, as it allows netting. For a new product this provides an incentive to standardize the contract terms (if possible) and develop a master agreement.

Added bonus of helping to increase liquidity.

A **clearing house** concentrates exposure – need only worry about the clearing house.



5 Counterparty Risk – wrong-way dependence

Some contracts will require the counterparty party to make collateral payments on being downgraded. Does the value of the collateral decrease as the value of the underlying asset decreases (wrong-way dependence)?

The **implicit assumption** is that the counterparty only has a small number of contracts outstanding and the credit rating is up to date and accurate.

The counterparty may have so many contracts outstanding that the aggregate amount of collateral that needs to be posted might jeopardize the solvency of the counterparty.

Is the counterparty a major player in the innovation?



6 Risk Management

Risk management entails being able to **measure** and **manage** risk over specified horizons.

1. At the specified horizon we need to calculate the value of the portfolio of assets in each state and generate the required risk measures.
2. This requires using the “risk neutral” and natural probability distributions.
3. To manage the risk profile means the ability to hedge the risk exposure. This will often involve calculation of the “greeks”.
If the pricing model is misspecified, the hedge ratios are misspecified and hedging will be ineffective.
4. Attempt to identify dimensions of risk that are difficult to quantify – “dark risk”.



6 Risk Management – data availability

With an innovation, there is usually limited data availability.

1. Data availability will affect the choice of pricing model.

If there is little data, difficult to be sophisticated. Must decide on the appropriate model for pricing.

2. Data availability also affects the ability to undertake

(a) the time series analysis of the properties of the price dynamics;

(b) raises the issue of whether it is possible to test a model.

Data limitations implies that it is difficult to judge model performance.



6 Risk Management – limitations of calibration

Models are often calibrated to match a subset of extant prices.

For a new innovation markets are illiquid.

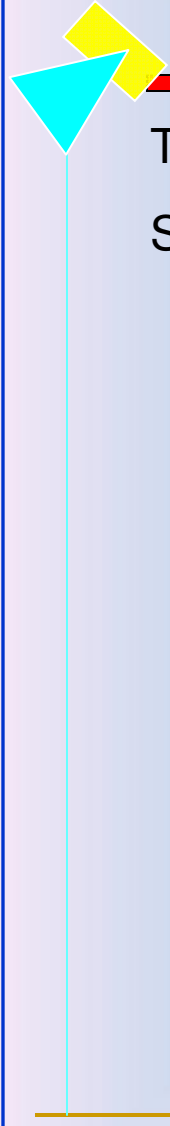
The effects of this illiquidity are compounded into the estimated parameter values – this increases parameter variability.

How good is the model for hedging?

The manager can stress test the model to determine the sensitivity of price, hedge ratios and risk measures to different parameter values.

If the model is deficient, stress testing may give the manager a false sense of security.

6 Risk Management – dealing with dark risk



There are dimensions of risk that models fail to identify – **dark risk**.

Some of the dimensions of dark risk

- parameter instability and limited data
- the effects of complexity of an instrument and parameter uncertainty on pricing and hedging
- legal/settlement/accounting/regulatory risk
- limited knowledge on the part of senior management

6 Risk Management – addressing with dark risk

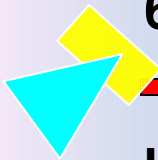


Parameter instability and limited data

Risk managers can undertake **scenario analysis**.

This requires risk managers to think outside the confines of their modeling framework.

What if house prices fall across the national? How will mortgage backed triple B bonds be affected and how will tranches in mortgage CDO be affected?



6 Risk Management – addressing dark risk

Incentives

Risk managers need to reflect on how the success of an innovation affects incentives and the consequences. Are there unintended consequences of the innovation?

Initially subprime mortgage backed CDOs were profitable.

To ensure an adequate supply, originators lowered their underwriting standards (they were rewarded on the basis of quantity not quality).

This lowering of standards increased the probability of default for the mortgages backing the bonds in the CDOs. Given the use of historic data, this change was not reflected in the data.



6 Risk Management – addressing dimensions of risk

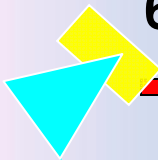
Risk concentration

Risk managers need to recognize that holding different examples of an innovation may result in a concentration of risk. For example, holding CDOs – the same asset may appear in different CDOs.

Standard and Poor's reported that just 35 different borrowers appear in nearly half of the 184 CLOs that it rates.

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Need the data about the underlying assets in the innovations to identify concentrations. Do we have the data and the IT to find concentrations?



6 Risk Management – addressing dark risk

Accounting incentives

When an innovation is introduced, an existing accounting system is adjusted to accommodate the new product without consideration as to the incentives it generates for traders.

Bonuses are determined on the basis of the profitability of the trading desk over the year.

Traders have incentives to take advantage of the accounting system by engaging in trading that generates profits over the short run.

The challenge for risk managers is to understand the incentives generated by the accounting system.



6 Risk Management – addressing dark risk

Limited senior management knowledge

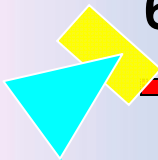
When an innovation is introduced, senior management may not understand its risk characteristics.

Senior management often refuse to acknowledge their ignorance and rely on the traders and their quants to characterize the profitability and risk.

Traders' incentives are not aligned with those of senior management.

Diligent risk managers may object to certain trades on the grounds that they are not in the best interests of the firm, being driven by the desire of traders to increase their bonuses.

Risk managers unlikely to receive support if management is ignorant and do not understand the issues, relying on the traders and their quants for advice.



6 Risk Management – addressing dark risk

Mark-to-model ignores many costs associated with an innovation, implying an innovation is over-valued.

With an innovation there is greater operational risk than with a seasoned product.

- identifying accounting incentives
- model risk
- complexity risk
- settlement risk
- legal risk
- regulatory risk. Do regulators understand the innovation?

Many of these factors also generate additional trading costs, which should be recognized when determining the value of an innovation.



7 Rating Agencies - the importance of a credit rating

For certain types of instruments a credit rating is often a prerequisite in order to increase the marketability of an innovation.

Why? The rating provides a certification that the instrument has a certain level of credit risk.

Determining a rating for an innovation is usually an interactive process between the issuer and the rating agency.

May involve both a quantitative and qualitative assessment.

For risk managers and investors not involved in the issuer/rater discussion, the methodology is not transparent.



7 Rating Agencies - implications for innovations

1. Does the methodology consider all the relevant risk factors?
2. What does a rating actually measure?
3. What data does the rating agency actually use?
4. What are the appropriate distributional assumptions?
5. How robust is the methodology over different parts of the credit cycle?
6. What use is a rating for an innovation?

The meaning of a rating is unclear and for a new innovation, the rating methodology is untested.

Risk managers and investors need to remember the tentative nature of the methodology.




7 Rating Agencies - regulators

Regulators have less incentive than senior management of a financial institution to understand the complexities and subtleties of an innovation.

They have placed great faith and reliance on credit ratings.

For innovations, there is no evidence to justify this reliance on ratings.



Conclusions - measuring and managing risk of innovative financial products

The challenge is simply identifying all the different dimensions of risk.

What do we do?

1. Stress testing – may give a false sense of security.
2. Scenario analysis – requires risk managers to think outside the confines of their pricing models.
3. The ability to hedge is critical.
4. All parties within a company – senior management, traders and risk managers have important roles to play in assessing, measuring and managing risk of new products.
5. The company's directors also have a responsibility to see that duties are fulfilled.



Conclusions – issues facing regulators

Regulators face micro and systemic issues following the introduction of an innovation

1. For innovations ratings are unreliable and it is inappropriate to use ratings for capital determination.

2. Data about an innovation must be available on a timely basis. For systemic risk, all players need to come under regulatory review.

1. Regulators need the ability to measure the holding of an innovation by different institutions.

2. Also need the ability to monitor the build up of concentrated holdings.