# Managing Model Risk Through Effective Governance

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# Outline

- Model Perceptions resulting from the Credit Crisis
- An Introduction to Model Risk
- The Product- Model- Calibration Paradigm
- The Calibration Debate
- Model Risk Governance
- Is it time for a Chief Model Risk Officer?
- References

# All Models are Wrong by Design Because They are Simplifications of Reality

# Model Perceptions resulting from the Credit Crisis

- Long period of cheap credit, abundant liquidity and benign market conditions leading to a loosening of credit standards and a search for yield (leading to increased risk taking)
- Financial innovation leading to increase in securitisation
- Rating agencies and monolines providing comfort to investors on quality of products and default guarantees
- The “originate-to-distribute” model leading to the apparent spreading of risk across investors globally, allowing further loan origination and a general increase in leverage (partly hidden by use of off balance sheet structures)
- The “broker/dealer” model relying on short term funding in wholesale and repo markets
- Overall impact- house and asset price bubble and high leverage

# Model Perceptions resulting from the Credit Crisis

- The trigger for the crisis was the rise in defaults in subprime loans
- Market liquidity for subprime loans evaporated leading to valuation issues, write downs and a liquidity crisis.
- Demand for additional collateral leading to further distressed sales, further erosion of balance sheets and a downward spiral in asset prices.
- Loss of confidence and trust by investors in financial markets and by institutions in their counterparties leading to liquidity hoarding and knock on effect on real economy
- Liquidity crisis turning into solvency crisis as balance sheets severely impaired
- Overall impact- complete loss of confidence, lack of liquidity and massive deleveraging

# Model Perceptions resulting from the Credit Crisis

## The credit crisis has been blamed on a number of causes:

- Complex products
- Under-pricing of risk
- Models used for securitised products
- Bad incentives along the entire securitisation chain
- Excessive reliance on external ratings
- Models used by rating agencies
- Lack of transparency and disclosure
- Fair value accounting
- Pro-cyclicality in accounting and regulatory frameworks
- Light regulation of financial institutions
- Remuneration structure in financial industry

# Model Perceptions resulting from the Credit Crisis

## "Perceptions" resulting from the credit crisis:

- Derivatives are dangerous, complex, opaque and socially useless ("WMD" comparison)
- Models are wrong
- Models can be manipulated
- There is a gap in the understanding of models between quants and senior management/non- quants.

**This cannot be resolved by simply building even more complicated models.**

# Model Perceptions resulting from the Credit Crisis

## How can these "perceptions" be addressed?

- Full openness, transparency, and communication from model builders
- Use of a very narrow definition of a model (the product- model- calibration approach)
- Treatment of model risk as a multidisciplinary subject
- Dissemination of model information to as wide an audience as possible

**The credit crisis has placed the role and use of models firmly in the spotlight**

## What is model risk?

- Model risk is the loss which results from a mis-specified, misapplied or wrongly implemented model, or resulting from incorrect decisions taken on the basis of model outputs affected by model risk.

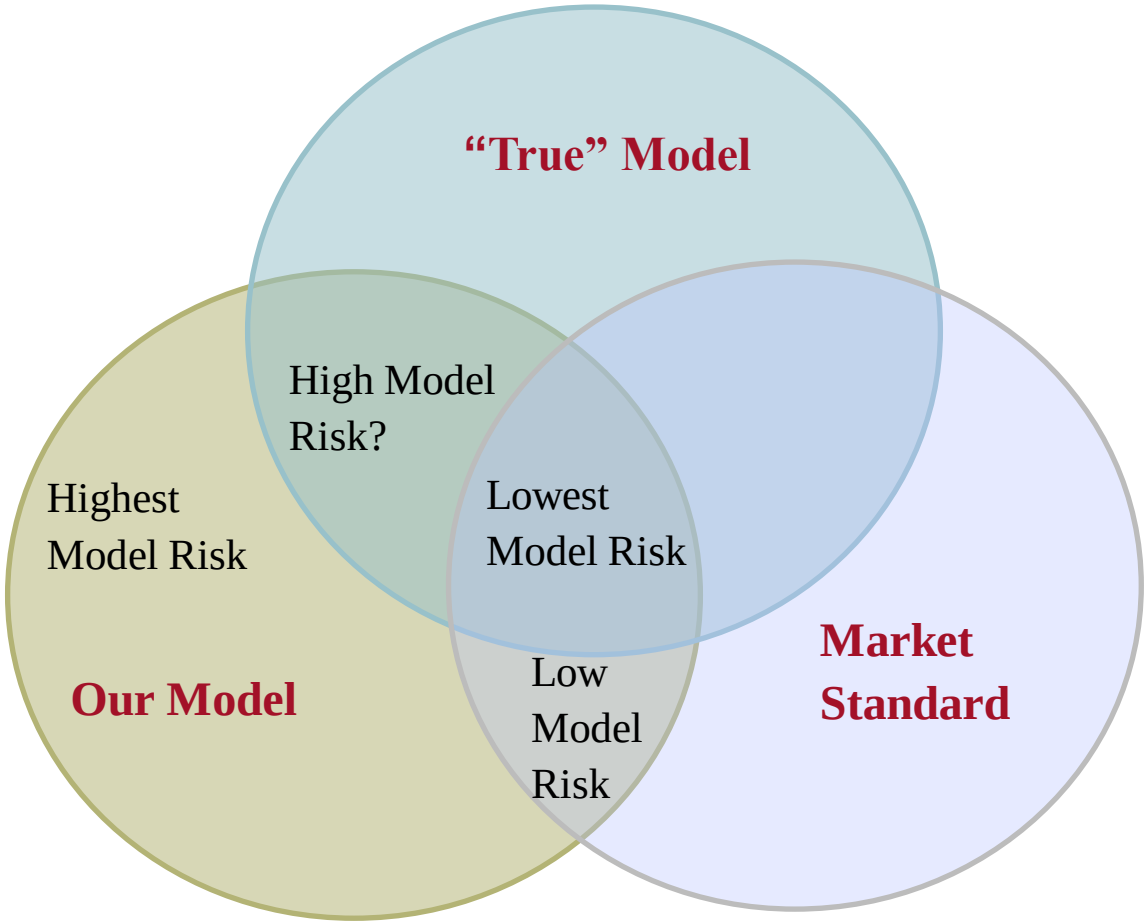
**Fair value accounting requires us to consider a further definition of model risk specifically for pricing models.**

- Model risk is the risk that the valuations produced by your pricing model will eventually be different from market observed prices (once these become visible) and / or the risk that your pricing model is revealed to be different from the market accepted model “standard”.

**Model Risk is inherent in the use of models and can never be eliminated**

# An Introduction to Model Risk

**The market standard model itself will evolve over time and the process by which a model becomes accepted as the "standard" is complex and opaque.**



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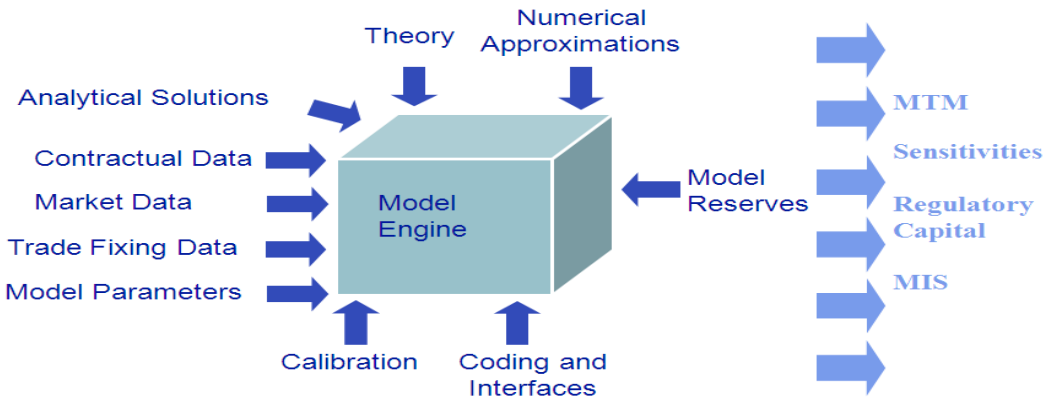
## Sources of Model Risk

- All 3 components of our model (input, model engine, output)




- Model applicability problems
- Model obsolescence
- Breakdown in model control culture and process
- Key person risk

# An Introduction to Model Risk

## The Evolution of Models and Model Risk

### Phase I

- New market
- Illiquid market
- Illiquid hedging instruments
- High margins
- No price consensus
- Simple models
- Infrequent model calibrations
- Low valuation volatility

### Phase II

- More established market
- Still illiquid
- Liquid hedging instruments
- Margins tightening
- Some price observability
- More sophisticated models
- Greater valuation volatility

### Phase III

- Well established, liquid market
- Small margins
- Full price observability
- Highest valuation volatility
- Market standard model as price interpolator

| Highest Model Risk? | High Model Risk | Low Model Risk |
|---|---|---|

**Less liquid products have greater uncertainty in their values, yet display less valuation volatility- a paradox which may provide a false sense of comfort.**

# The Product- Model- Calibration Paradigm

## What is a Model?

- The majority of models are in reality frameworks which can be applied to a variety of products using different calibration sets.
- If implemented in systems with very generic product representations, the resulting flexibility could allow the same product to be booked in different ways and on different models; and/or allow different products to be booked using the same system representation.
- Such flexibility reduces transparency, increases the likelihood of model applicability problems, and generally weakens the control environment.
- The solution is to enforce a **strict model- product scope- calibration approach** when developing, using and controlling models:

  **A model should always be associated with a product and a set of calibration targets.**

**"Model" = Product + Modelling Framework + Calibration Targets**

# The Product- Model- Calibration Paradigm

**Implementing a strict product scope- model- calibration approach requires:**

i. The adoption and maintenance of a granular product classification by FO, model developers and IT.

ii. Model approval process to be product based.

iii. Obsolete models to be decommissioned

iv. The implementation of unique product templates in systems

v. Strict restrictions on the use of scripts and payoff languages, such as:

-limit on total number of trades not on templates

-limit on number of trades on the same product prior to template implementation

-detailed script and payoff language review

vi. Calibration targets and process must be well- defined and visible

| Advantages | Disadvantages |
|---|---|
| - FO unable to arbitrage models and calibrations<br>-Limits model appropriateness issues<br>-Promotes consistency of model use<br>-Facilitates deal review process<br>-Simplifies model and system migrations | -Greater time to “market entry” for new products. |

# The Product- Model- Calibration Paradigm

## An Inclusive, Product- Based Model Approval Process

- The model approval process must include explicit sign- offs from the model developer, an independent FO approver, Model Validation and Valuation Control- the meaning of “approval” for each group must be enshrined in well- defined Roles and Responsibilities
- The model approval process must place the product scope in front:
  - Approval is for a **product** with a well- defined **payoff** to be valued and risk- managed using a particular **model** and referencing a clearly defined set of **calibration targets**

    Please note that this is separate from new product approvals which typically consider a wider set of issues (legal, reputational, compliance, and so on).
- **Model consistency** must be explicitly considered as part of the approval process- there should only be one model and calibration set approved at any one time for a particular product- the rationale for any exceptions must be clearly documented

# The Product- Model- Calibration Paradigm

## An Inclusive, Product- Based Model Approval Process

- The model approval process should capture changes to existing models or migrations onto new models
- Full approval should be withheld until the appropriate product template has been fully implemented in the production trading and risk management systems
- To streamline the documentation and approval process, modelling frameworks should be submitted through this process but with an empty product scope and a disclaimer that the framework approval does not constitute permission to use the framework for official valuations and that separate product approvals will be necessary.
- The core portions of the model documentation- product name, payoff, model approved for valuations, calibration targets, model limitations and model reserves- should be available to a very wide audience. Confidential theoretical and implementation details can be restricted as required.

# The Calibration Debate- Internal vs External Calibration

The calibration process can be carried out either:

- **Externally** to the pricing model, in which case the model parameters are themselves input parameters to the pricing model; or

- **Internally**, embedded in the pricing model, in which case the values for the set of calibration targets are the actual market- data related input parameter

- The choice of internal or external calibration will impact not only the representation of the market- data related input parameters but also the validation and control processes required to ensure the integrity and transparency of the calibration process (and hence valuations)

- The debate around internal or external calibrations revolves around the trade between speed, controls and the transparency around the use and identity of targets.

## Internal Calibration:

-Pricing model gets recalibrated every time a price is calculated so calibrations are never stale
-Calibration routine and choice of targets are part of the model and the model approval process, so enhancing transparency and visibility
- Very difficult for traders to manipulate calibrations
- Price verification process can use full revaluation

## External Calibration:

-Much faster for large portfolios
-Choice of targets may not be known
- Easier for traders to manipulate
-Price verification process may need to be risk- based using desk sensitivities

# The Calibration Debate- Global vs Local Calibration

The choice of calibration targets and the number of sets of targets associated with a particular modelling framework will depend on whether a local or global calibration approach is employed.

## Local Calibrations:

-Each product may have its own specific set of calibration targets and the appropriateness of each needs to be considered
-Calibration routine tends to involve solving a set of simultaneous equations
-Results in good calibration fit with very close or exact re-pricing of the calibration instruments
-A product will only show sensitivities to its targets
-Pricing may not be consistent across calibration sets
-Most likely to be used in conjunction with internal calibrations
-Bucketed sensitivities are fairly easy to obtain

How to aggregate risk with local calibrations?

## Global Calibrations:

-A single larger set of targets would be used for a wide range of products
-Calibration may involve heavy optimisation routines- global minimum hard to find
-Results in a reasonable overall fit but greater local errors in re-pricing of specific calibration instruments within the wider calibration universe
-Ensures consistency of pricing for all products on a model
-Most often associated with external calibrations
-Difficult to obtain bucketed risks
-Risk aggregation is simple
-Must be used when consistency of netting is key- e.g. CVA

## Treat model risk as a multidisciplinary subject

- Good communication between all relevant parties is essential
  - To understand the current market standard and the manner in which this is evolving and the desk's current risk profile
  - To promote a clear understanding of model limitations to senior management and model users
  - To ensure that a model is not misused
- Ensure a robust model control framework with clear audit trails evidencing all aspects of the framework
- The model control process must cater for fast moving businesses. Practical steps to control model risks involve a trade-off between level of model risk and necessary cost of controlling the risk

## Cornerstones of a robust model control framework

- Clearly defined responsibilities for all parties involved in model development, use and control (Front Office, Risk Management, Model Validation, Finance, Technology)
- Clearly defined model approval process involving all the above parties
- Adherence to a strict model- product scope approach
- Independent validation of models by a control unit separate from traders and front office research
- Clearly defined Model Reserving Methodologies
- Regular review of models ?
- Model inventory reports
- Model documentation standards (creates a corporate memory)

## Cornerstones of a robust model control framework

- Model Control Committees
- Model release and change management procedures
- Decommissioning of obsolete models
- Calibration Control
- Vendor models to be subject to the same process
- Audit oversight of all aspects of the Model Control Process

## Model release and change management procedures

- Code must be kept under source control with controlled access
- Change requests must be documented
- Regression testing of staging and production versions prior to release (against current and static portfolios)
- Sign-offs from relevant groups prior to release into production environment
- Production version must reside in a secure location

## Time for a Chief Model Risk Officer (CMRO) ?

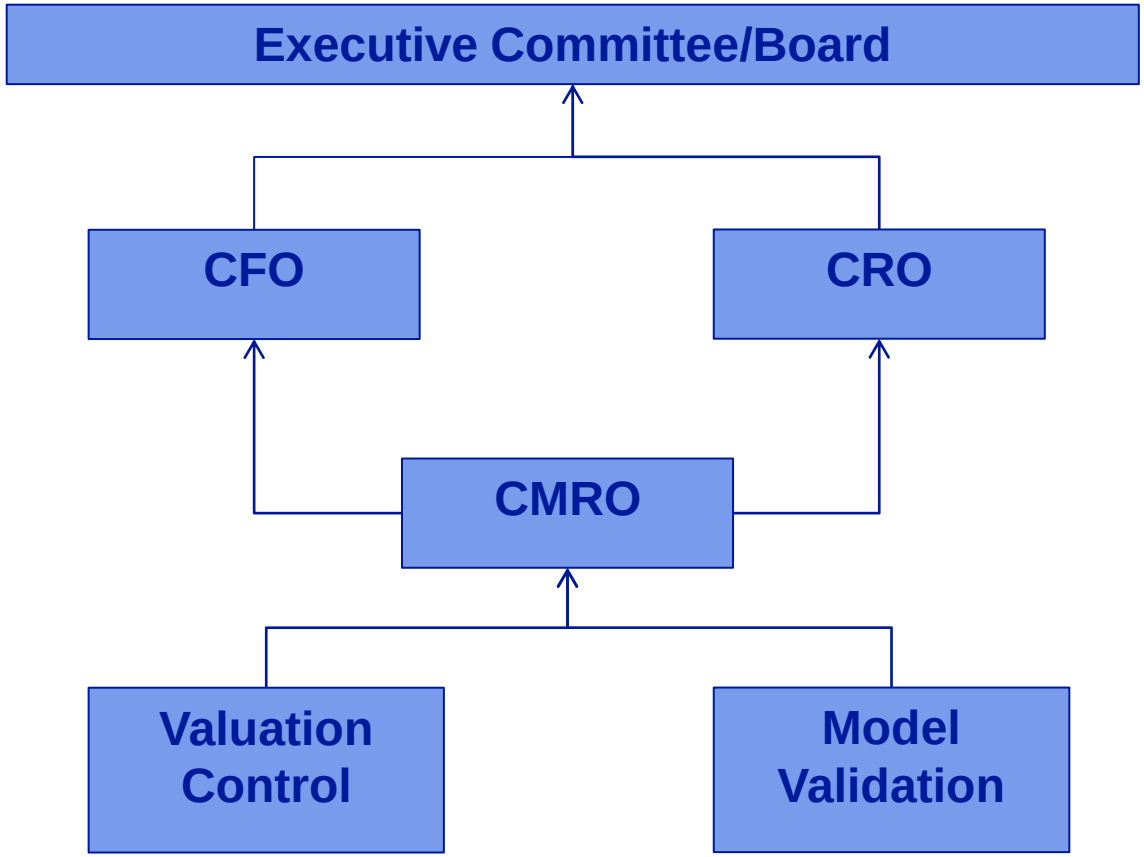
- The challenge on the control side is to reconcile the required skills and expectations of the two main teams involved in managing model risk:
  - The Model Validation Group, and
  - The Valuation Control Group

- … whilst ensuring the existence of direct oversight over both groups at a realistically manageable level (i.e. not at Board level!)

**There is the need to create a position of Chief Model Risk Officer**

# Is it time for a Chief Model Risk Officer?

## A possible organisational structure for model risk governance



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