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PANEL: Financial R&D: Can High-Tech Tools Improve Investment Performance and Economic Stability?

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R&D, stability and performance

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- There is a natural tension between research advances and market stability.
- By construction R&D is disruptive. (But that's the point.)
- The goal of R&D is to develop new ways to do things better, faster and cheaper than in the past.
- These technologies may be disruptive in a positive way (as in the case of electronic trading), but may also introduce new risks (such as the Flash Crash).
- Using new technologies also introduces new risks in three ways:
  1. They allow users to do things that were not previously possible.
  2. The technologies change the dynamics of the markets into which they are introduced.
  3. The technologies themselves may be incomplete.

An R&D anecdote from (civil) engineering

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George Washington Bridge
(opened October 25, 1931)
3500 ft (1.89x previous record)

Golden Gate Bridge
(opened May 27, 1933)
4200 ft (1.2x GWB)

- The early 20th century saw a surge of theoretical and empirical work on bridge construction.
- *Elastic deflection* theory enabled suspension bridges of unprecedented length and elegance.

The Tacoma Narrows Bridge was different

2800 ft (only 0.7x GG bridge)

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BEFORE
(July 1, 1940)

AFTER
(129 days later)

An R&D anecdote from (civil) engineering

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- Proximate cause of collapse: “never before seen” dynamics caused wild oscillations of the bridge deck.

- What caused this new behavior to suddenly “appear”?
  - In the years preceding the collapse, *deflection theory* (L. Moisieff and others) led to thinner, longer bridges.
  - This theory was further extended by Moisieff prior to the construction of the bridge.
  - At the same time, transportation modes migrated from primarily rail-based to primarily auto-based.
  - As a result, bridge requirements were relaxed and bridges became narrower and lighter (and cheaper to build).
  - Earlier bridges did not show the new dynamics because these were made heavier and wider (hold-over from demands of rail traffic) and the newer lengths increased incrementally.
  - Not only the *length* of the bridge induced risk, but the dynamics of the *very thin deck* on a *very light bridge* as well.
- Historical harbingers in retrospect:
  - Dryburgh Abbey Bridge (1818), Manai Strait Bridge (1826), Nassau Bridge (1834), Brighton Chain Pier (1836), Whelling Bridge (1854)

- At the time of the collapse there was no coherent theory to unify these historical instances (theory was introduced years later).

Postscript to TNB collapse

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- R&D on wind dynamics and bridge design continued and intensified.
  - Vertical as well as lateral motion added to models.
  - Stress-testing in wind tunnels added to design process.
- The theory of elastic deflection has been augmented with additional mathematical results that have not *replaced* the theory, only *extended* it. (The theory is still in use today.)
- Sometimes entire theories are discarded, often, existing theories are revealed to be incomplete.
- In October 1950, a rebuilt Tacoma Narrows Bridge opened to traffic. It was 40 ft longer than the original.

R&D, stability and performance

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- There is a natural tension between research advances and market stability.
- By construction R&D is disruptive.
- The goal of R&D is to develop new ways to do things better, faster and cheaper than in the past.
- However, new technologies also introduce new dynamics.
- Almost certainly there are dynamics that are currently not obvious but that, may manifest themselves unexpectedly.
- From this perspective, the goals of financial analytics R&D are to continually:
  - Identify and characterize some of these evolving uncertainties.
  - Describe as fully as possible the dynamics that underlie them as they evolve.
  - Provide tools to help price or hedge them better.
  - Repeat.

Some fertile areas for financial analytics R&D (today)

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- **Computing technology**
  - Distributed and GPU-based processing
  - In-memory databases
  - Document/news mining
  - Ontologies

- **Research and theory**
  - Systemic risk metrics
  - Liquidity measurement
  - Micro-finance and other SRI areas – impact vs. profitability, valuation
  - Network effects between FIs
  - Mechanisms for accessing capital markets for medical research, alternative energy, etc.

- **Risk management strategies & tools**
  - Retail finance (portfolio risk mgt, etc.)
  - Municipal and sub-sovereign risk
  - Project finance
  - Multi-asset class and multi-period analyses
  - Transfer pricing mechanisms (for capital allocation and incentive alignment)
  - Look-through analytics
  - Stress-testing and quantification
  - Network models of counterparty risk and contagion
  - Integration and estimation of frailty

Implementation considerations

Some challenges in building risk tools for opaque asset classes

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1. Determining the level of aggregation at which to model
2. Collecting/developing data in an analytically meaningful manner
3. Applying the measures in practical settings (risk attribution / allocation)
4. Constraints of IT and organizations

Logistics, technology and organizational issues can create impediments

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- Uptake of simpler tools that can be rolled out incrementally is more rapid.
- Uptake of complex models that require broad buy-in from across FI can take a very long time – particularly if they affect compensation.
    - Anecdotally, as of 2009, only about 1/3 of major banks reported using concrete transfer pricing (i.e., line risk takers are charged for capital usage). Though adoption continues, about half did not report doing any form of formal transfer pricing. (Lower in the US, higher globally.) - IACPM
- Smaller, newer firms and sectors are much better able to implement technological and analytic enhancements than larger, older ones.

Timeline of adoption of credit portfolio analytics

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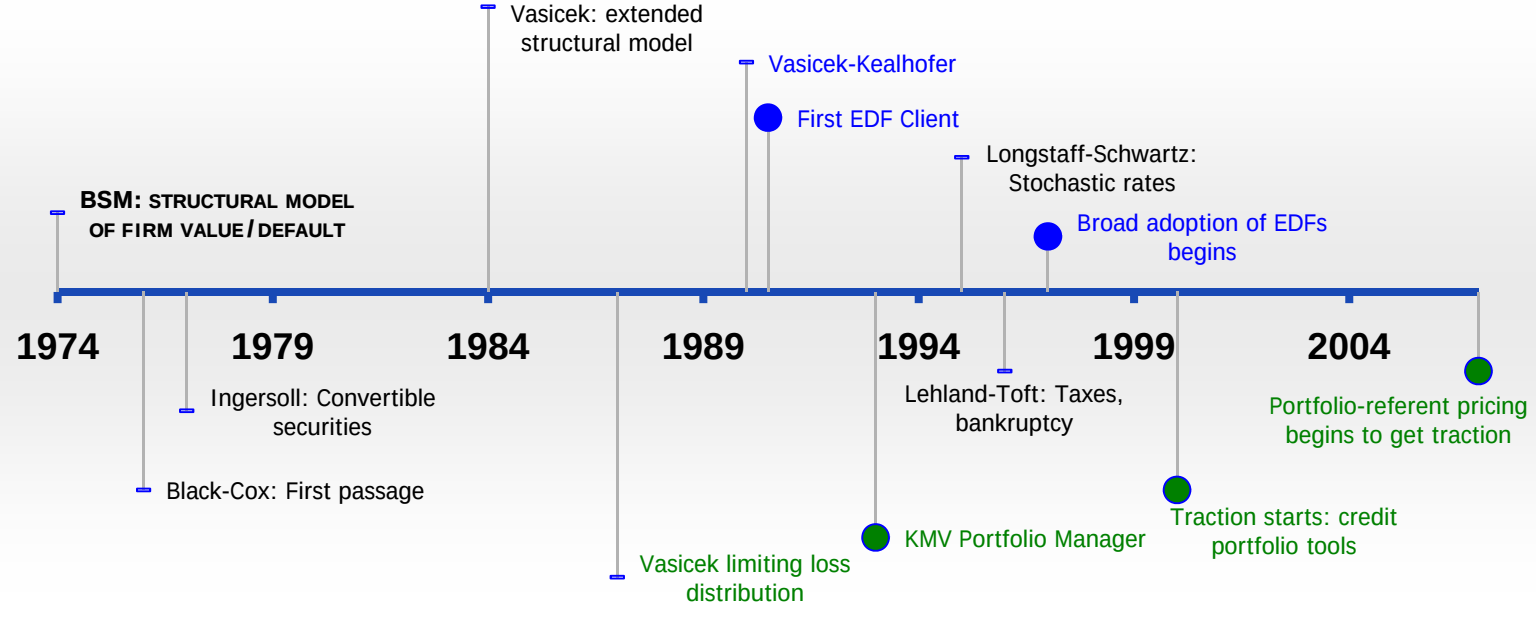

Historically, for credit risk, each phase of adoption took the better part of a decade

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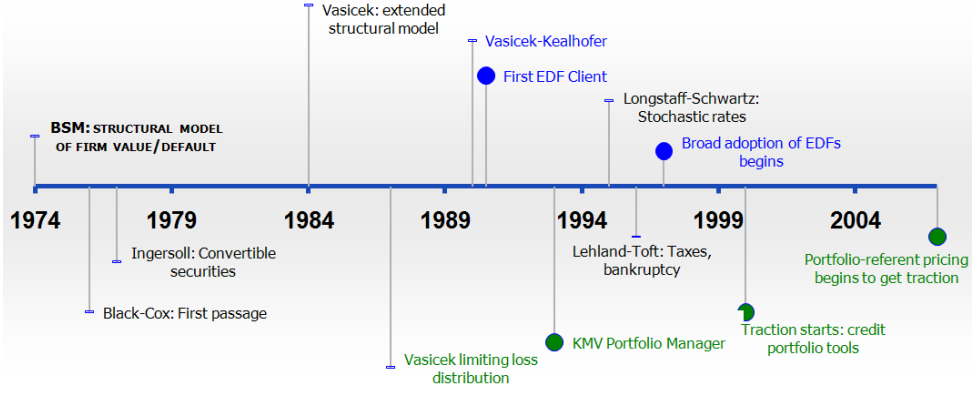
- First theory ➔ commercial adoption: **16 years**
- First EDF ➔ traction: **7 years**
- First portfolio tool ➔ traction: **7 years**
- Portfolio tool adoption ➔ interest in portfolio referent pricing: **7 years**



Improve Investment Performance *and* Economic Stability?

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Investment performance

- Return for proprietary R&D investment
- Minimize signaling, “waking up” competition
- Risk management = focus on own positions
  - Single- or multi-period optimization

Economic stability

- Return to industry-wide transparency
- Disclosure of concentrated positions and counterparties
- Risk mgt= focus on positions highly correlated w/other firms’
  - Multi-period optimization as sub-game

- Institutions that have not yet put in place robust risk management and analytics will enjoy returns to modernization.

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