

Modelling Financial Turmoil through Endogenous Risk and Risk Appetite

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Mechanism: Dynamics, Liquidity & Endogenous Risk

- Occasional extreme movements accompanied with big chunks of fresh information: healthy.
- Other seemingly unrelated or exaggerated movements, especially during “crises episodes,” are attributed by observers and the press to
 - the herd mentality of the financial market participants, or to
 - the fickleness and irrationality of speculators who seemingly switch between fear and overconfidence in a purely random fashion.

- Newspaper headlines feature stories on risk appetite daily, rising some times and abating others, using it as an explanation for market movements. How can risk aversion be changing so violently?
- Close cousins of the *contagious* risk aversion tantrum metric are
 - *confidence*,
 - *overreactiveness*,
 - *fear* and
 - *liquidity*
- Some of those are summarized in a variety of risk aversion barometers, such as the one depicted in graph 3.5 in the BCL Revue de Stabilité Financière (2010).
- On the basis of this view of the world, **regulating** such madness does not appear to provide the foundation for a very satisfying supervisory job.

- But how can it be that human beings are risk averse one day, in a perfectly coordinated fashion, selling their risky holdings across the board and reinforcing the crisis, only to become contagiously risk loving not too long thereafter, pushing prices back to the pre-crisis levels?
- Surely they do not all together feel compelled to look right and left ten times before crossing the street one day while blindly crossing the next? But that's how it appears to an outside observer.
- It is fair to say that the vast majority of research in theoretical macro-finance did not emphasize crises such as the one we're in. We agree with Mersch (2008) when he says that "In particular, we need more understanding of the financial market channel, which is usually neglected in economic theory as well as in empirical studies."

Endogenous Risk

- Roughly speaking, price movements have **two components**,
 1. a largely exogenous innovation component due to the incorporation of news, and
 2. an endogenous feedback component due to the trading patterns of the market participants over and above the incorporation of news.
- As to 2., sometimes markets gather momentum from the endogenous responses of the market participants themselves, rather like a tropical storm or the London Millenium Bridge [Danielsson and Shin (2003), Danielsson and Zigrand (2001, 2008)].
- Magnified vol purely due to market structure.

- Provided sufficiently many pedestrians found themselves in the same situation, they felt compelled to coordinate and lockstep and thereby reinforced the swaying into a rather wild wobble, a wobble many times endogenously amplified.
- Similarly, as financial conditions worsen, the willingness of market participants to bear risk seemingly evaporates even in the absence of any further hard news, which in turn worsens financial conditions, closing the loop.
- **Corollary.** Any regulatory interventions might best be aimed at understanding and mitigating those negative spillover effects created purely within the financial system: if one can't prevent gusts of wind, then at least one can make sure the pedestrians do not lockstep and cause the bridge to collapse by critically amplifying the initial swing.

- As financial conditions worsen, the willingness of market participants to bear risk seemingly evaporates in response to the deteriorating conditions.
- They curtail their risk-taking activities by cutting exposures and leverage: “Risk Aversion Went Up.”
- Notice *fallacy of composition*:

The **prudent and conservative actions of one market participant entail negative spillover effects on others**



further declines in the prices of those assets etc.

- No need for default and dominos. Formal modelisation was out aim.

- **Corollary.** This argument works in reverse also: “The value added of a good risk management system is that you can take more risks.” [Anonymous risk manager, Spring 2007]

Or [Andrew Crockett (2000)]: “risk increases in booms (as leverage and interconnections are formed) and materialises in busts.”

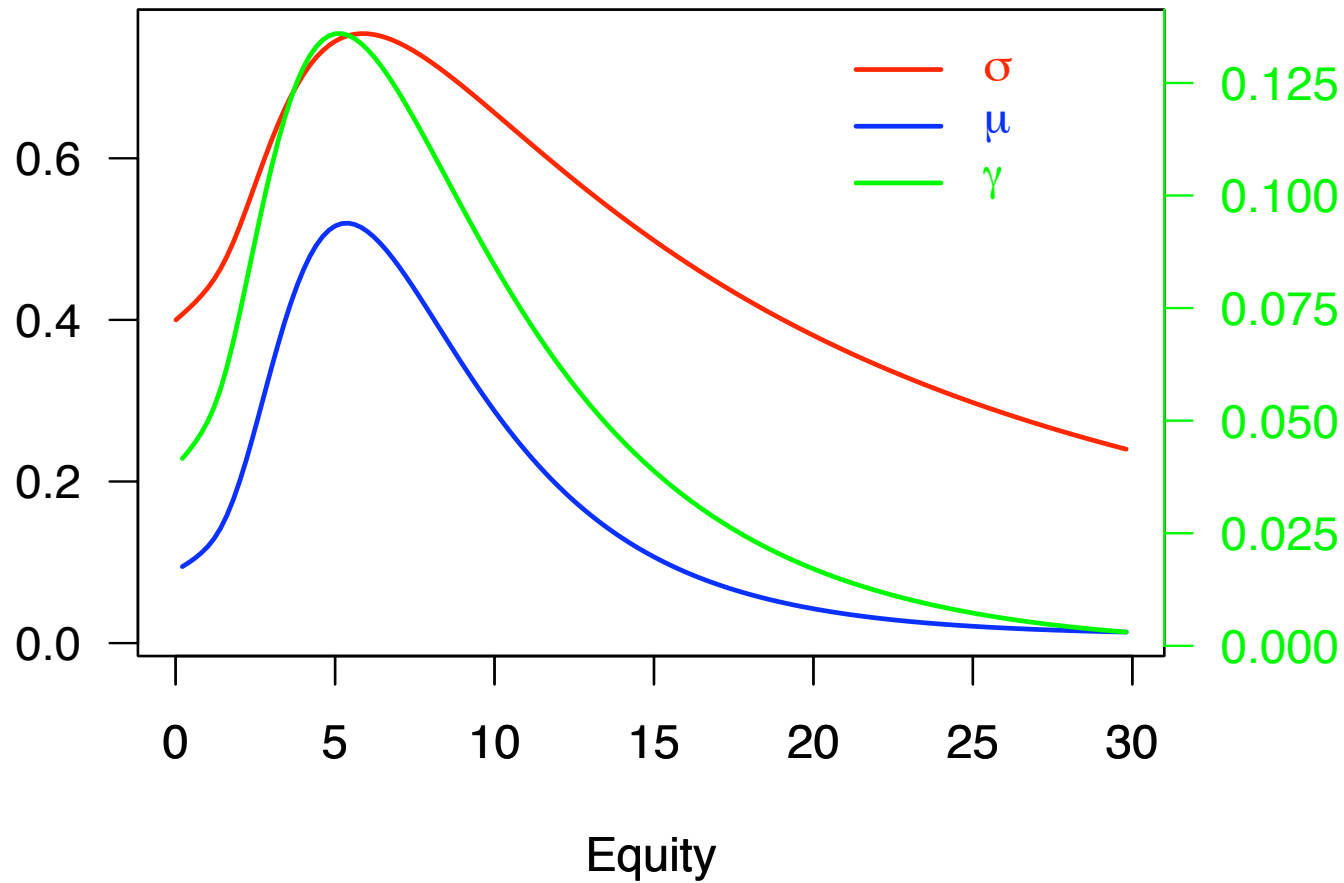
- Endogenous risk is over and above the traditional domino model of contagious default, it captures the **price and leverage spirals** created by the anticipatory and reactive actions of the market participants and the **double-edged nature of prices** (prices as signals and as **imperative** to act) [Brunnermeier and Petersen (RFS, 2009), Danielsson, Shin and Zigrand (2009), Geanakoplos (NBER, 2009), see Shin’s “Risk and Liquidity” 2008 Clarendon Lectures in Finance].

- Such spirals are **pro-cyclical** due to risk-sensitive constraints and regulations, time-varying vols, adverse selection and mark-to-market accounting \Rightarrow as if market participants had lost their risk appetite.
- Extent and the **pro-cyclicity of prices** depend on **leverage**, margins and **capital**, as well on extent of mark-to-market accounting that both sharpens and synchronizes the responses.
- The reverse of the medal is **liquidity**. Volatility measures the standard amount by which the market price is moved: as all FIs become sellers in a crisis, *liquidity dries up*, which is reflected in the increased volatility since each additional sale needs to move prices further still.

The Leading Model

- Danielsson, Jon, Hyun Song Shin and Jean-Pierre Zigrand (2010) "Risk Appetite and Endogenous Risk," FMG Discussion Papers DP647, LSE
- Description. IID (Brownian) shocks to securities (source number 1: news). Risk limited by tangible common equity through VaR.
- REE with realistic financial structure. Prices, quantities and expectations are shown to be driven in equilibrium by a set of relevant aggregate variables, chiefly the (marked-to-market) capitalisation level of the financial sector.
- Focus on endogenous risk; haircuts shut off. Dynamics and distributions all endogenous, with movements manifold the exogenous ones.

$$\frac{dS_t}{S_t} = \mu_t dt + \sigma_t dW_t, \text{ leverage}_t = \frac{\text{assets}}{\text{capital}} = \frac{1}{\text{VaR}_t} \text{ where } \text{VaR}_t = \alpha \sigma_t$$



Lessons: Fallacy of composition

- The prudent and conservative actions that an individual institution takes to enhance its soundness may undermine the soundness of others.
- Any one FI's fire-sales leads all other FIs to mark-to-market their entire portfolios to those lower marks.
- Furthermore, the volatility created from one big seller is reflected in a higher VaR for all other FIs, and therefore is an imperative for all other FIs to sell risky securities, creating further rounds of negative spillovers.

Lessons: Dominos

- Much social cost is borne even in the absence of any FI bankruptcies. **Not sufficient to focus on bankruptcies.**
- This idea is best summarized in a quote due to Hyun Shin (2010)[No pun intended, this quote predates the Greek Crisis]:

Rather like a classical Greek tragedy, it is the actions taken by the actors who want to avoid a bad outcome that precipitates disaster.
- Role for a **liquidity and capital provider of last resort**. FIs may be overly levered going into a crisis, the endogenous feedback effects may lead to excessive (and excessively fast) delevering relative to the true state of the economy. Lack of capital and lending that can only be filled by agents not subjected to risk regulation [a few hedge funds (but: prime brokers), SWFs, the Buffetts and the Central Banks of this world.]

- Financial crisis \Rightarrow shortage of financial intermediary balance sheet capacity (BSC) due to forced delevering and disintermediating. LLR operations are a public sector emergency offset of the decline of private sector BSC. [Liquidity facilities have been aimed at the repo market (TSLF and PDCF), the CP market (CPFF and AMLF), the FX futures markets (FX Swap lines), and ABS markets (TALF)]
- But: Central Banks can provide liquidity as a liquidity provider of last resort and thereby reduce fire-sales (by allowing FIs to get cash through repo'ing securities with the Central Bank instead of selling securities), they cannot provide solvency, i.e. act as capital providers of last resort, so a more permanent solution involves recapitalisation.

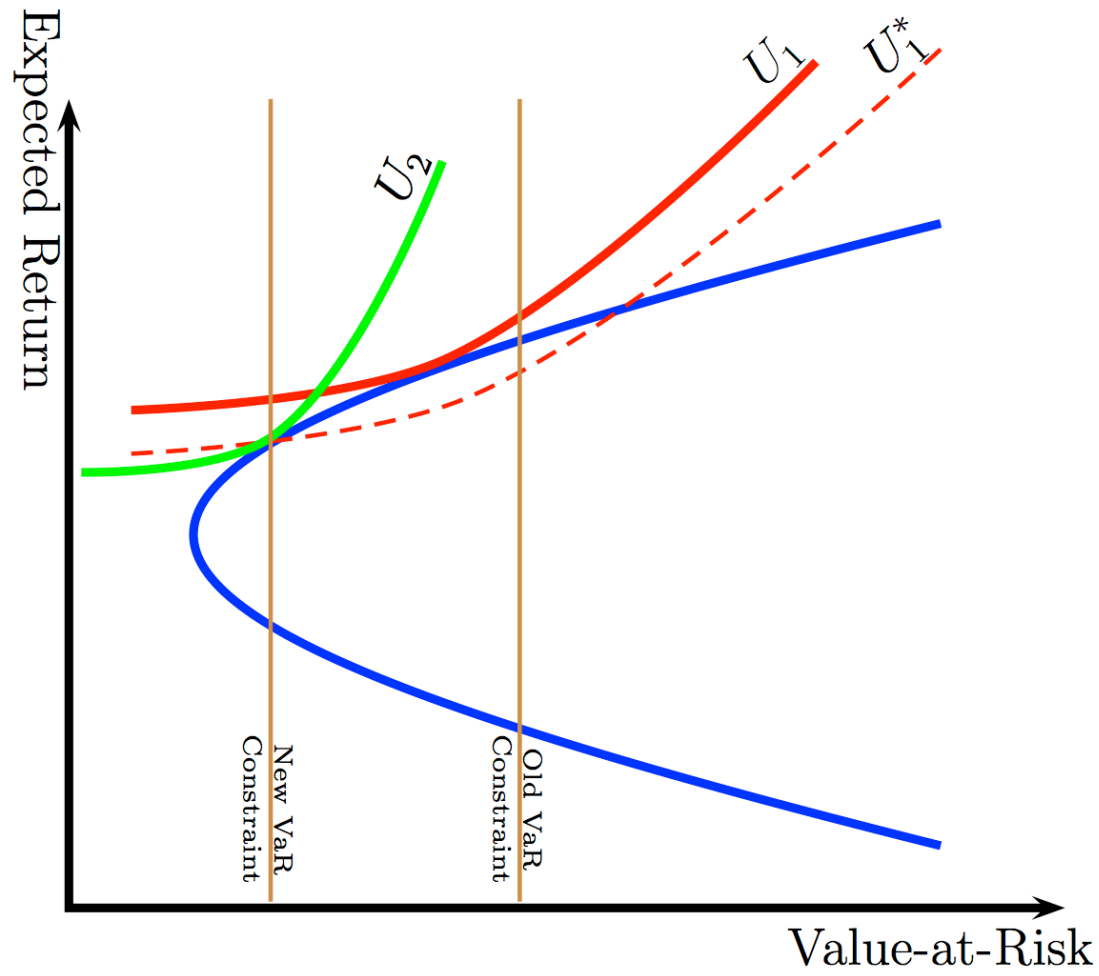
Lessons: Risk Appetite as Driver

coefficient of effective relative risk aversion

= coeff. of innate utility-based relative risk aversion

+ Lagrange multiplier on the VaR constraint

- To an outside observer, the FIs have highly correlated random risk aversion, all together shedding risk one day and loading up on it another day. But such behaviour, while stochastic, is organised.
- Marking-to-market is applied by many FIs and that many FIs use similar risk-sensitive constraints. This appears as *coordinated* or *contagious herding* to an outside observer. Costs of Herding, but beware if you don't (Paulson).



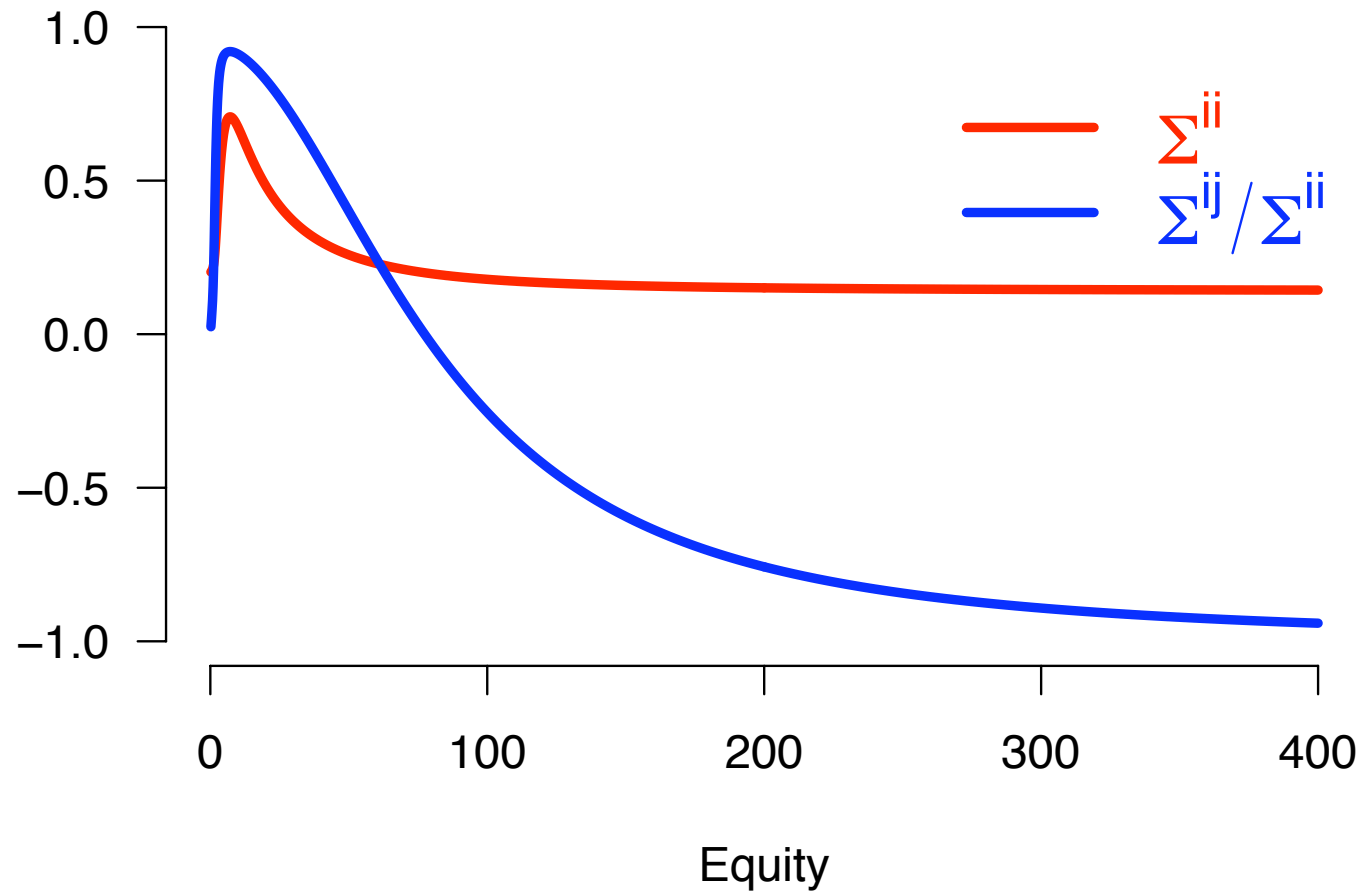
Lessons: Leverage and Capital

- Leverage is pro-cyclical. Capital matters.
- Leverage in the leading model is simply $\frac{\text{assets}}{\text{capital}} = \frac{1}{\text{VaR}_t}$ where $\text{VaR}_t = \alpha\sigma_t$.
- Leverage is procyclical and builds up in quiet booms where VaR is low and unwinds in violent busts, without requiring any exogenous increases in haircuts during crises.
- FIs have experienced increased haircuts in the recent crisis, reinforcing the feedback loops further through this second channel of forced delevering, see Adrian and Shin (2009) and Brunnermeier and Pedersen (2009).

- During sufficiently well capitalised episodes, FIs allow the absorption, diffusion and transformation of risk, resulting in calmer and more liquid markets than could otherwise be achieved.
- Financial crises and strong destabilising feedback effects naturally occur if and only if capital levels are too low.
- Once a crisis hits and risk-aversion and all the other factors peak, it will **take time for risk-aversion to come down**. This is borne out in the data as well (see Coudert et al (2008)). Financial sector capital needs to be replenished.

- **What to do about it?** Idea: Goodhart (2009). Initial capital buffer, plus an additional variation capital buffer that is a function of the *growth rate* of various assets (both on and off balance sheet) as well as of the maturity mismatch (and of the probable liquidity in a crisis) imposed by those asset classes.
- But there will always be strong procyclical forces:
 - FIs will still allocate capital to traders according to a VaR formula (moral hazard).
 - Central clearing houses will impose daily settlement and contribute to procyclicality.
 - Net derivative positions will still be at least partly delta hedged, implying reinforcing feedback effects (on top of the VaR induced feedback effects) if delta hedgers are net short gamma.
 - Haircuts are naturally procyclical.

Lessons: Correlations



- From Andersen et al. (2001) who show that

“there is a systematic tendency for the variances to move together, and for the correlations among the different stocks to be high/low when the variances for the underlying stocks are high/low, and when the correlations among the other stocks are also high/low.”

- Latent factor: here risk-aversion/capital.

Lessons: IV surfaces

- This model generates the typical skew.
- It also predicts IVs move together in a crisis, which has indeed occurred, across securities as well as across asset classes.
- Vol of Vol in our model leads vol: needs to be tested!
- Regulators would benefit from having information regarding vol of vol, as well as of the net gammas and vegas of broker-dealers to get an early indication of the possible extent of feedback effects.

Conclusion

- Each financial crisis has its own peculiarities that make it look different and unique.
- But once the trigger is pulled, crises develop in much the same fashion. Delevering and derisking imply that asset price movements increase manyfold through the feedback effects that are programmed into the financial system itself.
- The result is a natural combination of liquidity and solvency issues. This paper aims at spelling out the precise mechanism through which endogenous risk manifests itself and suggests ways of mitigating the individually prudent but jointly welfare destroying negative spillovers that worsen a crisis so much.

Merci fiir mer no ze lauschteren!