# Discussion of "Allocating systematic and unsystematic risks in a regulatory perspective" by Gourieroux and Monfort.

Bernd Schwaab
European Central Bank

CREDIT conference, Venice, 29-30 Sep 2011

email: bernd.schwaab@ecb.int

Not necessarily the views of ECB or ESCB.

# The paper ...

... is well written, addresses an important topic, accessible.

Three **main contributions**: (a) introduces three intuitive axioms and derives which allocation of risk reserves are compatible with those axioms, (b) considers the effects of changes in individual firm losses on a global risk reserve and associated contributions, and (c) disentangles systematic and idiosyncratic risk components in these allocations.

Main **challenge**: illustrate relevance of results and applicability in a real world context.

My plan: I'll talk about main approach, summarize results, and have two main comments.

# Literature on allocating internal capital

- Dhaene, Goovaerts, Kaas (2003), Frey, McNeil, Embrechts (2005, Ch. 6), Tasche (2000, 2007, 2008).
- $(X_1, ..., X_n)'$ are L&P of **product lines**, $X = \sum_{i=1}^{n} X_i$ total **L&P of entity**, $R(X)$ measure of **firm risk**.
- Example of Euler allocation: $R(X) = ES_\alpha(X) = E[X|X > q_\alpha(X)] = \sum_{i=1}^{n} E[X_i|X > q_\alpha(X)]$. Thus $E[X_i|X > q_\alpha(X)]$ is risk contribution to $R(X)$.
- Purpose: Allocate capital for internal purposes such as performance measurement (RAROC), efficient use of capital.

# Newer literature on systemic risk contributions

- Acharya, Pedersen, Philippon, Richardson (2010), Brownlees and Engle (2010), Düllmann and Puzanova (2011), *Gourioux and Monfort (2011)*.
- $(X_1, ..., X_n)'$ are L&P of individual **FIs**, $X = \sum_{i=1}^{n} X_i$ total L&P of **system**, $R(X)$ measure of **system-wide risk**.
- $R(X) = ES_\alpha(X) = E[X|X > q_\alpha(X)] = \sum_{i=1}^{n} E[X_i|X > q_\alpha(X)]$. Thus $R(X, X_i) = E[X_i|X > q_\alpha(X)]$ is TCE, or MES.
- Purpose: Measurement of systemic risk contribution, calibration of capital charges for SIFIs.
- **However**: IMO, there are downsides to this approach: Risk at system level is *endogenous*, and *unknown*.

# First main result of paper

**Proposition 3.4**: The contributions $R(X, X_i) = E[X_i|X = R(X)]$ satisfy the three axioms of decentralization, additivity, and risk ordering.

**Corollary 3.5**: The contributions $R_{\mu_p}(X, X_i) = \int E[X_i|X = x]\mu_p(dx)$ satisfy the three axioms of decentralization, additivity, and risk ordering as well, provided $\int x\mu_p(dx) = R(x)$.

- $R(X)$ in 3.4 can be VaR and ES, or some other DRM.
- The contributions satisfying the three axioms are not necessarily unique (but are e.g. in the Gaussian case).

# Second main result of paper

DRM (and thus VaR and ES) are such that $R(\lambda X) = \lambda R(X)\ \forall \lambda > 0$.
Thus the Euler condition holds, $R(e) = \sum_{i=1}^{n} \frac{\partial R(e)}{\partial \lambda_i}$.

**Proposition 4.1** [see also Gourieroux, Laurent, Scaillet (2000)]:

$$DRM_H(X) = \int q_{\alpha^*} H(d\alpha^*) = \sum_{i=1}^{n} DRM_{H,i},$$

where

$$DRM_{H,i} = \int q_{\alpha^*,i} H(d\alpha^*),$$

and

$$q_{\alpha^*,i} = \frac{\partial q_{\alpha^*}(e)}{\partial \lambda_i} = E[X_i | X = q_\alpha(X)].$$

This Euler allocation applied to DRM satisfies the three axioms and can be generalized to non-uniform changes in $\lambda$, see **Proposition 4.2**.

# Third main result of paper

Risks may be systematic or unsystematic. The Euler disaggregation approaches so far do not distinguish the two.

$$X_i = \sum_{k=1}^{K} \beta_{ik} f_k + \gamma_i u_i,$$

where $f_1, \ldots, f_K$ are systematic risk factors, and $u_i$ are idiosyncratic terms. Total loss is

$$X = \sum_{i=1}^{n} X_i = \sum_{k=1}^{K} \left[ \left( \sum_{i=1}^{n} \beta_{ik} \right) f_k \right] + \sum_{i=1}^{n} \gamma_i u_i.$$

Euler allocation can be done here as well:

$$\begin{aligned} R_s(X, X_i) &= \sum_{k=1}^{K} \beta_{ik} E[f_k | X = q_\alpha(X)], \\ R_u(X, X_i) &= \gamma_i E[u_i | X = q_\alpha(X)]. \end{aligned}$$

# 1. System level risk R(X) is endogenous

systematic risk $\neq$ systemic risk. Related but different.

The latter is related to **behavior (**and some **externality)**, such as banks acting in unison to a systematic shock and thus amplifying it.

Example 1: liquidity spiral and a fire sale externality. Initial shock to equity hits constrained agents $\longrightarrow$ asset sales in illiquid markets $\longrightarrow$ mark-to-market accounting $\longrightarrow$ further losses $\longrightarrow$ more asset sales in illiquid markets .$\longrightarrow$ ..

# 1. System level risk R(X) is endogenous

Example 2: Martin Hellwig (1996)'s "480 banks" and interest rate risk.

Example 3: Morris and Shin (2008): The prudential deleveraging of one bank can be perceived as a bank run to another. "Deleveraging externality".

Other examples include hoarding externalities, network externalities, bank runs due to coordination failure, etc.

How to regulate in a system context?

# 2. System level risk R(X) is unknown

No regulator knows R(X), or will commit to a certain level.

Knowing R(X) requires that we know how marginal L&Ps are related in a dependence structure. We don't.

Q: Problem for Euler risk allocation in practise?

# 3. Literature: Düllmann and Puzanova (2011)

This is the empirical counterpart to the theoretical analysis. Use of Euler allocation method to determine systemic risk contributions.
Main problem is that correlation structure is unknown.

Q: What to do then?

With apologies:
Koopman, Lucas, Schwaab (2010) decompose credit risk into systematic and unsystematic components empirically.
Schwaab, Koopman, Lucas (2011) look at financial system risk using a nonlinear multivariate factor structure.

# Conclusion

Great paper on a fundamental topic.