

Discussion: "Attributing Systemic Risk to Individual Institutions", by Nicola Tarashev, Claudio Borio and Kostas Tsatsaronis

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Research Question

- How can we **measure the "systemic importance"** of an individual financial institution?
- Can we find a **methodology to attribute contributions of individual institutions to systemic risk?**

Attribution Method: Shapley Value.

The framework for the attribution method is that of **n-person games in coalitional form with side payments** given by

- A set N of **players**, $1, 2, \dots, n$.
- A **coalition function** v that associates with every subset $S \subset N$ (coalition) a real number $v(S)$, the maximal total payoff the coalition members can obtain (worth of the coalition)
- There is a medium of exchange that is **freely transferable** between the players and every player's utility is additive with respect to it (side payments or transferable utility).
- The **Shapley-Value** associates to each player in the game a unique payoff (value) which respects four axioms. These axioms **uniquely determine** the values in **all** games.

How does the Shapley Value Look Like?

- The Shapley Value of a player in a game turns out to be his **expected marginal contribution to a random coalition**.
- Change in the worth of coalition S not containing i when player i joins S : $v(S \cup \{i\}) - v(S)$
- A random coalition not containing i is obtained by arranging all n players in a line and put in S all those that precede i in this order. All $n!$ orders are assumed to be equally likely.

Which situations are captured by such a model?

- Players have some **benefits to share** (political power, resource savings, diversification benefits) which they can achieve through cooperation.
- The **opportunity** to share benefits **results from cooperation** of all players or of subgroups of players.
- Players are **free to engage in negotiations**, bargaining and coalition formation.
- Players have **conflicting objectives**. They want to have the largest share of the benefits for themselves.

How does this model translate to Systemic Risk Attribution?

My **formal interpretation** is as follows:

- The players are N financial institutions.
- Assume there are two dates $t = 0$ (risk measurement) and $t = 1$ (risk realization).
- Assume there is a finite set Ω of states of the world at $t = 1$, each state occurring with known probability $p(\omega)$.
- Let L denote a $|\Omega| \times N$ matrix of losses of the N institutions occurring at $t = 1$ in all the states ω .
- Consider a **systemic risk measure** $\rho : \mathbb{R}^{|\Omega|} \mapsto \mathbb{R}$.
- Define the tuple $(N, |\Omega|, p, L, \rho)$ as a **risk environment**.
- The perspective of the systemic attribution analysis is from $t = 0$.

Systemic Risk Allocation Game

Definition Given a risk environment $(N, |\Omega|, \rho, L, \rho)$ a **systemic risk allocation game** is a n-person game in coalitional form with side payments (N, v) where the value function $v : 2^N \mapsto \mathbb{R}$ is defined by:

$$v(S) = -\rho(L(S)) \quad \text{for all } S \in 2^N$$

The idea then is to measure systemic risk contribution of individual institutions by the Shapley Value of a player i.e. by the **expected marginal contribution of an individual institution to the systemic risk measure of a random coalition**.

How does this describe the systemic risk problem?

- Benefits to share: A group of banks (subportfolios) benefits from being part of a bigger group because the bigger group has lower systemic risk. But why should the larger group have lower systemic risk?
- Cooperation opportunities: Not entirely clear in this context. Merge with other banks?
- Bargaining, Negotiations and Coalition Formation: Not entirely clear in this context. Negotiate bigger units or conglomerates?
- Conflicting objectives: A bank benefits from lower systemic risk but contributing to a coalition that brings this about is individually costly. But what is the interpretation in the context of the paper?

Why is this confusing?

- A sensible interpretation of the systemic risk allocation game and the attribution method depends on the properties of the systemic risk measure ρ .
- The authors take the perspective that the banking system is a portfolio of banks, with individual banks being subportfolios.
- There is some exogenous amount of risk that has to be taken by the banking system. Some part of it can be diversified and the rest is aggregate risk that has to be borne by the banks.
- But is the systemic risk attribution problem of this kind?

What is a useful measure of systemic risk?

- It seems that the attribution method can only be assessed if the properties of the systemic risk measure ρ are pinned down more specifically.
- In the paper the authors indeed pin down the risk measure and use Value at Risk and Expected Shortfall.
- But why are these sensible risk measures in a systemic risk context?
- Many recent contributions to the literature about systemic risk suggest that the nature of systemic risk has rather the nature of an externalities problem rather than the nature of a problem of portfolio diversification.

Comment Results

- Different systemic risk measures lead to very different attributions: What does this mean for applications?
- The methodology of attribution is certainly not "*... a methodology of attributing systemic risk to individual institutions **however it is measured***" (p.2)
- Whether the model underlying the attribution theory makes sense **fundamentally** depends on the properties of the risk measure.

Stylized Policy Approaches

- The stylized policy approaches with capital allocations based on Shapley Values and target risk levels work with an entirely mechanistic risk paradigm.
- There is a fixed and exogenous amount of risk out there that has to be borne by the banking system. The system can diversify the idiosyncratic risk in principle and somehow the remaining aggregate risk has to be shared.
- Some sharing rule is induced by the attribution scheme assuming that this does not influence the risks out there.
- This does not seem to capture the essential features of systemic risk.
- Moreover this is an approach to regulation that has failed in the Basel framework of risk weighted capital requirements. Why should it be useful in this context?

Can we measure systemic risk?

- There are good reasons to doubt whether systemic risk can be measured and modeled in principle.
- The risks we are concerned with do not have the character of a game against nature but are the result of complex interactions, they are **endogenous**. The problem with the systemic risk model used here is not that it is stylized but that it is **conceptually wrong**.
- The notion that we deal in the financial system with risks that can be objectively measured and analyzed by probabilistic methods is perhaps an illusion.

Should we confer the status of systemic importance to individual institutions?

- While it is true that in the current financial system there are institutions of systemic importance this need not be a given fact in the future.
- As soon as we even implicitly have to acknowledge that there are institutions that are too systemically important to fail we induce all kinds of opportunistic behavior ex-ante that relies on a favorable endgame scenario.
- Rather than concentrating on how to identify systemically important institutions we should focus the analysis on how to defuse the system in a way that no institution can claim this special status for itself.

How could the flaws in the method be fixed?

- Begin with a clear precise idea of what are the essential features of systemic risk and define a risk measure that reflects these properties. In particular it should reflect the idea that systemic risk has something to do with externalities.
- Find a convincing argument why the situation is usefully formalized by a N person cooperative game with side payments.
- If this can be done the Shapley Value might be one useful attribution scheme.