The ILB Research Review

Systemic Risk

With
Bruno Biais
Stéphane Crépey
Christian Gouriéroux
Gaëlle Le Fol

#5
March 2012

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PUBLICATION OF INSTITUT LOUIS BACHELIER
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ÉDITO

The recent emphasis on systemic risk stems from certain limitations to the Basel 2 and Solvency 2 regulations revealed during the 2008 financial crisis. These limitations were not the cause of the crisis, but they did accentuate it. In particular risk analysis and calculations of reserves were carried out for each entity, bank and insurance company, considered in isolation, i.e. without taking into account the links between the risks of the various entities. At the time of the crisis, bank balance sheets deteriorated simultaneously, resulting in corresponding increases in statutory reserves, calculated in isolation, and a concomitant need for large quantities of highly liquid, low risk assets. This demand resulted in significant sales of shares, a sharp drop in the price of these shares, and a liquidity crisis, particularly in the interbank market.

Given a particular system, say the set of all European banks, there are two causes of a simultaneous increase in the risks of a significant number of these banks: external causes and contagion. There may be a shock to a factor external to the system (exogenous shock), which negatively impacts on the values of assets held by these banks. For instance increasing the prime rate can have an impact on the monthly payments of adjustable rate mortgages, result in clusters of failures among individual borrowers, and adversely affect the earnings of institutions with a significant portion of these mortgages or their derivatives in their balance sheets.

Contagion phenomena occur in a subsequent stage and can greatly amplify the effects of exogenous shocks. Their impact is transmitted through the balance sheets. Thus the failure of a bank affects all creditor institutions – those with shares in that bank, those holding deposit accounts with it, etc. – which can in extreme cases cause the failure of other institutions, with further knock-on effects. Such contagion may result from a specific shock to an institution, and not necessarily from a shock to a common risk factor. An acquisition of a foreign bank, a credit enhancer or a life insurance contract portfolio may be made at too high a price if the purchaser has little knowledge of the country concerned. This can result in future losses, if the acquisition is reassessed at a value closer to reality, and decreased earnings for the buyer, possibly leading to further repercussions through contagion.

As with the previous regulations, stakeholders often focus on the calculation of reserves, here for systemic risk, leading to the classification of institutions according to the amounts of these reserves, from the most "systemic" to least "systemic" one, and assigning quantitative (systemic) scores or qualitative (systemic) ratings on these amounts. To avoid the mistake of relying solely on a single rating system, we need to take account of the multiple aspects of systemic risk. Such systemic risks and their measurements depend on the system under consideration, on the horizon at which the risk is analyzed – there is a term structure of systemic risk –, on the exogenous factors subject to shocks and on the magnitude of these shocks, and on the possible focus on contagion phenomena.

Pragmatically, we should be careful not to certify the first scoring system proposed by academics or service companies, even if it is always pleasant and interest-arousing to discuss the ranking of, say, the 10 the most systemic institutions, or the large amounts of estimated reserves. Conversely, we should have various rating systems and understand what each rating represents and why an institution may be poorly placed in one scoring system and ranked well in another. Rather than find out whether an institution is fundamentally systemic, something that is rarely the case, it is better to try to understand in which contexts it may be systemic.

The preceding discussions show that the notion of systemic risk is complex and that understanding it will take time. There has been considerable criticism of banks in regard to their behavior and short-term objectives. In the same vein, we should avoid too quickly setting in stone modes of management and control of systemic risks, while research and development in this area, which started barely three years ago, is still in its infancy (although growing rapidly). The articles presented in this issue of the Institut Louis Bachelier Cahier provide varied examples of this recent research.

Christian Gouriéroux

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Counterparty risk associated with OTC products

HOW TO MANAGE IT BY INCLUDING FINANCING COSTS ?

Based on an interview with Stéphane Crépey and on his paper "A BSDE Approach to Counterparty Risk under Funding Constraints" (Evry-Val-d'Essonne University pre-publication number 326, 2011), to appear in two parts in "Mathematical Finance", with the titles "Bilateral Counterparty risk under funding constraints - Part I : Pricing" and "Bilateral Counterparty risk under funding constraints - Part II : CVA".

The crisis has revealed the vulnerability of financial actors and highlighted counterparty risk. But how can this risk be assessed and covered? Stéphane Crépey is developing a new method for valuing and hedging counterparty risk, associated with the OTC products in the presence of illiquidity costs. He advocates a global approach to the problem centred on the notion of CVA (Credit Valuation Adjustment), which in practice is used by the major investment banks.

BIOGRAPHY

Stéphane Crépey

Stéphane Crépey is professor in the mathematics department of the Evry-Val-d'Essonne University, where he directs the "M2IF" Masters in Financial Engineering. He conducts research in the Evry-Val-d'Essonne University Analysis and Probabilities laboratory and in the context of the Fédération Bancaire Française "Credit Risk" Chair. His research interests include financial mathematics, numerical finance, credit risk and counterparty risk.

Counterparty risk is risk that, in a financial contract between two parties, the debtor refuses or is unable to meet all or part of his commitments. The term "contract" here in fact designates a portfolio of contracts linked by a CSA (Credit Support Annex). The CSA specifies how a guarantee is made through margin calls, and what happens to the remaining cash in the event of default by either party. Its purpose is to mitigate counterparty risk. But from the standpoint of financial modelling and numerical simulation, the CSA represents a major challenge. For it requires consistently and dynamically modelling, then numerically simulating, all the risk factors and positions related to thousands of contracts under the same CSA, including derivatives in all types of market. "Since the crisis of 2007-09, interest in counterparty risk has greatly increased, because it was realized that a bank's resilience to major financial turmoil was largely dependent on its ability to correctly estimate and cover such risk", Stéphane Crépey explains. "At the Credit Risk Chair (NDLR: founded in January 2008 by the Fédération Bancaire Française and the Fondation Institut Europlace de Finance, directed by Monique Jeanblanc, also professor at the Evry-Val-d'Essonne University), we have invested a lot in this subject in recent years." Stéphane Crépey first became interested in the subject as an academic partner in a project to develop an independent platform for valuing and managing credit derivatives (CRIS project), in the context of the global competitive cluster Finance Innovation. "Credit derivatives are those that pose the greatest difficulties in this area because of their dependency on the two parties' default risk."

A reduced-form approach to counterparty risk

In the case of derivatives other than credit derivatives, the situation is in principle easier. "One can count on the reduced dependency between the contract and the default of the two parties so as to situate oneself in mathematical frameworks that open the door to powerful numerical methods." The idea is to handle the default of the two parties through a so-called reduced-form approach. However, this approach is at the cost of simplification, which is not entirely satisfactory theoretically and requires further research. "To resolve the problem, one gives oneself a certain freedom in relation to arbitrage. Even though it is in principle only theoretical, it is possible to take advantage of it to carry out an arbitrage operation on the bank."

> *"take into account the constraints of financing the bank and the associated illiquidity costs"*

Having a global view of the problem

The problem is complicated by the need to take into account the constraints of financing the bank and the associated illiquidity costs. Stéphane Crépey models the interactions between the two parties to the contract and the third party that funds the bank. "To estimate counterparty risk in the presence of financing constraints, we have to focus on one of the parties to the contract (or portfolio of contracts under the aegis of the same CSA), for example the bank, and explicitly study the 'system' it forms with the other party and the backer. We cannot simply consider the contract itself, regardless of the specific characteristics of these three stakeholders. We also need to have a clear view of three pillars of potentially equal importance, namely the contract itself, its hedging portfolio and its financing portfolio."

CVA: from practice to theory

In practice, traders' desks only have a clear view of their own activity and not of the whole system, particularly aggregate data required to calculate the cash flows associated with CSAs (margin calls). As a result the tendency, in major investment banks, is to provide a specific central CVA desk responsible for obtaining this data, and for valuing and hedging counterparty risk. "This allocation of tasks between the various trading desks of an investment bank and the CVA desk motivates my mathematical approach to counterparty risk. The methodology of valuation and hedging counterparty risk that arises in practice in banks also turns out to be useful for analyzing the problem mathematically", says Stéphane Crépey.

METHODOLOGY

Stéphane Crépey has developed a method for valuing and hedging counterparty risk in the presence of financing constraints, based on the notion of CVA (Credit Valuation Adjustment). The method uses the mathematical techniques of backward stochastic differential equations (BSDEs) and partial differential equations (PDEs), in an approach involving reduced default risk for the two parties to the contract. His work has resulted in concrete recommendations for managing contract risks as a whole, or solely their CVA component, depending on the bank's objective.

KEY POINTS

- Good counterparty risk management is particularly important in the context of financial crises.
- Taking into account financing costs complicates the problem.
- A consistent and effective mathematical and numerical approach is possible.
- CVA is not only an important practical concern for banks, but is also a useful concept for the mathematical analysis of counterparty risk.

Recommendations

- Establish a front-office CVA desk in charge of collecting data from the different trading desks and calculating the corrections to their valuations and hedging of excessive counterparty risk. An overview is needed, especially for addressing "margin call" issues in the context of a CSA.
- Favour dynamic modelling for these CVA calculations. For CVA is inherently an optional quantity, that cannot be properly managed by applying a simple credit spread.
- Use EDSR techniques for these models, which usefully complement the more traditional EDP techniques. This applies theoretically for the analysis of the problem, but also numerically, so as to be able to address large-scale problems.
- Treat separately the case of CVA on credit derivatives, for which the dependency between the reference portfolio and the default of the two parties creates a special situation.

Further reading...

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- Piterbarg, V. (2010), "Funding beyond discounting : collateral agreements and derivatives pricing." Risk Magazine February (2010), 97–102.

Find the Stéphane Crépey's article on www.finXchange.org

Clearing counterparty risk in the presence of aggregate risk

WHAT IS THE OPTIMAL COMPENSATION FOR THE RISK OF DEFAULT BY A PARTY ?

BIOGRAPHY

Bruno Biais

Bruno Biais holds a PHD in finance from HEC. He has taught at HEC, Oxford, Carnegie Mellon University, and London Business School. He is now research professor of economics and finance at the Toulouse School of Economics (CNRS-CRM, IDEI). He has extensively published on corporate finance and financial markets, as well as on political economy and contract theory, in the Journal of Finance, the Review of Financial Studies, the Review of Economic Studies, the American Economic Review, and Econometrica. He has been Editor of the Review of Economic Studies from 2007 to 2010. He has just been appointed co-editor of the Journal of Finance where his service will start in 2012. He is a Fellow of the Econometric Society and an Economic Theory Fellow. Bruno Biais has been scientific advisor of the Paris Bourse, the London Investment Banking Association, the Federation des Banques Francaises, and he has spent one year at the New York Stock Exchange as visiting economist.

Based on an interview with Bruno Biais on the subject of his paper "Clearing, counterparty risk and aggregate risk" (Toulouse School of Economics (CNRS CRM – IDEI)). [1]October 2011.

Counterparty risk is a major issue for investors, highlighted by the financial crisis and bank failures. How do clearing systems affect risk and its distribution? Centralized clearing systems allow counterparty risk to be mutualised. This advantage of centralized clearing is limited by the presence of aggregate risk and because of moral hazard problems.

Strictly speaking, clearing is intended to determine the positions of the different counterparties (number of contracts or stocks bought or sold, amounts, entities, etc.), involved in a transaction. In a broad sense, clearing also includes transfers of assets between the parties, the transmission of information to regulators, margin calls and guarantee deposits, and the treatment of counterparty defaults. It is this last aspect, and the analysis of counterparty risk, that is the focus of Bruno Biais's analysis. At a given realization of risk, the clearing system does not eliminate losses, but it affects how they are shared. The clearing system can create value, if it leads to a better distribution of risk or losses.

It should be noted that clearing on the spot market differs from that of derivatives markets. In derivative markets, contracts have much longer maturities and depend on events that are difficult to predict, such as defaults activating credit default swaps (CDS). These characteristics imply that counterparty risk is high and difficult to manage. Bruno Biais's paper provides an abstract model, but the economic effects highlighted apply equally well to the CDS market, which has expanded dramatically in recent years.

Clearing may be centralized or decentralized. In the first situation, a clearing agent acts an intermediary between the seller and the buyer of the contract. For a fee, he may insure them against counterparty risk. In the second situation, the centralized clearing platform (CCP) interposes itself between all buyers and sellers of contracts (e.g. CDS.) To participate in the CCP, members must pay a subscription. The amount thus obtained by the CCP can be used to make payments owed by defaulting counterparties. Thus membership dues paid to the CCP can be seen as insurance premiums. Central clearing has several advantages, including the reduction of certain costs and especially the mutualisation of counterparty risk among the different members. "In a centralized clearing house, counterparty risks can be shared, rather like in a conventional insurance company", Bruno Biais says.

In 2009, the G20 leaders decided to establish centralized clearing in derivatives markets, with a target date of late 2012. But Bruno Biais is not sure that this deadline can be met.

However, even the optimal distribution of counterparty risk created by central clearing has its drawbacks in the presence of aggregate risk and moral hazard.

> *"a problem that is very familiar to insurance companies : moral hazard"*

Centralized clearing is not insurance against aggregate risk

Mutualisation is ineffective in the event of an aggregate shock, causing a series of defaults. "Pooling of counterparty risk protects CDS buyers against idiosyncratic risks, but it is impossible to insure the system against macroeconomic aggregate risk. This risk is not mutualisable", Bruno Biais says. To minimize the consequences of such a risk, agents have to find creditworthy and robust counterparties, who will not default during an aggregate shock.

Incentives for prudence and risk control are essential

However, although a CCP fully insures its members against the aggregate counterparty risk, they still need to find creditworthy counterparties. "We are dealing with a problem that is very familiar to insurance companies: moral hazard, which leads a fully insured actor to reduce his risk prevention efforts." Bruno Biais gives examples of incentives to limit the moral hazard of financial entities. "To obtain an ideal clearing system for counterparty risk, several conditions are required. On the one hand, clearing must certainly be centralized. But on the other, financial actors must be encouraged to seek strong, creditworthy counterparties and to control risks. This incentive constraint may exclude full insurance against counterparty risk."

[1] *Bruno Biais's research on clearing systems is carried out in the framework of the FBF IDEI Chair "Investment Banking and Financial Markets Value Chain".*

METHODOLOGY

In his paper, Bruno Biais endeavoured to identify the characteristics of an optimal clearing system. First, he summarized the institutional context and the existing literature on risk adjustment systems. Then, starting from methods traditionally used in microeconomics for analyzing risk sharing, insurance and the problems of moral hazard and incentives, he introduced a simplified model to study three different risk and clearing system scenarios :

- In the first scenario, the most favourable, there is no aggregate risk or moral hazard. Clearing is bilateral or centralized.
- In the second scenario, there is an aggregate risk but no moral hazard.
- In the third scenario, there is both aggregate risk and moral hazard.

The analysis and comparison of these three cases allows him to distinguish what type of problem clearing systems may or may not resolve, and under what conditions.

Recommendations

- Counterparty risk should be cleared though a centralized system.
- Incentives to control and manage risk should be retained.
- The centralized clearing house has a proactive monitoring role to play, by controlling its members' risk-taking.
- The centralized clearing house is a systemic actor. Its capital reserves must be sufficiently large.
- Margin calls are needed to reduce risky positions, and should lead to (at least partial) liquidation of positions, in the event of exposure to excessive risk.

Further reading...

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Find the Bruno Biais's article on www.finXchange.org

KEY POINTS

- The central clearing house allows a better distribution of counterparty risk. But it can reduce the incentives of its members to try and find creditworthy counterparties and to control counterparty risks.
- Aggregate risks are not mutualisable.
- A centralized clearing house should not totally insure its members against the risk of default, so as to preserve incentives for finding creditworthy counterparties and managing risk.

Market illiquidity generates volume

HOW TO CHOOSE THE MOST LIQUID STOCKS ?

Based on an interview with Gaëlle Le Fol and on her paper "When Market Illiquidity Generates Volume" (University Paris-Dauphine, July 2011), co-authored with Serge Darolles and Gulten Méro.

BIOGRAPHY

Gaëlle Le Fol

Gaëlle Le Fol is an economics and econometrics graduate from the University of Paris 1 Panthéon – Sorbonne and holds a Ph.D in Economics from Paris 1 University. She is Professor of Finance at Université Paris – Dauphine, where she is heading the master 203 - Financial Market program. She is a research Fellow at DRM (Dauphine Research in Managment) - Finance and at the CREST (Centre de Recherche en Economie et Statistique). Gaëlle Le Fol heads the Research Initiative QMI ("Quantitative Management Initiative").
Her research interests are in financial market microstructure and financial econometrics. Her recent research has include investors behaviors and their impact on the trading characteristics, market liquidity, contagion and systemic risk as well as high frequency algorithmic trading. She teaches financial econometrics and electronic markets.

Day-to-day liquidity is an important investment criterion. But how can it be measured? The answer to this and other questions is provided by the new econometric model (MDHL) developed by Gaëlle Le Fol and her co-authors. MDHL measures the day-to-day liquidity of a basket of stocks by observing changes in prices and daily trading volumes. The model allows the presence or absence of liquidity shocks at a given moment to be deduced.

There are numerous theoretical studies on two types of investor who intervene in the markets, according to two distinct trading strategies. The first is based on the daily flow of information reaching the market, which determines investment decisions. The second is arbitrage during liquidity shocks (the timing difference between buyers and sellers that temporarily destabilizes markets) and concerns market makers. "A market maker makes his profits from the succession of liquidity arbitrages throughout the day. He has to manage his portfolio so as to arrive at an inventory close to zero in terms of stocks and cash at the end of the session. In contrast, the other type of investor has a different time horizon, and buys and sells on the basis of the information available. Consequently, price changes and trading volumes depend both on the flow of information and on liquidity shocks", Gaëlle Le Fol explains. But how can their respective effects on the volume and volatility of stocks be determined? The new econometric model (MDHL) developed by Gaëlle Le Fol provides an answer to this question.

The markets are not completely liquid

The economic and financial literature has for a long time shown little interest in the question of liquidity. Thus the standard MDH model is based on the hypothesis of perfect market liquidity. Yet in practice, liquidity shocks frequently occur in the course of the trading day. To take account of this situation, Gaëlle Le Fol proposes modelling the effects of these liquidity shocks on intraday and daily trades in order to analyze their impact on volume. "Theoretically, at the end of the day, liquidity friction is no longer a problem, because the market makers have played their part by providing the market with the missing liquidity," says Gaëlle Le Fol.

Arbitrage increases trading volumes

When liquidity shocks occur in the markets in the course of a day, arbitrage is undertaken by the big institutional investors. "Our main contribution is to offer an analysis of the effects of both information and liquidity arbitrage on the volatility and volume of a set of stocks. We have shown that the volumes generated by the correction of liquidity friction are supplementary to the volumes that would be traded if there was no liquidity problem. Thus, liquidity shocks are factors that increase daily volumes." But they still have to be measured.

> *"daily volumes contain both information and liquidity shocks"*

MDHL goes further and provides a liquidity indicator

"Observation of volume is not a good measure of liquidity, although it is widely used in practice. Our research shows that daily volumes contain both information and liquidity shocks. Changes in intraday prices (and their volatility) also reveal information and liquidity shocks, but the latter are reabsorbed during the day by the liquidity arbitragers and variations in daily prices only reflect the information flows arriving in the market," says Gaëlle Le Fol. In fact the new MDHL econometric model can break down daily volume into two parameters: those coming from information flows and those induced by liquidity shocks. "Our work thus allows us to determine the liquidity of individual stocks."
The model was concretely applied to daily volatility and volume data from the FTSE 100 between January 2005 and July 2007. MDHL performed better than the standard MDH model, thanks to the inclusion of the two latent factors of information and liquidity shocks. The findings obtained confirm those of previous studies, which showed, at an aggregate level, that a positive relation exists between the volatility and volume variables.
Gaëlle Le Fol and her co-authors show that this positive covariance depends both on information and on liquidity shocks. Through the MDHL model it is possible to determine what proportion of daily volume depends on liquidity shocks. The shocks may be frequent and small-scale, or less frequent but of greater magnitude. The proposed measure can estimate what liquidity profile (in terms of size and frequency) characterizes the stocks examined.

METHODOLOGY

To build this new econometric model (MDHL), Gaëlle Le Fol first identified two trading strategies: active traders use the flow of information available on the market, while market makers focus on arbitrage liquidity. These strategies have different effects on volatility and volume and should be modelled differently. She then extended the GM microstructure (established by Grossman and Miller in 1988) to the daily frequency of trades, so as to model the effect of liquidity shocks on these trades. She was able to extend the standard MDH econometric model, which takes account only of information shocks, and incorporated the impact of liquidity shocks into the relationship between volatility and daily volume. This new model makes it possible to distinguish the daily volume generated by information from the volume generated by illiquidity problems. MDHL was tested on FTSE 100 data, using a standard statistical method (generalized moments).

Recommendations

- The use of MDHL enables the liquidity of a group of stocks to be statistically measured at a given instant, thereby allowing those stocks most affected by liquidity shocks to be distinguished.
- Stocks may thus be classified according to their degree of illiquidity, through the breakdown of daily volume, depending on whether their illiquidity derives from information or from liquidity shocks.
- The proposed measure can estimate what the liquidity profile is (in terms of amplitude and frequency) of the stocks being considered.
- The liquidity profile of stocks can help build a stock-picking strategy in the context of high-frequency trading.

Further reading...

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Find the Gaëlle Le Fol's article on www.finXchange.org

KEY POINTS

- The two trading strategies based respectively on information and liquidity arbitrage do not have the same effects on volatility and daily volume.
- Daily volume alone does not allow liquidity to be measured.
- The MDHL model provides a better understanding of the composition of daily volume.
- The standard MDH model is a special case of the MDHL model, in the absence of liquidity shocks.
- MDHL enables the liquidity of a stock portfolio to be determined.

The distribution of systemic risks in a regulatory context

HOW TO DIFFERENTIATE SYSTEMIC AND UNSYSTEMIC RISKS ?

Based on an interview with Christian Gouriéroux and on his paper "Allocating Systemic and Unsystemic Risks in a Regulatory Perspective" (CREST/University of Toronto, September 2011).

How can the public authorities detect systemic risks? This issue has become critical since the fall of Lehman Brothers and the coming of the sovereign debt crisis. Through his work, Christian Gouriéroux distinguishes the components of risk that are systemically important; he identifies the participation of each bank in the global financial system and proposes alternative solutions to the regulators, in relation to existing standards.

BIOGRAPHY

Christian Gouriéroux

Christian Gouriéroux is professor of Economics at the University of Toronto, director of the Finance-Insurance laboratory at CREST (Center for Research in Economics and Statistics in Paris), and head of the AXA chair on "Large Risks in Insurance". His current research interests are in Financial Econometrics, especially in credit risk, term structure of interest rates, longevity, hedge funds and regulation. Christian has received the Koopman's price in Econometric Theory and the silver medal of CNRS (the French National Research Found) for his research in Economics.

Since the eruption of the economic and financial crises in 2007, the viability of the global banking system has been increasingly subject to criticism. Governments have endeavoured to regulate the system by establishing new regulatory bodies (the Financial Stability Board in the United States, for example) or by the introduction of the famous bank stress tests, but to no avail. Doubts persist, while the risks do not decrease. Moreover, the Basel I and II regulations have many disadvantages, such as the inadequate reserves (or capital requirements) of banks to cover extreme risks. Indeed, the proportion of this capital held in reserve with central banks is not specifically allocated to systemic risks. Thus when a single entity's risk increases, due to a specific shock, its demand for liquid assets increases and can be easily satisfied by the market. But the presence of a systemic shock amplifies the demand for liquid assets by a number of banks simultaneously. As a result, in the ensuing panic they are often obliged to sell assets at low prices in order to meet regulatory reserve requirements, thereby accelerating the downward spiral, cycle effects and crises.

Furthermore, when systemic risk appears, it is often too late, since the role of each entity in the global system is not considered. "The standard method of risk calculation uses a bottom-up approach: value at risk (VaR) is calculated for each financial institution, then aggregated to obtain a total figure. This method has its drawbacks, because the risk of each bank is viewed as isolated. But in practice this is far from being the case. We have therefore preferred a top-down approach, which identifies systemic risk as a whole and then distributes it among the different financial entities", Christian Gouriéroux explains. "The main message of this paper is to avoid the use of a naive risk measure such as VaR to calculate the system's levels of individual and overall reserves."

> *"We have therefore preferred a top-down approach"*

Systemic and unsystemic risks: two separate calculation methods

Systemic and unsystemic risks have very different causes and consequences, and call for different calculation methods. "We have to separate the calculation of risk specific to each institution from the calculation of systemic risk. The latter must be smoothed out over a much longer cycle (a year, for example), compared to the three months usually used, in order to avoid unintended pro-cyclical effects. The crisis revealed the deficiency of the current regulation formula", Christian Gouriéroux says.

The regulators need to act so as to help economic policy

"There a several ways of calculating the amount of reserves needed to control systemic risk. In fact the regulators have considerable freedom in setting the methods of calculating overall risk, as well as in the process of reallocation between the different banks. Furthermore, the public authorities possess many control variables, depending on the scale of the desired risk-taking or the amount of credit wanted in the economy."
Put simply, the regulators' room for manoeuvre depends on the economic policy objectives of governments and central banks (mostly objectives in terms of inflation and/or economic growth). As a result, the control variables used by regulators should be constraining to a greater or lesser extent, depending on the economic cycle (growth, stagnation, recession), the business environment and the property market.
This type of question has to be discussed with public institutions, for there is not just one but many ways of distributing systemic risk among the different financial actors of a country or geographical region. At the moment, current regulation does not take account of these aspects.

METHODOLOGY

Christian Gouriéroux focuses on the notion of systemic risk and in particular its distribution among the various financial institutions. Taking a top-down approach (from macro- to micro-economics), he considers systemic risk in its entirety, and then apportions it among the different banks.
He next introduces three very important axioms (decentralization, additivity and the compatibility of reserves according to the risks covered), so as to derive a consistent distribution of systemic risk among the various financial players.
He then makes sensitivity calculations by deriving a formula disaggregated in terms of institutions and systemic and non-systemic risks, using linear and non-linear factor models, with the aim of identifying the systemic and non systemic components of global risk.
Finally he considers the link between the capital requirements for banks demanded by the regulators and objective indicators of risk, and concludes with alternative proposals.

KEY POINTS

- The Basel I and II rules (Basel III will progressively come into force in 2013) do not make sufficient distinctions between systemic and unsystemic rules, mainly because of differences between the prudential approaches at the macro- and micro-economic level. In particular they entail unintended pro-cyclical effects.
- The regulators have considerable freedom in setting the control variables, depending on cycles and economic conditions.

Recommendations

- An institution's systemic risk is different from its specific risk.
- The reallocation of systemic reserves to banks depends on the level of overall systemic risk.
- Although the data from banking institutions is centralized with the regulator, each institution must be allowed to make its own calculations of the amount of systemic reserves, while ensuring the confidentiality of the portfolio composition of competing banks (decentralization axiom).
- The regulatory measures of systemic risk imposed by the authorities should not be circumvented in mergers or demergers among financial institutions (additivity axiom).
- If a financial institution is less hedged against systemic risk, its reserves must be increased (axiom of compatibility with the risks).
- Non-linear factors can have a considerable influence on systemic risks. This non-linearity should be taken into account when the balance sheets include a large number of derivatives (options, credit risks).

Further reading...

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Find the Christian Gouriéroux's article on www.finXchange.org

Application of the principle of granularity to risk measurement

HOW TO REFINE MEASURES OF RISK IN PORTFOLIOS ?

Christian Gouriéroux

Based on an interview with Christian Gouriéroux and on his paper "Granularity Adjustment for Risk Measures : Systematic vs Unsystematic Risks" (CREST/ University de Toronto, September 2010)

Systemic risks are increasingly of concern to the financial sphere. But how do we measure the value of portfolio reserves comprising hundreds of thousands of individual contracts, in order to contain these risks? Christian Gouriéroux has addressed this issue by applying the principle of granularity. But, more recently, he has taken into account multiple factors and dynamics, whereas the current regulations (Basel II, Solvency II) imply static factor models that do not adequately match reality.

Video

Find, Christian Gouriéroux's interview video on www.finXchange.org

The principle of granularity was introduced for static factor models during the Basel II discussions in the early 2000s. This method can break down any measure of risk of a large portfolio, into the sum of the measure of asymptotic risk, in the case of an infinite number of individual contracts, and a correction term. This measure of asymptotic risk is known as CSA (Cross-Sectional Asymptotic) and identifies the non-diversified effects of systemic risk in a portfolio of securities. Conversely, the granularity adjustment (GA) takes into account the effects of specific risks and their combined effects on systemic risks, when the portfolio is large but comprises a finite number of contracts. "Granularity adjustment is used to measure specific risks, whereas CSA captures systemic risk", says Christian Gouriéroux.
Nevertheless, these models with a single risk factor are too restrictive to analyze the complexity and dynamics of systemic risks.

Risks on large securities portfolios are hard to measure

Standard measures of risk such as VaR are used to calculate the minimum capital requirement of banks, in order to hedge investment risks (Pillar 1 of Basel II). They also serve to control risk, through internal risk models (Pillar 2 of Basel II). However, these risk measures are complicated to use numerically in the case of large portfolios of individual contracts. "Carrying out simulations to calculate the amount of reserves of a bank, whose portfolio contains many individual contracts (loans, MBS, CDOs, CDS, credit cards, life insurance contracts, etc.) can take a day or two", Christian Gouriéroux points out.
Indeed, many factors as varied as the securities with which they are associated must be taken into account, such as terminations of contracts, payment defaults and anticipated repayment of credits. "For a large but finite number of contracts, it is necessary and preferable to apply, in the calculation formula, an adjustment according to the principle of granularity, which takes account of non-linear dynamic factors", he adds.

> *"the base recovery rates are constructed"*

The principle of granularity extended to dynamic risk factors is more relevant

"In the standard Basel II regulation approach, the risks are classified according to the probability of a borrower going into default. The uncertain aspect of the rate of debt recovery is not taken into account. In this standard approach, the regulator sets the recovery rates, without necessarily having detailed figures for such estimations. In the advanced Basel 2 approach, the base recovery rates are constructed and should be used to find the factors influencing defaults and recovery rates", Christian Gouriéroux says.
To illustrate the incoherence of not incorporating uncertainty around the recovery rate from a borrower in current measures of risk, he gives a concrete example. "If a company has a lot of problems and is structurally defaulting, its probability of failure increases and its recovery rate declines. Conversely, when a company only has cash flow problems, its recovery rate is much greater than in the first case. But a creditor bank can declare it bankrupt, even if the company is able to repay the capital owing. This artificially creates a kind of anticipated settlement, thereby increasing the firm's probability of failure, while the loss is diminishing. These two components of risk can therefore have a negative or positive relationship, depending on companies' different situations. For example, after two years, start-ups often have short-term funding problems, hence a negative relationship between these components of risk, because of banks' mistrust toward them."
To analyze the different parameters, a multiple factor model is essential.
"Dynamic factors are necessary for jointly analyzing the defaults and recovery rates of a corporate loans portfolio, in large securities portfolios. This is what we have applied in the calculations of our granularity adjustments", Christian Gouriéroux says.

Recommendations

- The financial crisis has shown that systemic risks should be distinguished from non-systemic risks. In a new organization, these two kinds of risk should supervised by different regulators.
- Recent studies on the principle of granularity have shown that the technology is now operational for the application of non-linear dynamic factor models. But this methodology has not yet been implemented.
- Static risk factor models assume that past observations are not instructive for predicting future risks, unlike dynamic factor models.

Further reading...

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- Gordy, M. (2004) : "Granularity Adjustment in Portfolio Credit Risk Measurement", in *Risk Measures for the 21.st Century*, ed. G. Szego, Wiley, 109-121.
- Gouriéroux, C., and J., Jasiak (2011) : "Granularity Adjustment for Default Risk Factor Model with Cohort", forthcoming in *The Journal of Banking and Finance*

METHODOLOGY

Christian Gouriéroux extends the granularity approach to multiple factors and dynamics, with a view to calculating the reserve values of very large portfolios. He first introduces a static multiple factor risk model to calculate the granularity adjustment (GA) of VaR (a standard measure of risk). GA may easily be used for many other existing measures of risk. GA is then applied to traditional static multiple factor credit risk models.
Next, the analysis is extended to dynamic factor risk models. In this structure, two GAs are necessary. The first concerns conditional VaR with the assumed value of the factor to be observed. The second takes into account the fact that the value of the factor is not observable.
Lastly, Christian Gouriéroux considers dynamic factor models, with a stochastic probability of default and a stochastic recovery rate in the event of default, and derives the corresponding GAs.

KEY POINTS

- Early studies on granularity and current regulations are limited to static models only.
- Static factor risk models are too restrictive for analyzing the complexity and dynamics of systemic risks.
- Systemic risk factors can be multi-dimensional.

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