Financial Stability, Monetary Policy, and Central Banking: An Overview

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The financial developments of the last decade had a large impact on the management of risk, providing more diversified portfolios to investors. Based on these complex financial contracts, investors were able to shift the investment possibilities frontier outward; however, that movement generated intricate networks. At the same time, global financial integration increased significantly, facilitating the propagation and expansion of financial shocks.

The recent financial crisis is evidence of such networking sensitivity. In February 2007, Freddie Mac announced its intention to reduce its mortgage portfolio risk by ceasing to purchase risky loans, and then in April of the same year, one of the leading companies in the subprime mortgage market declared bankruptcy. The two events foretold the ending of the housing boom in the U.S. economy and later exposed its financial fragility. In the following year, other U.S. companies related to the housing sector also declared bankruptcy. Meanwhile, the story in Europe was not too different. In September, Northern Rock was authorized additional liquidity provision by the Bank of England, consolidating the idea of a housing bubble that was transversal to developed economies.

The propagation of the mortgage crisis to other financial institutions was fueled by the use of securitized packages, which could be swept away from balance sheet reports, generating a

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false reduction in credit risk. These packages were outstandingly attractive to other investors, for they were classified as low risk by professional ratings agencies, while enjoying low financing costs during the long period of expansive monetary policy. The mortgage crisis thus mushroomed into a global financial crisis, and the associated financial instruments came to be labeled as toxic and, given their inherent complexity, were difficult to price in the face of falling underlying prices.

The closure of financial intermediaries linked to the mortgage sector affected financial institutions, with a potentially systemic impact. This motivated the U.S. Federal Reserve and the U.S. Treasury to undertake extraordinary actions, such as the provision of credit facilities for the acquisition of Bear Stearns by J.P. Morgan and the expansion of credit lines to Fannie Mae and Freddie Mac. The Federal Reserve also widened the list of acceptable collateral for liquidity provision. By mid-September, a new financial event shook all fragility indexes: Lehman Brothers declared bankruptcy. This event resulted in a crisis of confidence and the drying up of the interbank market for liquidity, mainly driven by the uncertainty about the liquidity and solvency of the involved parties. In the aftermath, the Federal Reserve provided generous funding to the insurance company American International Group (AIG) to ensure the continuity of its operation. Given AIG's intricate network of operations, its eventual fall would have resulted in a systemic liquidity problem. Afterward, both the Federal Reserve and the Treasury generated a recovery plan for the banking sector, which has been replicated by other industrial economies.

This crisis opened the debate on macroprudential policies and the role of monetary and international authorities. Thorough analysis of these policies implies assessing early alert indicators, the information on which these are based, and their properties. Likewise, the quantification of the systemic importance of any given financial institution allows informed choice among alternative policy actions. The assessment of these features allows improvements in the supervision framework governing financial institutions, which enables authorities to deal with a crisis in a timely and efficient manner.

The Twelfth Annual Conference of the Central Bank of Chile, "Financial Stability, Monetary Policy, and Central Banking," held in Santiago on 6–7 November 2008, provided the occasion to discuss early warning indicators, with the subprime crisis in the background. This conference presented theoretical and

empirical research in both risk analysis by financial institutions and the network effects in financial markets. It also provided the opportunity to sketch these tools in the context of financial crises, thereby generating a critique on the potential weaknesses of current regulation. This overview summarizes the main topics discussed at the conference.

1. Risk Assessment

Financial institutions must maintain a fragile balance between risk taking, stemming from multiple investment decisions, and adequate capital provisions that guarantee enough buffer to face previous commitments with demand depositors. Specifically, in the case of banks, regulators acknowledge that the riskiest operation in the banking business is also the oldest: loan provision. The risk stems from the unilateral reneging of the debtor. A second risk source is market risk, which consists in the deterioration of one's net position in a given unit of account, such as stock options, currency, or interest-bearing assets. Market risk and operational risk are regulated through the first pillar of the Basel II agreement, which covers minimum capital requirements based on risks measured from standardized methods or internally generated processes.

Credit risk analysis requires a statistical structure. Merton (1974) highlights the importance of default probabilities. His work assumes that a firm has risky assets, so that its market value corresponds to the value of a purchase option whose exercise price is the institution's debt burden valued at the risk-free rate. This model provides a method for extracting asset market values and their volatilities (Duffie and Wang, 2004). Alternatively, Crouhy, Galai, and Mark (2000) use Ito's lemma to relate asset volatilities with a firm's market value volatility, forming a system of nonlinear equations to obtain the market value of assets and their volatility.[1] One relevant statistic in this setup is distance to distress, which is the number of standard deviations that the asset value is above the debt value. Under Merton's (1974) model, default probability is

1. Byström (2007) presents a simplified distance to distress, in which (i) the trend factor is small and (ii) default probability is close to zero. Under these assumptions, distance to distress is defined by the firm's leverage and its market value volatility, so it can be obtained directly from balance sheets and market information without resorting to a system of equations.

computed using the cumulative normal distribution of the negative distance to distress.

Because the model is based on option values, it has been labeled contingent claims analysis (CCA) and has been used successfully at the institutional level (Duffie and Wang, 2004). In contrast, option pricing requires that the default probability derived from the distance to distress be calculated under a risk-neutrality assumption.[2]

Additionally, Crosbie (2001) modifies distance to distress so that the resulting default probability mimics the historical distribution of default. For this purpose, he uses the Sharpe quotient to correct the trend effect and employs more general density functions than the normal distribution. These measures are commercialized by Moody's KMV under the name of expected default frequencies (EDF). They have been successful in predicting firm insolvency and real variables (Gilchrist, Yankov, and Zakrajsek, 2008).

In this volume, Dale Gray, Robert Merton, and Zvi Bodie discuss how to extend CCA for different economic sectors, including the corporate, financial, household, and sovereign (government and monetary authorities) sectors. The authors outline the relevant risk transfers and then use these to elaborate a procedure for developing macroeconomic stress tests that affect financial stability, defined by the solvency of the banking system. Gray and Malone (2008) develop the CCA model using the cases of Thailand during the Asian crisis and Brazil in 2002. Blavy and Souto (2009) use banks' EDFs to establish a macro-financial model for the Mexican banking system. They find a strong relation between domestic interest rates and EDFs, which also provide an early warning for financial instability. For Chile, Dale Gray, Carlos García, Leonardo Luna, and Jorge Restrepo develop a small dynamic macroeconomic model that includes the distance to default of the banking system. The authors confirm that the dynamic and nonlinear elements of their model result in more persistent shock trajectories than those stemming from traditional vector autoregression (VAR) models.[3] They also

2. Because the risk-free rate is lower than asset returns, this probability should be adjusted to better reflect the distance to distress. Zurita (2008) uses this methodology for forecasting bankruptcies among Chilean businesses. He finds that CCA delivers much higher bankruptcy probabilities than those empirically observed.

3. Similar results are found by Alfaro, Calvo, and Oda (2009), who consider the dynamics of banking aggregates in a nonlinear VAR. Misina and Tessier (2008) consider that a fundamental issue in stress-test models is their nonlinear component, which better captures the dynamics of extreme events.

explore the consequences for output and inflation volatilities (and their trade-off) when the Taylor rule considers systemic risk through distance-to-distress deviations. Using simulations, they conclude that the central bank's consideration of distance-to-distress deviations reduces both inflation and output volatilities.

A micro-oriented approach is presented by Marcelo Fuenzalida and Jaime Ruiz-Tagle, who assess household financial risk using data from the Social Protection Survey (Encuesta de Protección Social, or EPS) and the Household Financial Survey (Encuesta Financiera de Hogares, or EFH). The EPS contains historical labor-related data on individuals who are active in the labor market, for each surveyed household. Using this information, the authors model unemployment duration to characterize labor income, which is the main source of financial risk at the household level. Their results show that the higher the attained educational level, the lower the probability of becoming unemployed. The EFH is conducted by the Central Bank of Chile and is based on a similar survey conducted by the Bank of Spain (Bover, 2004). Its aim is to characterize Chilean household debt, which translates into an oversampling of households in higher income quintiles and motivates the inclusion of extensive detail in the survey section relating to debt. Using the results from the unemployment duration section, Fuenzalida and Ruiz-Tagle simulate financial stress tests on the surveyed households. They consider as risky those households whose financial-burden-to-income ratio is above 75 percent, and whose expenditure level is above 20 percent of total household income. Under this definition, 9.5 percent of surveyed households are risky, and they account for 16 percent of the total debt documented in the survey. Stress test exercises also show that a rise in the unemployment rate generates a less-than-proportional increase of total household debt at risk.

2. Network Effects

A second element in risk analysis is the existence of network effects among involved financial institutions. These could be the outcome of financial and real factors. In the first category, we include the spillover effects generated between financial markets that had given rise to the literature on financial contagion well before the crisis. Statistical measures of financial contagion have been developed in the seminal work of King and Wadhwani (1990), who also explore its statistical implications for stock markets. In

the same line, Forbes and Rigobon (2002) propose the concept of contagion as a force that is exogenous to the inherent dynamics of financial markets.

In this volume, Francis Diebold and Kamil Yilmaz use the variance decomposition of a VAR model to capture the spillover effects that were observed in stock markets in Argentina, Brazil, Chile, Mexico, and the United States. They use this index to identify the main episodes of turbulence from 1994 to 2008. Their results show that the current financial crisis displays similar features to the Asian and Mexican crises. Beirne and others (2008) present statistical evidence on the increase of spillover effects during periods of financial turbulence. This is consistent with the empirical evidence that spillover effects run from developed economies to emerging economies during these periods of stress, and because emerging economies tend to be financially weaker, they are more prone to display higher volatility.

In terms of network contagion analysis, Prasanna Gai and Sujit Kapadia present a network model in which it is possible to separate the network contagion probability from its potential systemic impact. The authors discuss the observation by Cifuentes, Ferrucci, and Shin (2005) that the higher the connectivity of a network, the higher its capacity to absorb shocks, but at the same time, the more channels through which the shock can be transmitted. Under some of the scenarios studied, the total effect on the system is higher than would be the case with lower connectivity. In a different paper, David Aikman, Piergiorgio Alessandri, Bruno Eklund, Prasanna Gai, Sujit Kapadia, Elizabeth Martin, Nada Mora, Gabriel Sterne, and Matthew Willison present the RAMSI Project, which adds financing liquidity risk to a model of credit risk and valuation contagion. In particular, the project proposes a criterion to incorporate diverse information from financial institutions' balance sheets and from the market to determine intermediaries' access to market funding. The model represents an important advance in the available toolkit for stress test exercises on the financial system.[4]

Interdependencies among lenders have a strong impact on the credit risk of asset portfolios. Vasicek (1987) presents a simple solution to correct default probabilities under an atomized portfolio. The model assumes that the standardized returns of each asset can be

4. Jara, Luna, and Oda (2008) present a discussion on risk scenarios for the Chilean banking industry.

explained by a common factor and an idiosyncratic one. It then uses the average correlation between asset returns to correct the default probability. Crouhy, Galai, and Mark (2005) discuss the applicability of the credit-risk model proposed in Basel II, according to which it is possible to establish capital requirements for classes of loans.

Alternatively, copula models have been used in the joint modeling of asset risk (Cherubini, Luciano, and Vecchiato, 2004; Li, 2000). Copulas allow the generation of joint distribution functions based on the univariate distribution of each asset and on measures of their codependencies. Risk analysis can then be undertaken in a two step procedure: first, for every loan or institution, and, second, for the whole portfolio or related system. Copulas thus possess twice as many degrees of freedom, as the analyst may choose to work with several different univariate distribution functions and then obtain multivariate analysis based on different copulas.

Miguel Segoviano and Charles Goodhart present a paper on measuring financial stability in the U.S. banking system. They use univariate measures obtained from the market prices of banks' credit default swaps (CDSs) and a nonparametric copula (CIMDO) that collapses this information at the bank level on a maximum entropy basis. They use the CDSs to extract information on the default probability under risk neutrality, obtaining superior information to the EDFs when derivatives markets are developed. Singh and Spackman (2009) propose using these measures in combination with stochastic recovery rates, which would provide more adequate signals during episodes of stress. Additionally, CIMDO has advantages over parametric copulas, in that it does not require the parameterization of banks' default dependence measures, such as the Kendall or Spearman coefficients.

Finally, macroeconomic theory incorporates financial frictions into risk analysis, through extensions to general equilibrium models. Bernanke, Gertler, and Gilchrist (1999) present a model where firms face external financing costs that are above the risk-free rate. This difference can be traced to the firm's agency cost of generating a credit contract. The paper by Ethan Cohen-Cole and Enrique Martínez-García extends the Bernanke-Gertler-Gilchrist model to include banks' capital adequacy requirements in their modeling. This results in a higher difference, mainly through the balance sheet channel. The authors suggest that monetary authorities could use this effect to smooth the business cycle generated by the potential rise in agency costs.

3. The Financial Crisis

The recent financial crisis presents monumental challenges to regulatory design. This issue is discussed by Garry Schinasi who proposes a new regulatory framework that can generate the appropriate incentives and establish clear rules. The author holds that the current framework is flawed in the excessive confidence in private risk management and market discipline. Similarly, Claudio Borio and Mathias Drehmann discuss the difficulties of establishing an adequate regulatory framework when the authority observes only incomplete or lagged financial fragility indicators.

The papers by Charles Goodhart, Dimitrios Tsomocos, and Alexandros Vardoulakis and by Michael Bordo present proposals for understanding the current financial crisis. The former paper uses a model of heterogeneous agents for banks and households. The results show that monetary policy may help tame the effects of financial market illiquidity (which is consistent with the results found by Kiyotaki and Moore, 1997) and that bank provisions could have a role in times of scarce liquidity. Michael Bordo critically reviews the main milestones of the financial crisis. In his conference paper, he argues that the pressure on business cycles, generated by financial bubbles, originates in loan allocation. His conclusions stress that the lessons of the current financial crisis will strengthen the U.S. banking market and beef up the conviction that the coordination and efficacy of regulators are crucial elements in these extreme scenarios.

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