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FINANCIAL STABILITY, MONETARY POLICY AND CENTRAL BANKING: AN OVERVIEW

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Resumen

Este trabajo muestra un resumen integrado de los trabajos presentados en la duodécima Conferencia Anual del Banco Central de Chile "Estabilidad Financiera, Política Monetaria y Banco Central", realizada en noviembre de 2008 y por aparecer compilados en un libro de próxima publicación. Los trabajos, que incluyen aspectos tanto teóricos como empíricos, aportan elementos para el manejo de la estabilidad financiera en un contexto de integración financiera global.

Abstract

This paper summarizes the works presented at the twelfth Annual Conference at the Central Bank of Chile entitled "Financial Stability, Monetary Policy and Central Banking", held in November 2008 and compiled in a forthcoming book. These works, that include both theoretical and empirical aspects, provide elements to handle financial stability in a globally integrated financial context.

Introduction

Last decade's financial system advances have had a large impact on the development of risk diversification contracts available to investors. The latter, supported on such complex financial contracts, have been able to shift outwards the investment possibilities frontier, thereby generating intricate networks. This has been concurrent with a significant increase of global financial integration, which has facilitated the propagation and expansion of financial shocks.

The recent financial crisis is evidence of such networking sensitivity. Initiated on February 2007 with the announcement of *Freddie Mac*'s intention of reducing mortgage portfolio risk through the cease of purchase of risky credits, on April in the same year, one of the leading companies in the *subprime* mortgage market declares bankruptcy. Both events foretold the ending of the housing boom in the American economy, and later exposed its financial fragility. During the following year, other American companies, related to the housing sector, also declared bankruptcy. Meanwhile, in Europe, the story was not too different. On 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 this mortgage crisis to other financial institutions was rocketed by the use of securitized packages, which could be swept away from balance sheet reports, generating a false reduction of credit risk. These packages were outstandingly attractive to other investors, for they were classified as low risky by professional classification agencies, while they enjoyed low financing cost due to the long period of expansive monetary policy. This way, the mortgage crisis built into a global financial crisis and the associated financial instruments came to be labeled as toxic and were, due to their inherent complexity, difficult to price in the face of the falling underlying price.

Closure of financial intermediaries, linked to the mortgage sector affected financial institutions with potential systemic impact. This motivated the Federal Reserve (FED) and the U.S. Treasury to undertake extraordinary actions such as

credit facilities for the acquisition of Bear Stearns by JP Morgan and the rise in credit lines benefiting *Fannie Mae* and *Freddie Mac*. Additionally, the FED widened the list of accepted collateral assets 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 liquidity and solvency of involved parties. In the aftermath, the FED provided generous funding to the insurance company *American International Group* (AIG) to ensure the continuity of its operation. Given AIG's intricate operation network, its eventual fall would have resulted in a systemic liquidity problem. Afterwards, both, the FED and the Treasury generated a recovery plan for the banking sector which has been replicated by other industrial economies.

This crisis opened the floor to the debate about macro-prudential policies and the role that both, monetary and international authorities fulfill. Thorough analysis of these policies implies assessing early alert indicators, the information on which these are based and their properties. Likewise, the quantification of systemic importance of any given financial institution allows informed choice among alternative policy actions. The assessment of these features allows improvements in the financial-institutions-supervision framework 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 November 6 and 7, 2008 provided the occasion to the discussion on early alert 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 article summarizes the main topics discussed in such Conference.

Risk Assessment

From the viewpoint of a financial institution, i.e. a bank, there exists a fragile balance between risk-taking, stemming from multiple investment decisions, and the adequate capital provision which guarantees enough liquidity to face previous commitments with demand depositors. Specifically, for the case of banks, regulators have acknowledged that the riskier operation in banking business is also the oldest; loan provision. This risk is the result of the unilateral reneging of the debtor. A second risk source is "market risk", which consists in the deterioration of one's position in a given unit of account, such as stock options, currency or interest-bearing assets. Together, the latter risk and the operation risk, have been considered in regulation through the first pillar of the Basilea II agreement. This pillar refers to minimum capital requirements that consider risks measures from standardized methods or internally generated processes.

Credit Risk

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 allows extracting asset market values and their volatilities (Duffie and Wang, 2004). Alternatively, Crouhy, Galai and Mark (2000) use Ito's Lemma to relate assets volatilities with firm's market value volatility, thus forming a system of non-linear equations which allows to obtain the market value of assets and their volatility[1]. One relevant statistic in this setup is Distance to Distress (DD), which is the number of standard deviations from which the asset value is above

[1] Byström (2007) presents a simplification to the Distance to Distress in which: (1) the trend factor is small and (2) default probability is close to zero. Under these assumptions, DD is defined by the firm's leverage and its market value volatility, which allows obtaining it directly from balance sheets and market information without resorting to a system of equations.

the debt value. Under Merton's (1974) model default probability is computed using the cumulative normal distribution of the negative DD.

Because the model is based on option values, it has been labeled Contingent Claim Analysis (CCA) and has been successful at institutional level (Duffie and Wang, 2004). In contrast, option pricing nature results in that the default probability derived from the DD, be calculated under risk-neutrality assumption[2].

Additionally, KMV(2001) modifies DD so that the resulting default probability mimics the historic distribution of default. For this purpose, they use the Sharpe quotient which allows 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) and 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 such as: corporate, financial, household and sovereign (government and monetary authorities). The authors outline the relevant risk transfers and from these, they elaborate a procedure for the development of tests of macroeconomic tension which affect financial stability, assessed by solvency of the banking system. Gray and Malone (2008) develop the CCA model revising the Thailand and Brazilian cases under the Asian and the 2002 crises respectively. Blavy and Souto (2009) use banks' EDF to stablish a macro-financial model for the Mexican banking system. The authors find a strong relation between domestic interest rates and EDFs, which also provide early warning about situations of financial instability. For Chile; Dale Gray, Carlos

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[2] Because the risk free rate is lower than the asset return, then this probability should be adjusted to better reflect this distance to distress. Zurita (2007) uses this methodology for forecasting Chilean businesses' bankruptcies. He finds that CCA delivers much higher bankruptcy probabilities than those empirically observed.

García, Leonardo Luna and Jorge Restrepo develop a small dynamic macroeconomic model which includes the DD of the banking system. The authors confirm that dynamic and non-linear elements of their model result in more persistent shock trajectories than those stemming from traditional VAR-type models[3]. Later, they explore the consequences on output and inflation volatilities (and their trade-off) when the Taylor rule considers systemic risk through a DD deviations. Using simulations they conclude the consideration by the Central Bank of DD deviations reduces both, inflation and output volatilities.

A more tractable road is presented by Marcelo Fuenzalida and Jaime Ruiz-Tagle, who assess household financial risk using data from the Social Protection Survey (EPS, Encuesta de Protección Social) and the Household Financial Survey (EFH, Encuesta Financiera de Hogares). The EPS contains historical labor-related data of individuals who are active in the labor market, in each surveyed household. Using this information, the authors model unemployment duration to characterize the main financial risk source at the household level: work income. Their results show that, the higher is the attained educational level, the lower is 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 households' debt, which translates in the over-sampling of those households belonging to higher-income quintiles and high 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 EFH's households. They consider as risky those households whose financial debt burden to income coefficient is above 75%, and whose expenditure level is above 20% of total household income. Under this definition, 9.5% of surveyed households is risky, and are accountable for 16% of total debt

[3] Similar results are found by Alfaro, Calvo and Oda (2008) who consider banking aggregates' dynamics in a non-linear VAR. Misina and Tessier (2008) consider that a fundamental issue in stress test models is its non-linear component which allows to better capture the dynamics of extreme case events.

documented in the survey. Stress test exercises also show that a rise in unemployment rate generates a less than proportional increase of total debt at risk.

2. Network Effects

A second element in risk analysis is the existence of the network effects between 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 on 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 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 which were observed in stock markets in Argentina, Brazil, Chile, Mexico and the U.S. They identify through this index the principal turbulence events from 1994 to 2008. Their results show that the current financial crisis displays similar features to those observed during the Asian and Mexican crises. Beirne et al (2008) present statistical evidence on the increase of spillover effects during periods of financial turbulence. This is consistent with the empirical evidence that during these stress periods spillover effects run from developed economies to emerging economies, being the latter more likely to be less financially strong and thereby more prone to displaying 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 it can be transmitted. In some cases, the harm caused to the system is higher than would be in the case of 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, it proposes a criterion to incorporate diverse information from financial institutions' balance sheets and from the market to determine the access of intermediaries to market funding. The model represents an important advance in the available toolkit for stress test exercises on the financial system[4].

Regarding credit risk of assets portfolio it is important to consider the interdependencies between lenders. Vasicek (1987) presents a simple solution that allows to obtain, under an atomized portfolio, a lender-dependency "corrected" default probability. The model assumes that standardized returns of each asset can be explained by a common factor and an idiosyncratic one. Additionally, it considers the average correlation between such assets' returns which allows to correct the default probability. Crouhi, Galai and Mark (2005) discuss applicability of the credit-risk model proposed in Basilea, according to which it is possible to establish capital requirements for types of loans.

Alternatively, copula models have been used in the joint modeling of assets' risk (Cherubini, Luciano and Vecchiato, 2004; Li, 2000). Copulas allow the generation of joint distribution functions based on the univariate distribution of each involved asset and on measures of their co-dependencies. This in turn allows performing risk analysis in a two step procedure: first, for every credit or institution, and then for the whole portfolio or related system. Consequently, copulas possess "twice" as much degrees of freedom, as the analyst may choose to

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

work with several different univariate distribution functions and then obtain multivariate analysis based on copulas.

Miguel Segoviano and Charles Goodhart, also in this volume, present a paper on measuring the financial stability in the American banking system. For this, they use univariate measures obtained from market prices of banks' CDS and a non-parametric copula (CIMDO) which collapse this information at bank level on a maximum entropy basis. The CDS allow extracting information on the default probability under risk neutrality and can be considered as superior in terms of information to EDF when derivatives markets are developed. Singh and Spackman (2009) propose using these measures, along with stochastic recovery rates, which would provide more adequate signals under stress events. Additionally, CIMDO has certain advantages compared to parametric copulas, for it does not require parameterization of banks' default dependence measures such as *kendall* or *spearman.*

Finally, risk analysis has been studied in macroeconomic theory incorporating financial frictions, which are appended to general equilibrium models. Bernanke, Gertler and Gilchrist (1999) present a model which considers external financing cost for the firm which is above the risk-free rate. This difference can be traced down to the firm's agency cost of generating a credit contract. The paper by Ethan Cohen-Cole and Enrique Martínez-García includes banks' capital adequacy requirements in their modeling which results in a higher difference, mainly due to the balance sheet channel. The authors suggest that monetary authorities may use this effect to smooth the business cycle generated by the potential rise in agency costs.

The Financial Crisis

The recent financial crisis presents monumental challenges to regulation 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 considers the current framework is flawed in the excessive confidence that befalls on private risk managing and market discipline. On the same ground, Claudio Borio and Mathias Drehman elaborate their discussion about the difficulties on establishing an adequate regulatory framework when the authority observes only incomplete or lagged financial fragility indicators.

In a different reasoning line, the articles by Dimitrios Tsomocos, Charles Goodhart and Alexandros Vardoulakis; and Michael Bordo present proposals to understand 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 tam the effects of financial market illiquidity, which is consistent with the result found by Kiyotaki and Moore (1997), and that bank provisions could have a role in events of scarce liquidity. Further, Michael Bordo revisits critically the main milestones of the financial crisis. In his conference paper he argues that the impulse on business cycles, generated by financial bubbles, finds it origin in loan allocation. His conclusions stress that the lessons of the current financial crisis will strengthen the American banking market and beef up the conviction that coordination and efficacy of regulators are crucial elements in these extreme scenarios.

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