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THE CHALLENGE OF FINANCIAL STABILITY

A New Model and its Applications



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A New Model and its Applications

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Introduction

Charles A.E. Goodhart and Dimitrios P. Tsomocos

In the ECB *Financial Stability Review* (December 2005, p. 131) it was stated bluntly that, 'Financial stability assessment as currently practiced by central banks and international organizations probably compares with the way monetary policy assessment was practiced by central banks three or four decades ago – before there was a widely accepted, rigorous framework'. It is the aim of this publication to provide a set of papers that could assist in pointing the way towards such a framework.

It should be no surprise that the analysis of financial stability issues lags behind that of monetary policy. The former is just that much more difficult to model. In particular, financial (in)stability is generated by the probability of default (PD) and bankruptcy. Given the inherent implausibility of a world without default, it is quite remarkable how much such current mainstream models, which incorporate a no-default assumption, can achieve in monetary and macroeconomic analysis and policy prescription; Woodford's *Interest and Prices* (2003) is an icon in this respect. Whether or not such monetary policy analysis would retain all its validity in a more realistic setting, it is just not possible to approach an analysis of financial stability without addressing head on bankruptcy, PD, and the heterogeneity of agents, both banks and their clients; heterogeneity is a necessary corollary of PD, since a model in which either all, or no, members of a sector default is just not sensible.

Our purpose is to present a framework that attempts to model and assess financial (in)stability as an equilibrium phenomenon that is compatible with the orderly function of modern market economies. Our framework is analytically tractable and easily computable. Therefore, precise regulatory policy can be introduced and implemented and its consequences on the real as well as the nominal side of the economy can be readily investigated. In addition, a comprehensive analysis of the optimal regulatory and monetary policy becomes possible. Ultimately, our framework aims to be useful for crisis prevention as well as management. The main anchor of our approach relies on the interaction of liquidity and *endogenous* default. Together with investor and banking heterogeneity, our model allows for analysis in an economy with a monetary sector and financial markets. Ultimately, we reckon that our approach can serve as a foundation for financial stability management using a *quantifiable* metric of financial fragility.

Chapters 2 and 3 offer an overview of our methodology as well as a brief description of alternative approaches to deal with issues of financial stability. On the macroeconomic policy side of Central Banking a remarkable consensus has been emerging over the last two decades. This covers both the applicable theoretical framework for analysing the transmission mechanism of monetary policy and also the appropriate institutional structure for the Central Bank to deploy its macroeconomic policies.

The consensus about the latter structure generally involves a high degree of operational independence (from Government); the de facto selection of price stability as the primary objective (except in those countries on a pegged, or fixed exchange rate, or in a currency union); and the choice of a short-term interest rate, selected on pre-announced dates within the context of a forward-looking forecasting structure, as the main instrument. When a country strays from this consensus, for example when Poland or Venezuela seeks to curtail its Central Bank's operational independence, or when a French politician casts doubt on the primacy of the price stability objective, you can almost hear the sharp intake of breath amongst the worldwide 'club' of central banks and at its focal point at the Bank for International Settlements (BIS) in Basel.

As financial stability has gained focus in economic policy-making, the demand for analyses of financial stability and the consequences of economic policy has increased. Alternative macroeconomic models are available for policy analyses, and this paper evaluates the usefulness of some models from the perspective of financial stability. Financial stability analyses are complicated by the lack of a clear and consensus definition of 'financial stability', and Chapter 3 concludes that operational definitions of this term must be expected to vary across alternative models. Furthermore, since assessment of financial stability in general is based on a wide range of risk factors, one cannot expect one single model to satisfactorily capture all the risk factors. Rather, a suite of models is needed. This is true in particular for the evaluation of risk factors originating and developing inside and outside the financial system respectively.

Chapters 4 and 5 introduce the formal model upon which our framework is based. Chapter 4 first of all extends the canonical General Equilibrium with Incomplete Markets (GEI) model with money and default to allow for competitive banking and financial instability. Secondly, it introduces capital requirements for the banking sector to assess the short- and medium-term macroeconomic consequences of the Basel Accord. Monetary Equilibria with Commercial Banks and Default (MECBD) exist and financial instability and default emerge as equilibrium phenomena. Finally, because of the presence of capital requirements for banks, a trade-off exists between regulatory policy and efficiency.

Chapter 5 extends the model of Chapter 4 allowing banks to violate their capital requirements and introduces limited participation into the credit markets. Key analytical results are: a financially fragile system need not collapse; efficiency can be improved with policy intervention; and a system with heterogeneous banks is more stable than one with homogeneous ones. Moreover, variable credit spreads naturally emerge in equilibrium. A definition of financial fragility is proposed. Financial fragility occurs when aggregate profitability of the banking sector declines and defaults in the non-bank and banking private sectors increase. Thus, *equilibria with financial fragility requires financial vulnerability in the banking sector and liquidity shortages in the non-bank private sector*.

Chapter 6 highlights the equivalence of endogenous default with the commonly used exogenous probabilities of default in various Merton-based finance models. In Chapter 7, we develop a multi-period general equilibrium model of bank deposit, credit, and interim inter-bank loan markets in which banks initially specialize in their choices of debtors, leading to under-diversification, but nevertheless become

entwined via inter-bank markets, leading to the fortunes of one bank affecting the profits and default rates of the other in a *sequential manner*. Thus, we offer microfoundations for the assumption of limited participation of Chapter 5.

Chapters 8–12 provide some initial applications of our framework with simulations and data from the UK and Colombia to highlight our intuition of how our model can be implemented. The purpose of our work is to explore contagious financial crises. To this end, we use simplified, thus numerically solvable, versions of our general model. The simplified model incorporates heterogeneous agents, banks and endogenous default, thus allowing various feedback and contagion channels to operate in equilibrium. Such a model leads to different results from those obtained when using a standard representative agent model. For example, there may be a trade-off between efficiency and financial stability, not only for regulatory policies, but also for monetary policy.

In Chapter 9, we develop a two-period general equilibrium model with three active heterogeneous banks, incomplete markets, and endogenous default. The model is calibrated against UK banking data and therefore can be implemented as a risk assessment tool for regulators and central banks. We address the impact of monetary and regulatory policy, credit and capital shocks in the real and financial sectors. In Chapter 10, we extend the model proposed to an infinite horizon setting. Thus, we are able to assess how the model conforms to the time series data of the UK banking system. We conclude that, since the model performs satisfactorily, it can be readily used to assess financial fragility given its flexibility, computability, and the presence of multiple contagion channels and heterogeneous banks and investors.

Chapter 11 studies in detail the performance of a general equilibrium model of the financial system when applied to the case of Colombia. The results suggest that the model performs satisfactorily, especially in the prediction of short-run trends (two years). A shortcoming of the results is a slight overestimation of several trends in the medium to long term. Finally, Chapter 12 offers a precise algorithm of how to implement a simplified version of our framework for applied work.

In Chapters 13 and 14, the focus is on the analysis of endogenous liquidity, default and collateral. The volume of trade and asset prices depends on both the supply of liquidity by the Central Bank and on the liquidity of assets and commodities. As a result, monetary aggregates are informative for the assessment of economic developments and the conduct of monetary policy. We also show that higher future spot rates are associated with higher state prices and, therefore, a liquidity premium is embedded in the term structure of interest rates, even in the absence of aggregate uncertainty. Furthermore, higher spot rates reduce trade and contribute to the increase of state prices. Hence, states of nature with higher interest rates are also states with higher risk-neutral probabilities which are simply rescaled state prices. Consequently, the risk-premium in the term structure is, in effect, a monetary cost risk-premium. Finally, by introducing a durable asset that can serve as collateral we are able to model a housing and a mortgage crisis. We extend the general modelling approach to the analysis of the effects of an adverse shock to the housing market, and its effect on the mortgage market, and through that to the financial system more widely.

In summary, the objective of this volume is to lay bare the foundations of a framework that is capable of addressing issues of financial instability in a systematic

way that is also empirically tractable and operational. We reckon that the minimal characteristics of contagion, liquidity, default, missing financial markets, heterogeneity and genuine interaction between the real and nominal sectors of the economy are necessary in any self-respecting attempt to analyse financial instability and its impact on the economy. The interplay of liquidity and default justifies the presence of a monetary sector in any model. Otherwise, the analysis is tantamount to performing surgery without the patient being present on the operating table.

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PART I

OVERVIEW

Analysis of Financial Stability

Charles A. E. Goodhart and Dimitri P. Tsomocos

Abstract

There is a remarkable consensus about the framework whereby a central bank should fulfill its macromonetary functions. In sharp contrast, there is no consensus about the framework for achieving its financial stability objective, either on the appropriate theory or practice. In this chapter we record how and why it has been so difficult to achieve consensus in this field. We start with a historical outline of central banks' financial stability role, describe their current functions in this respect, and then discuss the reasons why there has been, in recent years, such a diversity of views on the best way to organize the management of financial stability. In the second part of the chapter we ask how a satisfactory theoretical basis to address financial stability issues might be obtained. The first essential is that any such theory and model must be firmly based on a proper analysis of the probability of bank default (PD). We outline how such a model can be developed.

5.1 Introduction: The Financial Stability Role of Central Banks

On the macroeconomic policy side of central banking, a remarkable consensus has been emerging over the last two decades. This covers both the applicable theoretical framework for analyzing the transmission mechanism of monetary policy and also the appropriate institutional structure for the central bank to deploy its macroeconomic policies. The consensus about the latter structure generally involves a high degree of operational independence from government; the *de facto* selection of price stability as the primary objective (except in those countries on a pegged or fixed exchange

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rate, or in a currency union); and the choice of a short-term interest rate, selected on preannounced dates within the context of a forward-looking forecasting structure as the main instrument. When a country strays from this consensus – for example, when Poland or Venezuela seeks to curtail its central bank's operational independence, or when a French politician casts doubt on the primacy of the price stability objective – one can almost hear the sharp intake of breath among the world-wide “club” of central banks and at its focal point, the Bank for International Settlements (BIS) in Basel.

There is no such consensus on the appropriate theoretical framework for the analysis of financial stability. Indeed, some would claim that there is no proper theoretical framework for this function at all. We shall turn to this issue later, in Section 5.2, but first let us turn to the great diversity of institutional structures that exist for central banks on the stability/prudential/systemic stability wing. On this, see in particular, Mayes and Wood (2007), especially their introduction, Mayes and Wood (Chapter 6, this volume), also Masciandaro and Quintyn (2007), and Masciandaro, Quintyn, and Taylor (Chapter 8, this volume).

5.2 Historical Development of the Financial Stability Role of Central Banks

The earliest banks that eventually became transformed into central banks, such as the Riksbank, the Bank of England, and the Banque de France, were initially established to provide certain banking and financial services to the government, notably including the provision of funding during war time. In return they received certain competitive and governance advantages that quickly enabled them to become the largest *commercial* bank in their own country. As a result of their central role, they had both a complementary relationship, especially with the smaller country banks, and also a competitive relationship, especially with the larger joint-stock banks (Cameron 1967, 1972; Goodhart 1988).

It then became more efficient to centralize reserve holdings of specie with the governments' (central) bank with the other commercial banks using claims on the central bank, notes, and deposits, as reserves. By the same token, it was far simpler to settle payment imbalances between banks by an exchange of claims on the central bank than by carting gold bullion around the country. Moreover, a commercial banker that held balances with a central bank and had a long-standing customer relationship with it would be more likely to obtain loans from the central bank when there were temporary liquidity problems.

Nevertheless, the central bank was also a direct rival for the other main commercial banks during the nineteenth century, especially for the large, diversified joint stock banks that developed in the second half of the century. There are many examples of quite bitter rivalry. It was only slowly, and quite reluctantly, that the central bank shed its commercial role toward the end of the nineteenth century. Given this commercial rivalry, the idea that the central bank should have direct supervisory oversight of the commercial banks and be able to inspect their books and review their management practices, would have been unacceptable to commercial bankers at the turn of the last century.¹

The way that central banks tried to keep oversight over the stability of the banking system was to keep watch over the *quality* of the commercial bills in money markets, as it was such bills that the central bank would be requested to discount in a crisis. Indeed many central banks have strict limits on the nature and quality of assets that they can buy, rediscount, or use as collateral for their lender of last resort (LOLR) functions; this was a major reason why the Bundesbank arranged for the establishment of the Likobank in 1974, since their own capacity to undertake LOLR operations was so constrained by legal limitations. The aim of central banks was to ensure that the quality of available money market assets was good enough to enable them to inject liquidity into the banking system in case of need, without running into unacceptable danger of loss themselves. This was one of the foundations of the “real bills” doctrine. This doctrine provided a unifying basis both for the prudential/systemic and the macroeconomic policy aspects of central bank policy.² If the self-liquefying characteristics of the commercial bills were good enough, being based on real trade activities whereby the final sale of products would raise more than enough funds to repay the debt, then both the quality and, it was assumed, the volume of such debt was sustainable, and could safely be the basis for central bank market actions, including LOLR (Bagehot 1873).

So much of the early central bank prudential oversight focused on the nature and quality of bank assets, primarily in commercial bill markets, and *not* on a direct examination of the books or the management practices of other commercial banks. For example, in the United Kingdom, prior to

¹ Also see Grossman (2006).

² Though, as well-known now, the “real bills” doctrine is a misleading guide for macropolicy purposes, and has been blamed for leading the Fed astray in the Great Depression in the United States, 1929–33, see Meltzer (2003), Friedman and Schwartz (1963), and Timberlake (2007).

the Fringe Bank crisis in 1973–1974, prudential oversight in the Bank of England was the province of the Discount Office, a small section within the Cashier's Department, run by a principal with a couple of deputies. They focused their attention on the Accepting Houses, whose role then included the acceptance of commercial bills, turning them into two-name bills, and on the Discount Houses, which acted as a buffer between the commercial banks on the one hand, and the central bank on the other. The discount houses were initially fostered by the Bank of England, and used by the commercial banks, precisely because the historical rivalry between the two made direct dealings between them problematic. When that faded into the dim, historical past in the 1990s, so did the discount houses.

The Bank of England's Discount Office was meant to gather general *market intelligence*, that is, the standing and reputation of banking and credit institutions, but had no right of onsite inspection of the commercial banks. In so far as there was any authority in the United Kingdom that could examine banks' books, it lay in the hands of the Department (Board) of Trade, but was rarely utilized. The Chairmen of the big London clearing banks did come into the Bank of England to discuss their accounts and general position with the Governor, but only on an informal, nonstatutory basis.

In the United States, prudential oversight of the national banks, as contrasted with state-chartered banks, had been allocated to the Office of the Comptroller of the Currency, a part of the Treasury Department in 1864 as part of the National Banking Act. Before the foundation of the Federal Reserve System in 1913, state banks were regulated and supervised by the respective state banking authorities.

The Glass–Steagall Act [of 1933] also created the FDIC with the authority to resolve failed banks, but left the authority to close banks with their respective regulators – state, Federal Reserve, OCC – or the bank's directors. This had the effect of creating a resolution process for banks that was entirely separate from the bankruptcy process that applied to other corporations (and individuals) (Bliss 2007, 135).³

The structure of U.S. financial supervision is, as a consequence of successive acts creating separate regulatory bodies, quite a muddle, involving problems of coordination and interagency rivalry. But attempts to rationalize it have failed; each of the agencies involved has defended its own turf with some passion.

World War I not only destroyed much of the prewar international financial system, centered on the international commercial bill on London, but

³ Also see Bliss and Kaufman (2006).