Edited by Mario Baldassarri,
Michele Bagella and Luigi Paganetto

FINANCIAL MARKETS

Imperfect Information and Risk Management

Central Issues in
Contemporary Economic Theory
and Policy

General Editor: Mario Baldassarri

Financial Markets

Imperfect Information and Risk Management

Edited by

Mario Baldassarri
Professor of Economics
University of Rome 'La Sapienza'
Italy

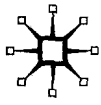
Michele Bagella
Professor of Monetary Economics
University of Rome 'Tor Vergata'
Italy

and

Luigi Paganetto
Professor of Economics
University of Rome 'Tor Vergata'
Italy

palgrave

in association with
Rivista di Politica Economica, SIPI, Rome
and
CEIS, University of Rome 'Tor Vergata'



First published 2001 by
PALGRAVE
Houndmills, Basingstoke, Hampshire RG21 6XS and
175 Fifth Avenue, New York, N. Y. 10010
Companies and representatives throughout the world

PALGRAVE is the new global academic imprint of
St. Martin's Press LLC Scholarly and Reference Division and
Palgrave Publishers Ltd (formerly Macmillan Press Ltd).

ISBN 0–333–80204–7

This book is printed on paper suitable for recycling and made from fully managed and sustained forest sources.

A catalogue record for this book is available from the British Library.

Library of Congress Cataloging-in-Publication Data
Financial markets : imperfect information and risk management / edited by Mario Baldassarri, Michele Bagella, Luigi Paganetto.
p. cm.
ISBN 0–333–80204–7
1. *Finance.* 2. *Risk management.* 3. *Capital markets.* 4. *Banks and banking.* 5. Finance—Italy. 6. Banks and banking—Italy. 7. Capital markets—Italy. I. Baldassarri, Mario, 1946– II. Bagella, Michele. III. Paganetto, Luigi.
HG173 .F5144 2000
332'.0945—dc21

00–066905

10 9 8 7 6 5 4 3 2
10 09 08 07 06 05 04 03 02 01

Printed and bound in Great Britain by
Antony Rowe Ltd, Chippenham, Wiltshire

Contents

*Introduction**

Michele Bagella - Mario Baldassarri - Luigi Paganetto
Università «Tor Vergata», Roma — Università «La Sapienza», Roma — Università «Tor Vergata», Roma

1. - *The problem of information and risk management, which is the focus of the papers presented in this volume, is a central issue in current financial and monetary economic literature. Several recent theoretical and empirical contributions consider asymmetric information between investors and financiers as a major determinant of financial risk.*

In this framework, we may regard financial and banking innovation as, on one side, policy and individual agents' response to the problem of asymmetric information and risk management and, on the other side, as a self-generated innovation process posing new challenges to policymakers in terms of informational efficiency and risk control.

The innovation process in the financial markets generates new problems in terms of efficiency and risk control. In recent years new payment systems have emerged which increased the fragility of the banking system creating growing concern about the risk associated with these innovation processes. Furthermore the increasing degree of interdependence among payment systems of the different countries may lead to contagion effect of possible crises in a multicountry framework. Thus, it is necessary to characterise the equilibrium

---

* This monographic issue contains a selection of papers presented at the V Financial Conference, *Financial Markets, Imperfect Information and Risk Management*, held at the University of «Tor Vergata» CEIS - Rome, November 28-30, 1996.

in these systems and identify the implications in terms of safety and efficiency.

In this perspective financial and banking innovation may be regarded as, either a response to the trade-off (institutional changes in bank or stock market regulation) or as an exogenous transformation of the system (introduction of derivatives) posing new challenges in the information-risk puzzle.

On the first point, we may examine how innovation in bank's reserve management, in deposit insurance regulation and how diversification of bank activities and improvement in monitoring technology represent adequate responses to the challenge.

On the second point, we should assess whether the danger of derivative trading is that of increasing the underlying asset volatility or that of increasing the individual exposition to risk of derivative trading firms.

Recent literature results seem to support more this second hypothesis showing that there is no significant increase in underlying asset volatility after derivative introduction. It seems then that derivative trading indirectly increases the exposition to risk of more risk adverse savers when non transparency vis-à-vis managers, regulators and markets creates severe information problems and the financial situation of firms trading derivatives cannot be constantly monitored.

2. - *The second viewpoint considers the banking innovation process as the policy and private agents response to asymmetric information problem and market imperfections.*

The traditional approach of economics of information in financial economics starts from the critique of the Modigliani-Miller theorem which demonstrates the equivalence of internal and external firm financing sources. This theorem cannot be reconciled with some stylised facts of economic reality such as: (i) *abnormal common stock returns at the announcement date of firms issuing equities, convertibles or bonds;* (ii) *changes in market value after changes in firms dividend policy;* (iii) *cost differentials between internal and external financing sources and bank credit rationing. The presence of market imperfections based on information asymmetries is the ba-*

sis for the neo-keynesian theory of endogenous money. Recent theoretical analyses demonstrate how informational asymmetries between financiers and investors may generate financial rationing and positive cost differential between external (bank, stock market and venture capital financing) and internal financing. Models explaining bank financing inefficiency show that the investor informational advantage may cause equilibrium credit rationing.

Models explaining venture capital financing inefficiency show that when property right shares are bargained ex ante between an investor and a venture capital financier, an imbalance between relative bargaining strengths and relative contributions to the venture generates an inefficient division of property rights with a divergence between private and social optimum.

Models explaining stock market financing inefficiency show that, for example, in markets where firm managers possess an informational advantage, a new equity issue will be considered as a negative signal from stock market investors, explaining in this way the phenomenon of abnormal common stock returns at the announcement date of a new issue. Furthermore negative externalities into an economy may be generated by an efficiently functioning stock market, when the increase in efficiency is combined with other distortions in the real economy. An example of this may occur when increasing efficiency of financial stock markets may generate inefficiency in the real economy, in the form of pressure exerted by listed companies to maintain distorsions in the market for their inputs. Such companies, for example, may take advantage in the capital market and the input market, collecting rent from their suppliers and using this rent as a subsidy which improves the overall performance of listed companies. This can exert a pressure which pushes stock prices up; the more efficient the stock market the more rapidly this positive effect over the price will spread. The example is a typical second best phenomenon showing that, if informational asymmetries and other sources of extra costs (costs of coordination and risk of loss of control for small family owned firms) prevent small-medium firms from being listed in the stock exchange, increased stock market inefficiency may exacerbate distortions between large listed firms and small unlisted firms.

These and some other issues presented in the papers of the conference describe the potential inefficiences that may be generated by the informational problem.

Bank, stock market and venture capital financiers can reduce financing inefficiencies only by increasing their bankruptcy risk unless the informational asymmetry is directly solved. More informational efficiency could then shift the «financial inefficiency-financial intermediaries' risk» trade-off with positive effects on both risk management and investment financing.

This is, in our opinion the most important direction for research on banking and finance for the next years and this is the direction in which, we hope, the conference papers collected in this volume, have concentrated their effort with success.

3. - *The selection of discussed papers which are included in this volume is divided into three sections. The first* Imperfect Information, Financial Markets and Financial Intermediation: Empirical Analysis *deals with theoretical and empirical analyses on the functioning of the banking system and on bank-firm relationship in a framework of imperfect information. The second* Risk Management, Banking System and Financial Markets *deals with new approaches to management and evaluation of risk in its different facets: exposure to asset price and return variability of financial institutions' portfolios including derivatives, borrowers' insolvency risk and consequent evaluation of non performing loans in bank lending portfolios, exposure to currency risk for firms whose present and expected assets and liabilities are partly denominated in foreign currencies. The third part* Money, Finance and Macroeconomics *deals with various issues including measurement of banking system efficiency, reaction of financial markets to political and economic new and the relationship between financial and real sector in model of growth.*

I - IMPERFECT INFORMATION, FINANCIAL MARKETS AND FINANCIAL INTERMEDIATION: EMPIRICAL ANALYSIS

Portfolio Choice and Competition in the Banking System

Gabriella Chiesa*
Università di Brescia

1. - Introduction

This paper develops a model of imperfect competition for lending to study the links between firms' cost of capital, bank industrial structure and the overall availability of lending. Banking competition is imperfect in that a bank is constrained by its size. This results endogenously from bank's moral hazard vis-à-vis final investors, and it implies that the credit market equilibrium is non-Walrasian and it may entail credit rationing. The model predicts that firms' cost of capital, credit availability and banks' profit margins are linked to the cycle and to the bank industrial structure. Firms' cost of capital and banks' profit margins are higher the less capitalized and the more concentrated the banking sector, and are higher at the end of a recession when credit may be rationed.

The premise of the paper is that banks serve a special role as delegated monitors of borrowers (Diamond [5], Ramakrishnan - Thakor [8] and Boyd - Prescott [2]). Banks' intermediation activity is valuable in that it avoids the duplication of monitoring costs

* The author, Professor of Economics, is grateful to John Moore for most helpful advice and suggestions, and to Sudipto Bhattacharya, Mike Burkart, Vincenzo Denicolò, Mathias Dewatripont, Denis Gromb, Jorge Padilla, David Webb, Andrew Winton and Marie Odile Yanelle for discussions and comments. Financial support from CNR and MURST is gratefully acknowledged.

N.B. the numbers in square brackets refer to the Bibliography at the end of the paper.

that would be incurred with direct lending by final investors to firms, since in that case each investor would spend resources in *ex ante* monitoring (acquiring information about) the firm to lend to and eventually in *ex post* monitoring of (auditing) the firm's revenue to make sure that the loan is repaid whenever the firm has sufficient funds to do that.

However, by acting as an intermediary, i.e. by investing final investors' funds, a bank is subject to moral hazard problems vis-à-vis final investors, in that it may find profitable to underinvest in the monitoring of the firms to lend to betting on the lucky event that these firms succeed in repaying their loans.

If all risk were diversifiable, then banks' moral hazard problem would be solved at no cost. The outcome of a fully diversified credit portfolio is in fact certain and fully determined by a bank's choice of monitoring. Thus if a bank were underinvesting in monitoring it would be insolvent with probability one, and this is sufficient to make undermonitoring an unattractive option all together (Diamond [5]).

In a more realistic scenario not all risk can be diversified away, i.e. the returns of the projects that bank loans fund are not all independent[1]. One important reason that prevents fully diversified credit portfolios is systemic (macroeconomic) risk. Firms are more likely to succeed and repay their loans when the economy is booming than in a recession, since in a recession only the firms that are fit are likely to succeed and honor their debts. With systemic risk, a bank's *ex post* credit-porfolio return is then necessarily uncertain and state dependent, it is higher in a boom than in a recession. This makes undermonitoring, i.e. underinvesting in sorting out the firms that are fit, an attractive option, because there is scope for betting on the lucky event that firms, no matter their type, repay. Furthermore, this option is more attractive the larger is the amount of lending that a bank undertakes, since the profits it makes in the fortunate event that firms repay are increasing in the number of firms it has financed. This suggests that limitations to bank's lending reduc-

[1] This prevents delegation costs being eliminated through diversification and provides a scope for intermediaries putting at stake their own capital (HOLMSTROM B - TIROLE J. [7]).

es the profitability of undermonitoring, i.e. incentivate a bank to take good risk by investing sufficiently in information acquisition about the firms to lend to. We study the credit market equilibrium for this economy and find that in an equilibrium final investors, or under deposit insurance the Regulator, ration a bank's availability of funds so as to constrain the bank not to lend in excess of a (well defined endogenous) ceiling. A bank's lending ceiling is determined by the amount of capital a bank is endowed with and by (its choice of) the lending rate. The intuition for this result is that bank capital and bank's lending rate substitute and complement each other in defining the penalty that a bank suffers by underinvesting in monitoring, since by so doing it increases the likelihood of being insolvent and forgoing its capital and loans' revenue.

Banks compete in prices for loans to firms. Because banks are subject to lending constraints, this competion is imperfect and its outcome, i.e. banks' profit margins, firms' cost of capital and aggregate lending, is linked to the cycle and to the bank's industrial structure. The driving force for these results is that limitations to a bank's size provide banks with market power. Even in the event that a bank has set its lending rate above the ones set by its competitors, it still faces a (captive) market, i.e. it lends to the firms that by having been unable to obtain loans at better terms have no choice other than borrowing at the highest rate. This induces a bank to set its rate above the zero-profit level, and the more so the bigger is the size of its captive market, i.e. the higher is the overall demand for lending and the smaller is the amount of lending that a bank's competitors can undertake. The latter is ultimately determined by the number of competitors that a bank faces and the amount of capital they are endowed with. We find that the lower is banks' aggregate capital relative to the aggregate demand for lending and the more concentrated is the banking sector, the higher are the equilibrium values of firms' cost of capital and banks' profit margins. Banks' profit margins widen at the end of a recession, when banks have suffered loans' insolvencies (decumulated capital), and credit may be rationed.

The rest of the paper is organized as follows. Section 2 presents the model. Section 3 studies the game that is played when a bank raises financing to fund its lending. The solution defines the lend-

ing constraint that a bank faces when it competes in the lending market. Section 4 studies interbank-price competition for loans and characterizes the credit-game equilibrium as a function of the banks' aggregate capital, the aggregate demand for lending and the degree of concentration of the banking sector. Section 5 concludes.

2. - The Model

Imagine a credit market consisting of M entrepreneurs – firms –, I investors, n banks and lasting a single period. We shall name bank i, B_i $i = 1, 2, \ldots n$. Everybody is risk neutral and maximizes the expected value of his wealth at the end of the period. Each entrepreneur can undertake one investment project that requires one unit of resources, but is endowed with zero wealth. Each investor is endowed with $1/m$, $m > 1$, units of resources that can be either stored at zero net return or deposited into a bank. Investors are in large number ($mI > M$). A bank, B_i, lends to entrepreneurs and borrows from investors. Banks are endowed with an amount of aggregate capital, TA, that satisfies $TA > 0$, and is symmetrically distributed among banks, i.e. B_i is endowed with $A_i = A = TA/n$, $\forall i$. Additional capital is expensive (see Smith [9] for a survey of evidence on the cost of issuing equity), as a matter of simplicity it is prohibitively high.

2.1 *Project Technology*

Banks' lending consists of project financing. A project requires one unit at the beginning of the period and delivers a (random) return at the end of the period. The realization of this return depends on the macrostate realization at the end of the period, $s \in (s_u, s_d)$ where s_u, occurs with probability p, and the project type, $i \in (g, b)$. A type g project delivers an observable and verifiable return of x both in s_u, and in s_d, a type b project delivers an observable and verifiable return of x in s_u and of zero in s_d. The probability according to which a project funded by a bank is of type g depends upon the bank's choice of action $a \in (m, nm)$ where m indicates «monitoring», and nm «non-monitoring», i.e.:

$$\text{prob}\,(i = g \mid a = m) = \alpha$$

$$\text{prob}\,(i = g \mid a = nm) = l$$

Bank's monitoring costs $F > 0$. This cost is a non-pecuniary effort cost that bears on the bank.

An unmonitored project is negative in net present value, assumption *A*1:

$$px + (1 - p)lx < 1 \tag{1}$$

A monitored project is positive in net present value, assumption *A*2:

$$px + (1 - p)\alpha x > 1 + F \tag{2}$$

Assumption *A*3: a bank's choice of action is unobservable.

The crucial ingredients of the model above are: *a*) the average loan return is uncertain (its realization depends on the macrostate realization); *b*) there is an action that a bank can take, which is unobservable and costly to a bank that positively affects loans' return realizations.

This action could be one of *ex-post* monitoring, like providing services tailored on the firm, or constraining the entrepreneur's choice of project by agreeing on the appropriate debt covenants with the entrepreneur and then monitor they are fulfilled[2]. Alternatively, it could be one of *ex-ante* monitoring, like costly testing the credit-worthiness of an entrepreneur in an (adverse-selection) environment where the percentage l of the population of entrepreneurs are endowed with type g projects, the remaining, $1 - l$, with type b projects, and the test result is either success or failure[3].

---

[2] This would be the case if an entrepreneur undertaking a type b project would enjoy private benefits, and these benefits were large enough to induce the entrepreneur, if unconstrained, to always choose the type b project.

[3] In which case, F is the cost of performing a test divided by the probability that the test result is success; $\alpha = \text{prob}\,(i = g \mid a = m)$ is the probability that the project type is g conditional upon the test result being success.

2.2 *The Credit Game*

Banks, entrepreneurs and investors play the following extensive-form game.

Stage 1: interbank-price competition for loans. 1*a*) B_i announces R_i, gross rate per unit of lending, $i = 1, 2...n$; 1*b*) firms choose which bank(*s*) to apply for loans, and contingent upon being accepted by more than one bank, which bank to borrow from. B_i, $\forall\, i$, chooses how many firms' applications to accept.

The outcome of the game at stage 1 determines B_i'*s* lending rate, R_i, and volume of lending, L_i.

Stage 2: banks raise financing. B_i seeks deposit financing of amount $D_{di} = L_i$, and offers investors R_{di}, gross rate per unit of deposits, $i = 1, 2,...n$; investors observe R_i, L_i, R_{di}, A and choose whether to apply for a deposit contract with B_i[4].

Let D_{si} denote the aggregate quantity of funds that are offered to B_i at stage 2, and let D_i denote the aggregate quantity of funds that B_i effectively raises at stage 2. Then $D_i = \min (D_{di}, D_{si})$ and the total amont B_i's resources available for the execution of its lending contracts equals D_i. If $D_i < L_i$, then B_i defaults on its lending, B_i is bankrupt and the game for B_i ends. If $D_i \geq L_i$, then B_i has sufficient funds to meet its contractual obligations with firms and B_i reaches the following stage 3 of the game.

Stage 3: project monitoring. If $L_i > 0$, then B_i privately chooses how much to invest in project monitoring $\beta_i L_i F$, $0 \leq \beta_i \leq 1$, $i = 1, 2...N$[5].

Notice that B_i choosing β_i effectively chooses the riskiness of its lending portfolio. This is decreasing in β_i and socially optimal at $\beta_i = 1$.

---

[4] Alternatively, the bank could sell all or part of A in order to fund its lending and consequently reduce the amount borrowed from external sources. However it is easy to show that under this second alternative the bank's expected payoff would be exactly the same as in the case developed in the paper.

[5] Since B_i'*s* action, i.e. B_i'*s* choice of β_i, is unobservable, the timing of B_i'*s* choice of monitoring is irrelevant, and a game form where B_i chooses β_i contingent on R_i, R_{di}, L_i at the outset, is by all means equivalent to the one defined in the paper.