Institutional Risk Management, Financial Fragility and Market Structure in the Banking Firm: Theories, Regulation Effects and International Evidence

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ABSTRACT

We study the behaviour of banking intermediaries focusing on the joint *relationships* among risk management, fragility and the market structure. Theoretically, we use the industrial organisation approach to analyse the relationships between banking behaviour and risk management goals and between banking behaviour and regulation effects. We develop and calibrate models to study the monopolistic competition effects on banking stability and to study the effects of asset and liability uncertainty on banking decisions. We extend such analyses to study the effects caused by portfolio restrictions and deposit interest-rate regulations on banking behaviour. Empirically, we characterise the financial and banking stylised facts associated to stable and unstable banking systems. Furthermore, we assess among competing theories and policy views regarding the relationships between banking stability and management practices, and between fragility and banking market structure. The empirical study relies on OLS regressions and random effects logit models for panel data. The dataset includes data for a sample of 47 countries during the period 1990-1997.

Theoretically, we show that the *optimal risk management asset allocation* for banking firms *depends on the banking market structure*. We also show that the maximisation of long-term profits and the minimisation of financial distress are *complementary* and *compatible* management objectives. Furthermore, our findings suggest that the achievement of *banking and regulatory goals may depend on the degree of competition* in the banking market. Moreover, they also suggest that interest-rate instruments may be better than asset portfolio restrictions as regulatory devices. Empirically, our findings suggest that *financial development is associated with market-based financial systems* and *non-competitive banking systems*. We also provide evidence that banking *competition enhances fragility*. Furthermore, the analyses reject the bank-based policy view regarding the relationship between financial system and banking stability. Hence, the use of derivatives and cross-sectional risk sharing techniques might encourage stability.

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CHAPTER 1
INTRODUCTION

Banks perform essential activities for the economy. Banking activities aim to provide access to liquidity and payment services, to transform assets, to manage risks and to monitor and process information. The necessity of these activities, and the existence of intermediaries, is justified by the incompleteness of financial markets and because of the real services that the intermediaries provide to depositors and borrowers. Adequate banking activities and services are necessary to guarantee an efficient allocation of resources in the economy.

Given the importance of intermediaries´ activities, banking behaviour concerns academics and practitioners alike. Paradoxically, it has been recognised that little research has been developed to explain the behaviour of intermediaries. According to some economists, "many current theories of intermediation are too heavily focused on functions of institutions that are not longer crucial" [Allen and Santomero (1997: p.1461)]. However, it also seems that there is a consensus that the reconciliation between intermediation theory and the observed behaviour of the intermediaries may be achieved through the analysis of their risk management goals [Scholtens and Van Wensveen (2000)].

In this thesis we study the behaviour of banking intermediaries focusing on the *joint relationships among risk management, fragility and market structure*. We analyse these relationships under the assumption that these relationships delimit the activities and decisions of the intermediaries. We do this because current intermediation theory has dealt with these behavioural relationships only on a partial basis.

Theoretically, we analyse these relationships postulating two behavioural principles. The *compatibility principle* assumes that the intermediaries' behaviour can be understood in terms of the compatibility of their risk management goals with the

economic and financial environments within which they operate.[1] The *interdependence principle* assumes that banking behaviour depends on the joint relationships, or interdependence, among risk management practices, fragility issues and the features of the banking market structure.[2] These principles act as the main guideline assumptions on the development of this research. Moreover, they also define an "institutional perspective" for analysing banking institutions.

Analytically, the research follows the theoretical guidelines of the industrial organisation approach to banking, and the theory of comparative financial systems.[3] Specifically, we use the industrial organisation approach to theoretically analyse the microeconomic relationships between banking behaviour and risk management goals and between banking behaviour and financial regulation effects. We use the theory on comparative financial systems to empirically analyse the aggregate relationships among financial and market structures, development and banking crises. Academically, we justify this duality under the basis that both guidelines provide complementary elements to understand the behaviour of intermediaries.

For microeconomic analytical purposes, our research defines banking intermediaries as firms that maximise profits by managing risks. [4] The relevance of this definition relies on the associated implication that the behaviour of the intermediaries may be understood in terms of the nexus between their risk management activities and the search for profitability.[5] This definition allows us to build a microeconomic framework to study the behaviour of the intermediaries, based on industrial organisation tools. A modelling framework able to take into account the existence of imperfect competition, multiple uncertainty, liquidity and solvency risks and the availability of liquidity-risk contingent strategies.

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[1] This principle is based on specific suggestions about how financial intermediation theory could be amended [See Scholtens and Van Wensveen (2000)].

[2] This principle is postulated under the basis that banking constraints are imposed by a bank's customers, by its competitors and by the nature of their activities.

[3] See Freixas and Rochet (1997) and Allen and Gale (2001) for introductions to the industrial organisation approach to banking and the theory of comparative financial systems, respectively.

[4] This definition relies on the consideration that " The management of risks, in the full acceptation of the term, can be seen as the major activity of banks" [Freixas and Rochet (1997: p. 221)].

[5] We emphasise this feature because, it has been recognised that "the risk/reward relation has not yet been analysed on an industry level or on a macroeconomic level" [Scholtens and Van Wensveen (2000: p. 1247)].

Analytically, the framework provides us with a tool to study of the risk management decisions and to study banking regulations (the key managerial issues in banking). Regarding the management decisions, we focus on the microeconomic effects of uncertainty and market structure and the likelihood of short-term stability and long-term profitability of the intermediaries.[6] Regarding banking regulation, we focus on the effects of specific regulations on the viability, solvency and profitability of the asset transformation process.[7] We develop the analyses of these issues with variations of the basic microeconomic framework.

For aggregate analytical purposes, our research defines an econometric methodology to analyse the relationships among risk management, fragility and banking market structure based on currently available financial and banking data. This methodology is based on analyses of indicators of episodes of systemic and borderline banking crises, financial development, and financial and banking market structure.[8] Econometrically, the research methodology is based on the analysis of sets of OLS regressions and qualitative models for panel data. Banking and financial data for a sample of 47 countries, during the period 1990-1997, are used for the empirical assessments.

The main aggregate issues that we empirically analyse relate to the *characterisation of the financial and banking stylised facts* associated with stable and unstable banking systems. [9] They also relate to the *assessment of competing theories and policy views* regarding the relationships between banking stability and management practices,[10] and

[6] Notice that "Most current theories of intermediation have little to say about why risk management should play such an important role in the activities of the intermediaries" [Allen and Santomero (1997: p.1465)].

[7] The relevance of such analyses, regarding the effects of banking regulation, relies on the academic recognition that "the possible impacts of regulation on the industry are in dispute" [Rose (2002: p. 36)].

[8] We build these indicators using panel-data extracted from the cross-country database on financial development and structure [Beck, Demirguc-Kunt and Levine (2000)], and from the database on episodes of banking crises [Caprio and Klingebiel (2002)].

[9] Regarding banking stability, it has been indicated that: "Aspects such as the degree of capitalization of banks, the degree of concentration and the structure of competition of the market for credit, the liquidity of the interbank market and of the bond market, the ownership structure of the banks (public versus private), and the quality of regulatory supervision are likely to play an important role in breeding banking crises, but they are neglected here because of lack of data." [Demirguc-Kunt and Detragiache (1998a: p. 105)].

[10] Controversies and debates around financial structure and economic performance have been registered since the nineteenth century [Goldsmith (1969)]. Such controversies usually focus on the relative merits

between fragility and banking market structures.[11] In both cases we use individual indicators and principal-component indexes to develop the econometric analyses.

Academically, our research is motivated by theoretical and policy concerns. Specifically, from a theoretical point of view, this research is motivated by the necessity to reconcile the observed behaviour of banking intermediaries with intermediation theory. From a policy point of view, our research is motivated by the demands for soundness and safety from the intermediaries and by the necessity to design optimal banking systems. Given that our interest relies on the banking decisions and actions for theoretical and policy purposes, institutional risk management considerations permeate this research.

The concrete microeconomic questions that we explore are the following: What is the relevance, if any, of the study of the joint relationships among risk management, fragility and market structure? How may the industrial organisation approach to banking be used to develop a framework to analyse such relationships? What are the effects of market structure determinants and uncertainty on optimal risk management decisions? Is there any justification to support the claims that asset-liability management practices and banking regulations are irrelevant? Does the competitive environment affect the risk management optimal decisions or the effects that regulations may have on regulated institutions? Which may be better regulation practices, those that impose portfolio restrictions or those that impose restrictions on market instruments?

The corresponding aggregate questions are the following: What are the theoretical foundations that relate financial systems with the behaviour of banking intermediaries? What are the competing theories and policy views for designing stability-enhancing banking policies? How can we build a framework to analyse such theories? What are

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of banking institutions or financial markets to lead the financial development process. More recently, Merton and Bodie (1995) and Levine (1997) have rejected such a dichotomy arguing that financial development reforms should encourage the creation of an environment in which intermediaries and markets could provide financial services.

[11] Historically, it has been considered that competition in the banking markets enhances financial fragility [Friedman and Schwartz (1971)]. However, some authors' views explicitly differ from this

the financial and banking stylised facts associated with stable and unstable banking systems? What are the relationships among financial structure, financial development and banking market structure? What does the empirical evidence show us about the relationships among risk management, fragility and banking market structure? Which risk management and policy views may be better to avoid systemic banking failure, according to international evidence?

We explore the above research questions in the subsequent five chapters. In each chapter we define the specific questions explored, the theoretical and empirical background, the analytical framework, and their associated conclusions. Particular attention is paid to the limits and scope of the conclusions and on the discussion of the theoretical and policy implications associated with them. Given that each chapter focuses on specific research questions, this thesis may be considered as a collection of relatively independent and self-contained essays.

Concretely, in Chapter 2 we offer an overview of the literature that has been written about the behaviour of financial intermediaries, focusing on the relationships among institutional risk management, financial fragility and market structure. We do this by dividing such literature in two main areas. The first area includes studies that have analysed, the microeconomic relationships between banking behaviour and risk management goals, and between banking behaviour and financial regulation. The latter area includes studies that have focused on the aggregate relationships between financial structure and banking behaviour, and between the banking industry and banking crises. In both cases, we include theoretical and empirical investigations.

In Chapter 3 we develop the basic microeconomic framework to analyse how former asset decisions and the subsequent availability of liquidity-risk contingent strategies, influence the viability of the intermediaries' asset transformation process and the solvency of banking firms. We achieve this goal through the study of the inter-temporal asset decisions that monopolistically competitive intermediaries take to maximise long-term profits and avoid bankruptcy costs. Particularly, we focus on the

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position by stating that competitive banking systems can "mitigate the risks of financial crises" [Claessens and Klingebiel (2001: p. 19)].

bank-risk management process. The process includes firm interactions in the deposit market, uncertainty on both sides of the balance sheets, and the necessity to deal with solvency and liquidity risks associated with the financial structure of the intermediaries.

In Chapter 4 we study the profit maximising behaviour of banks that manage short-term and long-term assets; that face uncertainty on both sides of their balance sheets, and that develop their activities under imperfect competition in the deposit market. We analyse the ex-ante optimal banking decisions, focusing on the effects of the number of monopolistically competitive institutions in the banking system, and on the effects of uncertainty. We develop the analysis using the, previously presented, microeconomic framework and two simplified monopolistic versions of it. Specifically, we use the former basic framework to study monopolistic competition effects on banking stability, while the two variations are used to study the specific effects of asset and liability uncertainty on banking decisions.

Academically, the main achievement of both chapters consists of the development of tractable models to analyse the joint relationships among risk management, fragility and banking market structure. We believe that the analytic derivation of the reserves/deposits allocation that maximises profits and that minimises short-term fragility is particularly important because it shows that the *optimal asset allocation* of banking institutions *depends on the existing market structure* of the banking industry. Another important contribution relates to the clarification that the maximisation of long-term profits and the minimisation of financial distress are *complementary* and *compatible* management objectives.

In Chapter 5 we analyse the effects on the intermediation process of portfolio restrictions and deposit interest rate regulations. More specifically, we study the effects on liquidity and solvency risks caused by reserve-ratio and deposit-return requirements. We investigate the effects of such regulations on banking intermediaries using two variations of the basic framework. We use one variation to analyse the effects of required reserve ratios on the optimal behavioural banking decisions, the likelihood of liquidity and solvency risks, and the viability and long-term profitability

of the asset transformation process. Regarding the second variation, we use it to analyse the corresponding effects of deposit-rate requirements.

The analyses of the effects on the likelihood of liquidity and solvency risks suggest that the achievement of *banking and regulatory goals may depend on the degree of banking competition* in the banking market. Specifically, our research findings suggest that deposit-return ceiling regulations may be better than minimum reserve requirement regulations due to the existence of differentiated effects. Interestingly, our research findings *justify regulatory practices*. Moreover, they also suggest the use of interest-rate instruments as regulatory devices, instead of asset portfolio restrictions, because they eliminate the possibility of differentiated, and undesirable, risk effects regarding the viability, solvency and profitability of intermediaries.

In Chapter 6 we investigate the aggregate empirical relationships among risk management, banking fragility and banking market structure based on the theory of comparative financial systems. Concretely, we characterise the financial and banking stylised facts associated with stable and unstable banking systems, and we assess competing theories and policy views regarding the relationships between banking stability and management practices, and between fragility and banking market structures. Methodologically, the investigation uses OLS regressions and random effects logit models for panel data.

Our research findings suggest that *financial development is significantly associated with market-based financial systems*. Our findings suggest that banking crises *are more likely* in bank-based financial systems and that *financial development enhances banking stability*. Regarding banking market structure, we provide some evidence that banking *competition enhances fragility*. Interestingly, the regression sets provide evidence rejecting the bank-based policy view. Hence, the use of derivatives and cross-sectional risk sharing techniques might be better to encourage banking stability.

Finally, in Chapter 7 we summarise our research findings and suggest some ideas for developing further research.

CHAPTER 2
LITERATURE REVIEW

2.1. Introduction

In this chapter we offer an overview of the literature that has studied the behaviour of financial intermediaries focusing on the relationships among institutional risk management, financial fragility and market structure. We do this by dividing such literature in two main areas. The first area includes studies that have analysed the microeconomic relationships between banking behaviour and risk management goals and between banking behaviour and financial regulation. The latter area includes studies that have focused on the aggregate relationships between financial structure and banking behaviour and between the banking industry and banking crises. In both cases, we include both theoretical and empirical investigations.

We focus on such relationships under the hypothesis that the intermediaries' behaviour can be understood in terms of the compatibility of their individual risk management goals with the economic and financial environments.[1] We concentrate on the *interactions* of: institutional risk management practices, the likelihood of banking fragility and the market structure. Instead of concentrating on the more traditional concern about how these specific elements may affect other agents, we review how the *relationships* among these factors can explain the behaviour of banking firms. [2] However, our review is not comprehensive. Basically it aims to show the scope, limits and possibilities of current research.

We develop this overview under the guidelines of the industrial organisation approach to intermediation, and the theory of comparative financial systems. Specifically, we use the industrial organisation approach to describe the relationships between bank behaviour and risk management goals and between bank behaviour and regulation

[1] Risk management goals relate to the maximisation of profits and the minimisation of financial distress. We consider both goals as equally important because they concern to bankers and regulators alike. Evidently, depending on the context, a particular goal may be more relevant than the other.

[2] Several surveys and textbooks show how these elements may affect banking customers, regulatory and policy design or the overall economy [See Bhattacharya and Thakor (1993), Freixas and Rochet (1997),

practices. We use the theory of financial systems to describe the relationships between financial structures and development with banking behaviour, and between banking market structure and banking crises. Thus, we offer an overview on different aggregation levels. In both cases, institutional risk management considerations permeate the analysis.[3]

The broad questions that we explore in this chapter are the following: Why is it important to analyse the relationships among risk management, fragility and banking market structure? How may bank behaviour and risk management be related? What are the effects of market structure determinants on banking fragility? Is banking regulation necessarily a good thing? What are the most common banking management and regulatory practices? Does the nature of the financial system affect banking behaviour? What are the most common types of banking crisis studies?

Our review shows that we are far from a consensus regarding most of the above questions. Theoretically, it seems *that the main consensus relates to the necessity to develop further theories on risk management issues in order to reconcile intermediation theory with the observed behaviour of the intermediaries in the financial markets*. Regarding applied practices, we show that *regulatory and banking practices seem to depend on national considerations*. We are still far from a consensus regarding the desirable standard practices that could define adequate banking and regulation practices. However, we also show that the industrial organisation approach to banking seems to offer the tools to study the above relationships, from an analytical framework.

From an aggregate view, we show that theory and evidence seem to support the idea that *banking behaviour depends on the main features of the financial systems*. Theoretically, we show that some controversies exist around the financial structure reforms that may be good for an economy. However, we also show that some studies

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Mishkin (2000)]. Paradoxically, it is rarely, if ever, mentioned how the interactions between them may influence intermediaries' behaviour.

[3] Institutional risk management focuses on the institutional practices that intermediaries develop to perform their activities. It does not focus on the specific operative tools and models available to deal with risk. See Appendix for chapter 2 for an introduction to institutional risk management theory.

support the idea that risk management practices should be differentiated according to the financial structure and the degree of financial development. Competition, between banks and markets and between banks themselves, determines this differentiation. Empirically, we show that further research is needed to understand the nexus between financial structure and banking behaviour.

The chapter is divided in five sections. Section 2.2 reviews the theories and controversies around the relationships among risk management, financial fragility and market structure using the industrial organisation approach. Specifically, it focuses on the relationships between banking firm behaviour and risk management goals and between banking behaviour and regulation. Section 2.3 reviews the empirical findings regarding the previously described relationships. Section 2.4 describes some relationships between nature of the financial system with the banking intermediaries. Specifically, it deals with the relationships between financial structure and development with banking behaviour and between banking behaviour and fragility. Section 2.5 summarises and discusses the main results. Finally, the appendix of the chapter focuses on banking risks and institutional risk management theory.

2.2. Theoretical issues on risk management, banking fragility and market structure

In this section we review the microeconomic theories regarding the relationships among risk management, banking fragility and market structure. First, we analyse such theoretical relationships in the context of the nexus between banking firm behaviour and risk management goals. Then we analyse them in the context of the nexus between banking behaviour and regulatory aims. We base our review on analyses developed from the perspective of bankers and regulators to point out the relevance and scope of current theories and to suggest ideas for further research.

2.2.1. Banking firm behaviour and risk management

Risk management goals relate to the provision of liquidity, the acquisition of assets with an acceptable level of risk and of funds at a low cost in order to achieve the highest profit. Banks search for profits offering liquidity, credit and payment services,

transforming assets and processing information. These considerations give us the key definition to understand the behaviour of banks for analytical purposes. *Banking intermediaries are firms that maximise profits by managing risks.* [4]

Surprisingly, traditional theory *does not* define banks as firms that perform specific activities, but as specialised agents that provide financial services.[5] The reason relies on the prominence of a "functional perspective" regarding how financial intermediaries should be defined.[6] Our definition relies on an "institutional" one. Under the latter, it is postulated that the study of intermediation activities should be the departure point to understand the behaviour of banking institutions. The availability of theories of the banking firm based on borrowing and lending activities support "institutional perspective" approaches to analyse banking institutions. [7] But also they suggest that the industrial organisation tools may be adequate to analyse them.

According to the theory of the firm, the decisions and actions of banking institutions should be delimited by technological, economic and market constraints. In the banking industry, adequate decisions and actions depend on making compatible the risk management goals of the banking firms with the prevention of fragility under the existing market environments. Both considerations suggest that an indirect approach to analyse banking behavioural issues relies on the study of the specific *relationships* that delimit the activities and decisions of banking firms. Specifically, we believe that the

[4] Evidently, this definition mainly refers to commercial banks. Other banking intermediaries, like mutual and development banks, do not necessarily have profitability aims. Theoretically, we adopt this definition to analyse intermediaries´ behaviour in terms of the specific nature of banking activities. Here it is interesting to point out that, in spite of that management of risks is a key area of intermediaries' activities, "current theories of intermediation have little to say about why risk management should play such an important role in the activities of the intermediaries." [Allen and Santomero (1997: p.1465)]. Moreover, in what concerns the nexus between risk management and profitability, it has been indicated that "the risk/reward relation has not yet been analysed on an industry level or on a macroeconomic level" [Scholtens and Van Wensveen (2000: p. 1241)].

[5] See Freixas and Rochet (1997), Mishkin (2000) and Rose (2002) for some definitions.

[6] A "functional perspective" is a methodological approach to analyse financial systems and intermediaries. Specifically, it is one that focuses on the services provided by the financial system, rather than on the activities of existing institutions. See Merton and Bodie (1995).

[7] The theory of the banking firm relies on the works of Klein (1971) and Monti (1972). The Monti-Klein model analyses the behaviour of a monopolistic bank that sets its volume of deposits and loans.

relationships among risk management, financial fragility and market structure may be among the most important for understanding the behaviour of banking institutions.[8]

Probably, the most studied relationship is the one among banking behaviour, market structure and financial fragility. Paradoxically, there is no consensus about the nature of this relationship or about its implications for economic policy. [9] This seems relatively strange because policy-makers usually deal with competition and banking stability issues at the same time. Academically, the "banking competition and fragility" literature provides several arguments for and against promoting competition according to the approach used to study banking institutions.[10] Thus, the literature implies that the relationships among banking behaviour, fragility and market structure determinants are not univocal or straightforward.

Studies on the relationship among banking behaviour, risk management and fragility relate to the avoidance of financial distress costs. Theoretically, it has been suggested that such costs rationalise the intermediaries' behaviour and their risk management activities.[11] Specifically, in the banking industry, these costs may be important because they can be associated to license or charter withdrawals and the loss of monopolistic positions [Allen and Santomero (1997)]. Studies on why banks may choose low risk strategies under this rationale include Marcus (1984) and Santomero (1989).

Theoretical studies on the relationship among banking behaviour, risk management and market structure rely on the industrial organisation approach to banking.[12]

[8] We include fragility issues because the prevention of financial distress is the most accepted economic rationale for risk management activities [Allen and Santomero (1997), Scholtens and Van Wenveen (2000)]. Notice that, from the point of view of banking entrepreneurs, risk management activities provide the means to maximise profits and to minimise financial distress in the banking markets. From the view of regulators, these activities provide the means to allocate resources and to avoid financial crises in the economies.

[9] Recent surveys on this relationship are Canoy et. al (2001) and Carletti and Hartmann (2002).

[10] The hypothesis that competition enhances financial fragility has found support in analyses focused on banking liabilities and deposit insurance for individual banks [Matutes and Vives (1996) and (2000)]. The opposite hypothesis argues that competition may enhance stability by reducing information asymmetries or by increasing liquidity provisions through inter bank markets [Caminal and Matutes (2002) and Bossone (2001)].

[11] Bankruptcy costs induce firms to avoid risks by modifying the firms' objective functions.

[12] Banking firm models that fall into this category are Dermine (1986) and Prisman, Slovin and Sushka (1986). The relevance of these models is that extend the Monti-Klein framework to include risky assets

Basically these studies have analysed issues regarding the optimal lending and borrowing decisions and the justification of certain regulations.[13] The main feature of these studies is that they describe intermediaries as independently agents that optimally react to their environment to maximise profits. However, this literature is not very extensive. The microeconomic analysis of banking usually relies on asymmetric information studies.

We believe that the analysis of the relationships among risk management, financial fragility and market structure can deal with recent behavioural concerns. The latter include concerns regarding the financial intermediary as an entrepreneur, the effects of regulation policies, risk/reward optimisation and risk management for mentioning some relevant ones.[14] This is necessary given the recognised academic necessity to reconcile intermediation theory with the observed behaviour of intermediaries in the financial markets [Scholtens and Van Wensveen (2000), Allen and Santomero (1997) and (2001)]. Evidently, a further reason relies on public demands to promote better banking systems and banking practices.

2.2.2. Banking behaviour and financial regulation

Traditionally, banking behaviour and the need for regulation are closely related from the view of policy makers. In most countries, the regulation of banking activities is more comprehensive than for other economic sectors. The regulation of banks is done under the basis that banking problems may carry repercussions of social nature in addition to the ones of private one [Freixas and Rochet (1997), Goodhart et al. (1998)]. Essentially, the conventional argument for regulation states that banking problems not only may affect depositors, stockholders and borrowers but also they may affect financial and non-financial firms and the security of the payment system.

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and liquidity risk. Specifically, the former model allows borrowers to default. The second one introduces randomness in the volume of funds distributed by the bank.

[13] In the literature, the analysis of these issues relates to the "separability property" problem. The separability property is a result associated to the Monti-Klein banking firm model. Basically, it states that the borrowing and lending optimal decisions are independent one of the other. The relevance of this result relates to regulation practices. The property implies that regulations imposed on deposit rates will *not* decrease the rates that banks charge to borrowers.

[14] See Scholtens and Van Wensveen (2000) for a detailed list of concerns of regarding the state of the art of current intermediation theory.

Regulation is necessary to avoid these potential problems and to deal with the market on failures that may exist in the financial markets [Stiglitz (1994)].

Paradoxically, the theoretical nexus between banking behaviour and financial regulation is not well defined [Freixas and Santomero (2004)]. Given that regulations modify the behaviour of banks by constraining their activities and operation modes; it seems obvious that regulations may be relatively undesirable for them. However, this is not necessarily the case. Stigler (1971) argues that firms in regulated industries actually seek out regulation because it brings benefits in the form of market entry barriers. Moreover, Caminal and Matutes (2002) suggest that regulation, by reducing the degree of competition, may enhance risk-taking activities and the likelihood of banking crises under certain circumstances. Free-banking economists have supported the latter view.[15] This situation has been summarised by Rose (2002: p. 36) who indicates "While the reasons for bank regulation are well known, the possible impacts of regulation on the industry are in dispute".

Behavioural banking models under regulation are relatively scarce in the literature. Regulation models usually focus on the financial and economic environments, rather than on the behaviour of the banking firm under regulation.[16] Even when these studies focus on banks, they usually analyse the effects of regulations on macroeconomic settings.[17] Behavioural models have been used to analyse the impact of deposit rate banking regulations on deposit rates and the recomposition of banking portfolios due to solvency regulations [Freixas and Rochet (1997) and Kim and Santomero (1988), respectively]. Interestingly, the relationships among risk management, financial fragility and market structure with respect to banking behaviour have been considered only on an individual basis by the regulation literature. The study of the joint relationships still needs to be addressed by researchers.

[15] See Dowd (1996a) and (1996b), Benston and Kaufman (1996).
[16] Conventional regulation studies focus on the role of the government, the impact of regulations on depositors' welfare and systemic fragility issues. See Freixas ans Santomero (2004) for a review.

2.3. Empirical studies on risk management, banking fragility and market structure

In this section we review the evidence regarding the relationships among risk management, banking fragility and market structure. First, we review empirical studies that have focused on the nexus between banking firm behaviour and risk management practices. Then we summarise some findings regarding banking behaviour and regulatory practices around the world. Like in the previous section, we base our review on studies developed from the perspective of bankers and regulators to define the scope and limits of current research. However, here we stress the interplay between theory and data.

2.3.1. Banking firm behaviour and risk management practices

Conventionally, it is accepted that current intermediation trends relate to the development of risk management activities.[18] Specifically, descriptive data studies suggest that the banking industry has concentrated on asset trading and risk shifting activities. According to some authors, these activities have become the major and most important activity of banking institutions [Allen and Santomero (1997) and (2001)]. Paradoxically, studies regarding banking behaviour and risk management are relatively recent on the empirical literature and focus mainly in US banks.[19] However, these studies do not necessarily focus on the *joint* relationships between banking behaviour and its determinants (banking fragility, banking market structure) with their risk management practices. The reasons rely on the difficulties associated to the quantification of risks of banking institutions and data availability.[20] Thus, further research is necessary to analyse the joint empirical relationships between individual banking firm behaviour and risk management.

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[17] See Fry (1995) for a review on the debates and policy implications associated to banking regulations on macroeconomic settings. Recent examples are Hellman, Murdock and Stiglitz (2000) and Espinosa-Vega and Smith (2001).

[18] See Allen and Santomero (1997) and (2001) and Bossone (2001) for a review.

[19] Santomero (1995) provides an analysis of the risk management process in commercial banks. Rose (2002) provides several references regarding the empirical literature. However, the studies referenced mainly focus on specific risk management techniques. Interestingly, Stulz (2003) reviews studies on the empirical evidence of institutional risk management practices for non-financial firms.

[20] The quantification of risks is difficult because banking risks are less tangible and visible than income. Usually, risks remain intangible and invisible until they materialise into losses. Another difficulty relies on the absence of models for tracking risks. Rose (2002) provides references on the explanation of measuring and evaluating bank risk [Chapter five].

Studies that rely on systemic aggregate banking data have been used to indirectly analyse the microeconomic relationships between banking behavioural determinants and risk management. These studies have provided the basis to analyse, from an international perspective, the relationships between banking firm behaviour and risk management practices.[21] However, it is important to point out that these banking studies have been mainly designed to study fragility and efficiency issues on partial basis.[22] So, the evidence can only provide us with insights about the joint relationships among risk management practices, fragility and market structure with banking behaviour.

Under the above considerations, the most studied relationship is the one among banking behaviour, market structure and financial fragility. Like its theoretical counter-part, empirical studies on banking crises do not provide conclusive evidence regarding the nature of this relationship. Traditionally, the view that competition enhances fragility has found support in classic historical analyses [Friedman and Schwartz (1971)]. However, some other studies have challenged this view using international evidence [Claessens and Klingebiel (2001)]. The controversies involving these two extreme positions have been complicated by some studies that suggest that market structure determinants may have differentiated effects on banking fragility [Beck, Demirguc-Kunt and Levine (2003) and Berger et. Al. (2004)].[23] Evidently, further studies on this relationship are still needed.

The relationship among banking behaviour, risk management and fragility has also been analysed using banking crisis studies.[24] However, it can be argued against this indirect approach that the "visibility on losses is not visibility on risks" [Bessis (2002: p. xi)]. However, because these studies do not focus on risk management practices, it

[21] The World Bank Research Group has done extraordinary efforts to collect international data on financial and banking issues. These data are available at the World Bank web-site (http://www.worldbank.org).

[22] Heffernan (1995) and (2000), Demirguc-Kunt and Detragiache (1998a) and (1998b) constitute the first studies on the empirical banking fragility literature. On the empirical efficiency literature, see Demirguc-Kunt and Huizinga (2001).

[23] The main conclusions of these studies indicate that banking crises are less likely in more concentrated banking systems, when there are fewer regulatory restrictions on bank competition and when national institutions encourage competition.

can only be assumed that banking determinants reflect them. Interestingly, studies regarding the empirical relationships among firm behaviour, risk management and fragility exist for non-financial firms.[25] Thus, the study of the relationship among banking behaviour, risk management and fragility for financial firms is a relatively unexplored area.

The empirical relationships among banking behaviour, risk management and market structure have been analysed through efficiency studies [Hanson and De Rezende-Rocha (1986), Barth, Nolle and Rice (1997) and Demirguc-Kunt and Huizinga (1999)].[26] These studies usually explore the determinants of banking efficiency using international data for comparative purposes. [27] Empirical associations, like the inverse one between reserves and profitability and the inverse one between competition and profitability, have been found in these studies [Demirguc-Kunt and Huizinga (1999)]. However, there are several issues that remain relatively unexplored around the relationships among banking behaviour, risk management and market structure. Issues like the ones regarding government regulation and the determinants of bank profitability and interest margins. [28]

Evidently, the above mentioned studies have shown that the study of the relationships among banking behaviour and risk management seems a promising area for research. Traditional behavioural banking studies are related to efficiency, profitability, entry

[24] Examples are Demirguc-Kunt and Detragiache (1998a) and Hardy and Pazarbasioglu (1999).
[25] Stulz (2003), summarises sixteen empirical studies to show that the rationalisation of management activities can be explained in terms of the avoidance of the costs of financial distress and taxes and in terms of managerial incentives. Interestingly, these findings are consistent with the theories on why intermediary firms may be interested in risk management activities [See Allen and Santomero (1997) and Scholtens and Van Wensdeen (2001)].
[26] Hanson and De Rezende-Rocha (1986) discuss some of the determinants of bank costs and profits such as market structure. The Barth, Nolle and Rice (1997) examine the impact of banking powers on bank return on equity, controlling for several bank and market characteristics. Demirguc-Kunt and Huizinga (1999) examine the underlying determinants of interest rates and bank profitability.
[27] Methodologically, bank interest spreads usually are interpreted as indicators of the efficiency of the banking system on the above studies. However, it is worthy to point out that the efficiency literature provides several methodologies to analyse the above relationships from an applied microeconomic view [Lloyd-Williams, Molyneaux and Thorton (1994), Molyneaux and Forbes (1995)]. See Altunbas et. al. (2001) for a literature review.
[28] An exception is Demirguc-Kunt, Laeven and Levine (2004). They analyse the empirical relationships among financial regulation, market structure, institutions and the costs of financial intermediation.

and exit effects, competitive modelling and banking fragility [29]. They do not relate to the joint relationships among them. The relevance of the study of such relationships does not limit to academic or managerial purposes. We believe that it also extents to the design and formulation of effective financial policies.

2.3.2. Banking behaviour and financial regulation practices

In practice, banking behaviour and financial regulation practices are closely related. Everywhere, supervision and regulatory authorities put emphasis on the quality of balance sheets and the risk management process to achieve regulatory goals [Heffernan (1996), Mishkin (2000)].[30] However, it is interesting to mention that despite the consensus around the justification, instruments and goals of financial regulation, international evidence shows that less agreement exists among regulators.

Recent efforts have been made to collect information about specific financial regulation practices around the world. The most comprehensive study is the one of Barth, Caprio and Levine (2001a). Using data from surveys given to regulators, international authorities and banks of 107 countries, they compare banking regulation and supervision practices in an international context.[31] In the following table we include some of the collected questions and answers to show the differences in regulation and supervision practices regarding behavioural issues.

[29] Examples are Maudos (1998), Demirguc-Kunt and Huizinga (1999), Claessens, Demirguc-Kunt and Huizinga (2001), Jaumandreu and Lorences (2002), and Beck, Demirguc-Kunt and Levine (2003) respectively.

[30] We follow the definitions of Goodhart et. al (1998) to define regulation, monitoring and supervision. According to these definitions, *regulation* is the establishment of specific rules of behaviour; *monitoring* involves observing whether the rules are obeyed; and *supervision* is the more general oversight of financial firms' behaviour.

[31] The Barth Caprio and Levine (2001a) database compares requirements and regulatory powers regarding bank entry, ownership, capital, powers and activities, auditing, organisation, liquidity, provisioning accounting and disclosure, incentives for supervisors, deposit insurance and disciplining powers including bank exit. This database is available in the Worldbank website http://www.worldbank.org/research/interest/prr_stuff/bank_regulation_database.htm

Table 2.1 Banking Behaviour and Financial Regulation around the World

Question	Yes (Countries)	No (Countries)
Must banks disclose risk management procedures to public?	19	84
Background/experience of future managers?	97	9
Does the minimum required capital-to-asset-ratio conform to the Basle guidelines?	100	7
Does the minimum capital-to-asset ratio vary with market risk?	24	81
Is the value of loan losses deducted from loan capital?	57	47
Are unrealised losses in the securities portfolio deducted from reported accounting capital?	60	44
Are unrealised foreign exchange losses deducted from reported accounting capital?	62	40
Can initial and subsequent infusions of regulatory capital include assets other than cash or government securities?	45	57
Can the initial infusion of capital be based on borrowed funds?	34	67
Are the sources of funds that count as regulatory capital verified by the regulatory or supervisory authorities?	86	19
Are there explicit, verifiable, and quantifiable guidelines for asset diversification?	38	69
Are banks prohibited from making loans abroad?	15	91
Is there a minimum liquidity requirement?	77	26
Are there pre-determined levels of solvency deterioration that force automatic actions, such as intervention?	49	55
Notes : The table contains selected questions contained in Barth, Caprio and Levine (2001a)		

It is immediate from the table above that there are no standard regulation and supervision practices around the world. Except in what concerns the minimum capital-to-asset-ratio Basle guideline, the necessity of liquidity provisions and the necessity of experienced bank managers, banking regulation practices seem to depend on domestic considerations. Interestingly, in most economies, regulators do not modify minimum-capital-asset-ratios according to market-risk neither define explicit guidelines around asset diversification for banking institutions. This is particularly relevant because bank capital reduces the possibility that banks will become insolvent given adverse conditions, while asset diversification reduces lending and investing risks.

Barth, Caprio and Levine (2001a) show that regulation and supervision practices among economies shows certain patterns accordingly to their level of income. Concerning risk management issues, they indicate that restrictions in banking activities decline and the degree of private monitoring increases as the income raises in the studied economies. They also indicate that the stringency of capital requirements and loan classification is lower in low-income economies than in high-income ones, while the reverse holds with respect to the stringency of provisioning. Interestingly, they show that the number of supervisors per bank is more than three times bigger in developing economies than in developed ones. However they also indicate that in developing economies their number is associated with a higher political dependence of the supervisory authority.

In a subsequent paper, Bart, Caprio and Levine (2001b) suggest that certain regulatory and supervisory practices promote bank performance and bank stability. Specifically, these include practices that force accurate information disclosure; that empower the private-sector corporate control of banks; and that foster incentives for private agents to exert corporate control. Moreover, they stress that regulation and supervision practices that force accurate information disclosure and that limit the moral hazard incentives of poorly designed deposit insurance schemes seem to improve bank performance and stability. However, their conclusions are preliminary because of the nature of the qualitative data involved in their investigations.

Finally, it is worthy to mention that Demirguc-Kunt, Laeven and Levine (2004) have recently studied the impact of regulations, market structure and national institutions on bank net interest margins and overhead costs. Their econometric study shows that tighter regulations on bank entry and bank activities increase the cost of financial intermediation. They also show that concentration is not associated to net interest margins when controlling for regulatory impediments to competition and inflation. Interestingly, their main conclusion is that bank regulations reflect broad national approaches to private property and competition.

2.4. Financial systems and banking intermediaries

In this section we review the aggregate relationships between financial system features and the behaviour of banking intermediaries. First, we analyse such relationships in the context of the theoretical nexus between financial structures and development with the behaviour of banking firms. Then we focus on the empirical studies between banking behaviour and banking crises. We base our review on theoretical and empirical analyses to point out the nexus among risk management, fragility and banking market structures with the financial and economic environment.

2.4.1. Financial structures and development and banking behaviour

Conventionally, it is accepted that banking behaviour depends on financial structure. The reason is because the financial structure of an economy influences the financial contracting process and the functioning of intermediaries and markets. [32] Unfortunately, there is no consensus about how financial structure and development are related to banking behaviour. [33] Nor about the policy reforms that may encourage better financial systems.

Historically, the academic and policy debate has focused around who should drive the development of the financial system, banking institutions or financial markets (*bank-*

[32] Notice that financial structure can be defined as "the mix of financial contracts, markets and institutions" [Levine (1997: p. 702)].

[33] The academic and policy debates regarding the nexus between financial structure and economic performance can be dated back to the nineteenth century [Goldsmith (1969)]. Literature surveys on the relationships between financial structure and aggregate economic activities are Gertler (1988); and on the comparative theory of financial systems are Allen and Gale (2000a) and (2001).

based and *market-based views*, respectively).[34] More recently, other economists have rejected such dichotomy arguing that reforms should encourage the creation of an environment in which intermediaries and markets could provide financial services (*service-based view*).[35] Evidently, the existence of diverse policy views shows that there is no consensus about which financial structure reforms could encourage both adequate economic performance and long-run development.

The bank-based view stresses the importance of financial intermediation in ameliorating information asymmetries and inter-temporal transaction costs. The market-based view stresses the importance of well-functioning securities markets in providing incentives for investors to acquire information, impose corporate control and custom design financial arrangements. The financial services view does not conceptually reject the bank-based versus market-based debate. Rather it emphasises that reforms should create an environment in which intermediaries and markets could provide sound financial services; under this framework, reforms to the legal system might play the main role. Neither banks nor markets per se matter.

Theoretically, it has been suggested that risk management practices should change according to the prevailing financial structure because the opportunities to engage on inter-temporal risk smoothing activities differ significantly between financial systems [Allen and Gale (1997) and (2001)]. Specifically, in bank-based systems, adequate practices should be oriented to the accumulation of low risk, liquid assets. While in market-based ones, they should be oriented to the use of derivatives and other similar techniques [Allen and Gale (2001)]. Evidently then, what it is implied is that policies

[34] Development economists usually favour bank-based reforms arguing that banks are better to deal with uncertainty, costly information, transaction costs and scale-economies in information collection [Fry (1995)]. Economists that support the bank-driven financial systems argue that there are reasons for believing that market systems will not promote adequate activities concerning the acquisition of information from firms and the supervision of managers. Specifically, what they argue is that markets enhance informational "free riding" activities regarding firms' performance; and also that markets are ineffective to exert corporate control [Allen and Gale (1999)].
On the other hand, the basis for disagreement relies on the Modigliani-Miller theorem [Modigliani and Miller (1958)]. According to the view of economists that favour market-based reforms, policies should not only focus on the development of banking institutions because intermediaries and securities markets can substitute each other. For example, Cho (1986) has argued that equity markets are as important as bank lending to counter adverse selection problems of the kind analysed by Stiglitz and Weiss (1981).
[35] Merton and Bodie (1995) and Levine (1997) are among the ones who have minimised the importance of the bank-based versus the market-based debate.

pursuing banking goals should encourage risk management practices according to the financial structure and the degree of financial development prevailing in the economies.[36]

Interestingly, comparative financial system theory provides us with an *alternative and complementary* justification for the joint study of risk management practices and market structure with banking fragility. According to this literature "inter-temporal smoothing by banks is not viable in the presence of direct competition from markets" [Allen and Gale (2001: p.14)]. [37] Competition between financial markets and banking institutions, which is reflected on the structure prevailing in the financial system, provides different incentives and opportunities for risk sharing. Furthermore, it introduces a complementary rationale for introducing market environment conditions into the risk management decision process. Individual decisions of banking intermediaries are determined by competition among banks and markets, and by competition between banks themselves.

Paradoxically, there are few empirical studies on the relationship financial structure with banking performance [Demirguc-Kunt and Huizinga (1999) and (2000)].[38] Even though, it has been pointed out that studies between financial structure and fragility may improve our understanding about the likelihood of crises [Demirguc-Kunt and Detragiache (1998a)], little research has been done.[39] We believe that further research on financial structure and development will be necessary to understand banking

[36] There are further studies that support the hypothesis that financial development may reduce the necessity of inter-temporal smoothing risk management practices. Di Giorgio (1999) derives the optimal reserve requirements of a simple economy with production and financial intermediation subject to costly state verification, and shows that one motivation for the reduction of mandatory reserves is linked to the process of financial markets development.

[37] Notice that the traditional fragility literature explains banking crises as equilibrium outcomes due to the existence of inter-temporal risk sharing [Diamond and Dybvig (1983)].

[38] The study of Demirguc-Kunt and Huizinga (1999) seems to be the first one that includes financial structure variables to analyse commercial bank interest margins and profitability. In a latter study they focus on the impact of financial development and structure on banking profitability [Demirguc-Kunt and Huizinga (2000)]. The conclusions of their studies suggest that financial development reduces bank profitability and margins.

[39] Allen (2001) informally discusses the relationship between financial structure and financial crises in the context of the Asian crisis. His main point is that financial structure is not that important for whether financial crises occur. What are important are the management practices available to banks. Thus, what he expresses are his doubts about the market-based reforms implemented after the crisis.

behaviour.[40] Evidently, the relevance of this knowledge will be associated to academic and policy purposes alike.

2.4.2. Banking crises and banking behaviour

Banking failures have a long history throughout the world.[41] Paradoxically, there is not an extensive empirical literature regarding banking financial fragility issues in different economies and institutional settings [See Beck, Demirguc-Kunt and Levine (2003)]. Methodological and institutional issues regarding data availability, accounting, regulatory and economic methods have inhibited the development of this literature until recently.[42] This situation explains why there are not recent surveys on the empirical relationship between banking behaviour and fragility.[43] But also explains the necessity to offer a contemporary overview of these studies.

Banking crisis studies can be divided according to their purpose or according to the type-level of the indicators used to assess fragility. The former classification divides them into early-warning system studies and studies of the determinants of banking failure.[44] The second divides them according to the level of aggregation of indicators used to assess financial fragility. According to this criterion, we can classify the empirical studies as microeconomic, macroeconomic or macro-micro ones.

[40] However, Demirguc-Kunt and Huizinga (2000) suggests the opposite conclusion. Specifically, they find some evidence that financial structure per se does not have an independent effect on bank performance.

[41] Banking crises have been reported, at least, since 33 AD, when Tiberius Caesar had to provide Roman government funds to support banking houses [Caprio and Klingebiel (1996b)]. See Calomiris and Gorton (1991) for a historical review.

[42] In an international comparative context, Heffernan (1995) and Demirguc-Kunt and Detragiache (1998a) and (1998b) were the pioneering studies of domestic banking failure. Before those papers, almost all published literature used to refer on US banks because of the availability of data.

[43] Interestingly, the last surveys on the banking fragility empirical literature are Barnes (1987) and Demirguc-Kunt (1989). That is well before the financial crisis phenomenon could be observed in an international context and also before the first international banking studies were done.

[44] Early-warning systems statistically analyse financial ratios constructed from balance sheets, government agencies and other economic organisations. Their purpose is to signal financially troubled institutions or banking systems as early as possible. Studies of the determinants of failure attempt to explain officially recognised insolvency among intermediaries or troubled banking systems. These studies seek to identify financial factors that affect the likelihood of banking problems. Thus, while early-warning systems are ex-ante studies, failure-determinant are ex-post ones.

Here we classify the empirical financial fragility literature following the type-level convention. The main features of each type of study are and some examples are indicated for methodological purposes.

Microeconomic studies

Micro studies focus on individual banks' balance-sheet data to predict financial distress and to evaluate the determinants of failures. Most studies have been developed in the context of US banks. These studies use several methodologies and financial ratios to produce assessments. However, the variables suggested to analyse fragility usually involve accounting measures derived from balance sheets and income statements.[45] Occasionally, macroeconomic and regional variables are included in this type of study. Its main advantage is that the usage of financial ratios facilitate comparisons among intermediaries by adjusting by size, and also that the statistical techniques tend to produce satisfactory estimation results under stable economic conditions. These features facilitate to distinguish institutions according to their management practices.

Methodologically, these studies rely on the CAMEL system and market-based indicators. CAMEL indicators can be summarised in five key variables. These variables – capital adequacy, asset quality, management earnings and liquidity –, conform the CAMEL system. In industrialised countries this system, or variations of it, are the most commonly used by economic authorities and rating agencies. Other indicators commonly used to assess banking fragility are based on market-based considerations. Equity prices, standalone measures and support rating indicators fall in this category.[46]

Micro studies have been criticised on the grounds that they require bank-specific data [Gonzalez-Hermosillo (1999)]. Usually this type of data is not readily available and requires certain institutional knowledge about local accounting practices to be used properly. Moreover, because information is difficult to compare among different

[45] See Demirguc-Kunt (1989) and Gonzalez-Hermosillo (1999) for some representative examples.
[46] Rojas-Suarez (2001a), extents the description of the CAMEL system and other measures used by rating agencies to analyse banking strength. She also includes relevant academic studies.

economies, conclusive findings are difficult to establish. Statistically, another criticism relies on accounting data assumptions that are taken for granted for econometric purposes. One common assumption is that the financial ratios have the properties necessary for handling and summarising the data. Another is that the data follow the specific probability distribution functions for which the techniques are designed. Moreover, it has been argued that the stability of the econometric relationships and ratios over time cannot be guaranteed [Barnes (1987)].

Micro studies in emerging economies have additional problems associated to financial development. In such economies, deficiencies in accounting and regulatory frameworks and the lack of liquid markets for bank liabilities and assets accentuate differences between accounting banking values and real ones. These differences, indicated formerly in the context of the US banking system [Demirguc-Kunt (1989)], arguably explain why common indicators of banking problems have performed poorly in emergent economies. Moreover, they suggest the necessity to develop alternative measures to evaluate the nexus between banking fragility and banking intermediaries.

Rojas-Suarez (2001a) deals with the latter problem with "effective-market-based" indicators. These indicators are supposed to reveal the true risk of individual banks because they are based on indicators derived from banking markets rather than from banking accounting ratios.[47] Using an early-warning signal microeconomic system, effective-market indicators seem to perform better to analyse banking fragility in emergent countries than the ones based on the CAMEL system.[48] However, analyses based on these indicators have been developed only for Latin-American countries. Further evidence is required to guarantee their effectiveness for financially underdeveloped economies.

[47] The alternative indicators are "Implicit interest rate paid on deposits", "Spread between lending and deposit rates", "Rate of loan growth" and "Growth of inter-bank debt".

[48] This market-based approach has been studied in the context of emerging economies by Martinez Peria and Schmukler (2001), who evaluate the interaction between market discipline and deposit insurance, and the impact of banking crises on market discipline. The cases analysed are Argentina, Chile and Mexico during the 80s and 90s.

Macroeconomic studies

Macro studies use macroeconomic and institutional indicators to study financial fragility in banking systems. Business cycles, shocks, macro trends and regulation practices are considered in these studies to evaluate financial fragility. They pursue to explore the relationships among financial fragility, monitoring and supervision practices and economic performance. Currently, most studies on banking fragility belong to this category.[49]

These studies are based on a country risk analysis literature.[50] Cross-section, panel data and non-parametric techniques are used in these studies. Institutional, economic and financial indicators from samples of countries that are known to have banking crises during specific periods of time are used to analyse financial fragility. These studies are relatively new because international databases have not been public available until the second half of the nineties.[51] The main advantage of these studies is that they allow cross-country comparisons. The reason is because these indicators are centralised and comparable.

Macro studies, as their micro counterparts, can be divided into failure-determinant studies and early-warning system ones. In the former category, studies suggest that banking crises relate to weak macroeconomic environments, financial liberalisation and cyclical movements [Demirguc-Kunt and Detragiache (1998a) and (1998b) and Hardy and Pazarbasioglu (1999)]. Low growth rates, high inflation, currency movements, balance-of-payments crises and high real interest rates are associated to banking sector problems. Deposit-insurance schemes and weak law enforcement are also associated to them. In the early-warning category, the best-known banking-specific one is Demirguc-Kunt and Detragiache (2000).

These studies have been criticised because they require ex-post knowledge about crises occurrence and its timing, and because there are not accepted measures of

[49] Representative examples are Demirguc-Kunt and Detragiache (1998a) and (1998b).
[50] See Saini and Bates (1984) for an introduction to this literature.
[51] International banking research relies on data from standard rating agencies (Fitch IBCA, JP Morgan and Goldman Sachs), IMF's International Financial Statistics and the IFC's Emerging Market Database. Research has been done in small scale because data are not bank specific and dispersed.

fragility prior to these crises occurring [Gonzalez-Hermosillo (1999)]. Specifically, the shortcomings associated to failure-determinant studies are that they are incapable to explain the channels through which macro shocks affect banks and the characteristics of the institutions that survive them. The shortcomings associated to early-warning studies relate to their relatively poor predictive performance.[52]

Macro studies in the context of emerging economies have been mainly related to the twin-crises phenomenon. Such studies focus in the causality relationship between currency and banking crises with mixed results. Examples are Kaminsky and Reinhart (1999), Glick and Hutchinson (1999), Schumacher (2000) and Martinez-Peria and Schmukler (2001).[53] Methodological issues regarding twin-crisis early-warning systems for emerging economies are described in Goldstein, Kaminsky and Reinhart (2000). A non twin-crises study on the determinants of banking crises in emerging economies is Eichengreen and Rose (1998). Interestingly, this paper finds that high interest rates in industrialised economies are strongly associated with the onset of banking crises in developing ones even after taking into account internal macroeconomic factors.

It has been suggested that further development on macro studies should focus on the analysis of the effects of financial structure on banking fragility [Demirguc-Kunt and Detragiache (1998a)]. According to the theory of comparative financial systems, the financial structure and the degree of financial development may affect banking behaviour because the opportunities to engage in risk management activities differ between financial systems [Allen and Gale (1997) and (2001)]. Thus the study of financial structure and banking fragility seems a promising area for further research.

[52] Demirguc-Kunt and Detragiache (2000), show that the estimated probabilities of banking crises are relatively low for the East Asian countries using forecasts available as of April-May 1997.

[53] Kaminsky and Reinhart (1999) shed light on the association of bank and currency crises. Glick and Hutchinson (1999) implement the "signals" approach to explain banking and exchange-rate crises following Kaminsky, Lizondo and Reinhart (1998). Schumacher (2000) analyses how international determinants trigger informational bank runs considering the 1994-95 Argentinean experience. See Breuer (2004) for a review on the twin-crises literature.

Macro-micro studies

Macro-micro studies that relate banking failure with individual behaviour and macroeconomic conditions are scarce mainly due to data availability. From a macro perspective, they should simplify the comparability among similar economies and should help to study the effects of macroeconomic shocks and cycles. From a micro one, they should help to discriminate between institutional banking practices and their effects given common shocks in the macro environment. Thus macro-micro studies should offer an integrated approach to study financial fragility issues for international comparative purposes.

The first analysis of the determinants of banking failure using macro-micro indicators is Heffernan (1995). This paper shows that profitability and capital adequacy are negatively correlated with financial failure in developed economies. A latter study, with a bigger sample of economies, confirms such results, but also shows that the conditional panel logit model is not superior to the multinomial logit one [Heffernan (2000)]. Interestingly, both studies use bank size measures to test the "too-big-to-fail" hypothesis. Although relevant, the correlation signs found are opposite, making difficult to establish their relevance. The same problem occurs for several macro variables. [54]

Demirguc-Kunt, Detragiache and Gupta (2000) analyse what happens to banking systems in the aftermath of banking crises in 35 economies. They find that deposit and credit are not reduced. However they also show that credit growth does not necessarily recover with economic growth because banks reallocate their investment portfolio away from loans.[55] Finally, Mckenzie (2002) analyses the determinants of international bank failures in banks that operate in several economies. Interestingly he finds that a graduated hierarchy of defaults exists. Countries in trouble first default to

[54] Heffernan (1995) and (2000) has analysed this relationship for banking systems in developed economies without conclusive results. Methodologically, a possible explanation relies in the indicator used in these studies. The indicator, size of individual assets to total banking assets, has been criticised as a proxy of market structure [Maudos (1998) and (2001)].

[55] Notice that this study is not a failure-determinant, nor an early-warning one. It is a study of the stylised facts that characterise post-crisis periods. However, we include it here because it belongs to the financial fragility macro-micro literature.

Paris Club and/or Commercial bank creditors and then they default to the IBRD (World Bank). [56]

Concerns around the proper indicators to analyse financial fragility in emerging economies are at the heart of macro-micro studies. Given their particularities and the costs associated to financial crises, this methodological issue has special importance. Honohan (1997) has suggested macro-micro indicators to diagnose and predict banking failures in these economies considering failures of both macro and microeconomic varieties, and also of the endemic failure variety (banking crises associated to government intervention). His suggestion is a first attempt to deal with the necessity to improve diagnosis and prediction methods on these economies.

Macro-micro studies in emerging economies have been focused in Latin American economies. Gonzalez-Hermosillo, Pazarbasioglu and Billings (1997) show that bank-specific variables and contagion effects explain the likelihood of banking failure in the Mexican 1994-95 financial crisis, whereas macroeconomic ones determine its timing. An early-warning study is Gonzalez-Hermosillo (1999). The latter paper analyses three episodes of banking problems in United States, the Mexican 1994-95 crisis and the Colombian 1982-83 one. Using discrete logit and duration models, capital equity and coverage ratios are found as leading indicators of financial distress.[57] In this study, macro variables seem to increase the predictive power of the bank-specific analysis.

Beck, Demirguc-Kunt and Levine (2003) have analysed the impact of bank concentration, bank regulations and national institutions on the likelihood of systemic banking crisis. Interestingly, they find that crises are less likely in economies with concentrated banking systems, few regulatory restrictions on bank competition and when national institutions (represented by variables such as the economic development and growth, inflation, terms of trade and credit growth) encourage competition.

[56] According to Mckenzie (2002), IBRD creditworthiness with a lag of one annual period is determined by the extent of arrears to private creditors, the proportion of total debt service, the government budget deficit, the extent of military involvement in politics and by the G7 current account deficit. Default to the IBRD seems to be triggered by a high proportion of IBRD and short-term debt.

[57] The coverage ratio is the ratio of capital equity and loan reserves minus non performing loans to total assets. Thus the ratio is an indicator of reserve coverage of problem loans.

However, as the authors recognise, their work still needs to be complemented by introducing market structure variables and more microeconomic variables.

2.5. Conclusions and discussion

The understanding of the behaviour of banking firms concerns researchers and practitioners alike. Specifically, among researchers, there is a consensus around the necessity to "move further in constructing a theory of financial intermediation that can explain the day-to-day operations of financial institutions and markets and their role within the real economy" [Scholtens and Van Wensveen (2000: p. 1249)]. Concerning practitioners, there is the necessity to reconcile the observed behaviour of financial intermediaries with intermediation theory [Allen and Santomero (1997)]. The relevance of such understanding relies on the importance of the banking functions for the economies.

Here we have offered an overview of the studies that have analysed the behaviour of banking institutions focusing on the relationships among institutional risk management, fragility and banking market structure. The idea underlying such an approach is that these relationships are the most important ones that define and delimit the activities and decisions available to banking firms. Under these considerations, the review is organised in two aggregation levels: One based on the industrial organisation theory, and the other based on the theory of comparative financial systems. In both cases, an institutional perspective permeates the review.[58]

Our review shows that certain banking behavioural issues, associated to the consideration that intermediaries are independent market parties that manage risks to achieve their goals, constitute relatively unexplored areas for theoretical research.[59] Particularly, concerning empirical issues, our review shows that further studies are needed to describe the behavioural patterns among intermediaries. Regarding

[58] Notice that, from the point of view of banking entrepreneurs, institutional risk management activities provide the means to maximise profits and to minimise financial distress in the banking markets; while for regulators, they provide the means to allocate resources and to avoid fragility in the financial system. These considerations make us emphasise the institutional perspective of the review.

[59] Particularly, we believe interesting to point out that "We suggest that the analysis of policies of optimization of risks and rewards by financial intermediaries [can] helps to better understand the essence of its business" [Scholtens and Van Wensveen (2000: p. 1251)].

regulation theory and practice, our review suggests that further advances may be achieved by studying the joint relationships among risk management, fragility and market structure and the effects of regulations on the banking industry. Thus, review suggests that the joint analysis of the banking behavioural relationships may be important for theoretical and policy reasons.

The relevance of the study of joint relationship does not only have support from a microeconomic view. The theory of comparative financial systems provides an alternative and complementary justification to analyse these relationships from an aggregate one. This view is based on the opportunities of banks to engage on inter-temporal smoothing activities under different financial systems. Then we include a review of the empirical studies between banking behaviour and banking crises because of their importance for academic and policy purposes. We conclude by indicating that further research on financial structure and banking determinants is required not only to test the theories but also to formulate policy recommendations.

The above findings suggest a joint study of the relationships among institutional risk management, financial fragility and banking market structure. The review suggests and justifies further theoretical analyses around banking behaviour and regulation effects on the banking industry based on the industrial organisation approach to banking. On the empirical side it validates the necessity to assess banking theories and policies based on the framework of the theory on comparative financial systems. Thus, it places our own research in the context of the literature. [60]

In the following chapter we will develop the basic microeconomic framework for analysing the above relationships. Concretely, we will build the modelling structure to study the profit maximising behaviour of a bank that manages short-term and long-term assets facing uncertainty on both sides of its balance sheet and imperfect competition in the deposit market. In the subsequent chapters, we will analyse the ex-

[60] Definitively we agree with the statement that: "the extension of financial distress based models of risk management to an equilibrium setting is, as noted earlier, also an important area for further research" [Smith and Hunter, (2002: p. 219)]. Moreover, we also agree with the view that "the empirical hypothesis and policy prescriptions from such expanded models may be sharply at odds with those from essentially looking at one firm in isolation."[Smith and Hunter, ibid.].

ante optimal banking decisions considering the degree of banking competition, liquidity and solvency risks, liquidity risk management strategies and trade-offs between liquidity insurance and profitability of banking investment. This will be done for various banking models to analyse banking behavioural patterns and the effects of specific regulations on banks.

Finally, we will investigate the aggregate relationships between financial structure and banking behaviour focusing on the assessment of stability-enhancing policies. Concretely, we will characterise the banking and financial stylised facts associated to stable and unstable banking systems and we will assess competing theories and policy views regarding the relationships between banking stability and management practices, and between fragility and banking market structures. We will develop the analysis using qualitative, financial structure and development indicators.

CHAPTER 3

A MICROECONOMIC BANKING FRAMEWORK

3.1. Introduction

In this chapter we develop a microeconomic framework to analyse how former asset decisions and the subsequent availability of liquidity-risk contingent strategies, influence the viability of the intermediaries' asset transformation process and the solvency of banking firms. We achieve this goal through the study of the inter-temporal asset decisions that monopolistically competitive intermediaries take to maximise long-term profits and avoid bankruptcy costs. Particularly, we focus on the bank-risk management process considering firm interactions in the deposit market, uncertainty in both sides of the balance sheets, and the necessity to deal with solvency and liquidity risks associated with the financial structure of the intermediaries.

The framework extends the Monti-Klein model by introducing uncertain long-term portfolio investment and random deposit withdrawals based on Dermine (1986) and Prisman, Slovin and Sushka (1986) respectively. Regarding its inter-temporal structure, it follows Diamond and Dybvig (1983). Analytically, this approach makes explicit the decisions that intermediaries take to deal with their fragility-prone financial structure and maximise their expected long-term benefits (the expected difference between profits and private bankruptcy costs given specific asset allocations). Furthermore, it makes explicit the relationship between asset and liability management practices and the sequential decision process. [1]

The modelling approach is based on the balance sheets of banks. This approach reflects that both sides of the balance sheets are equally relevant to understand the institutional risk management process. Here, we consider that asset and liability management practices relate when contingent banking strategies induce intermediaries to deal with idiosyncratic liquidity shocks. Interestingly, we find that *the viability of the asset transformation process and the temporal dimension of the management*

process allow us to differentiate between solvency and liquidity risks. We emphasise this feature of our framework because "In imperfect capital markets the distinction between insolvency and illiquidity is crucial." [Bougheas (1999: p. 133)]. Analytically, this is a contribution to the intermediation literature.

The framework allows the study of the inter-temporal relationships among risk management practices, banking fragility, solvency and profitability. Specifically, we show that liquidity problems do not necessarily imply bankruptcy. Furthermore, we derive the long-run banking solvency function that defines the portfolio investment returns that guarantee the viability of the asset transformation process. Both findings *clarify the inter-temporal relationship between liquidity and solvency risks and contingent banking strategies*.

The above clarification is important because traditional liability-side fragility models directly associate liquidity risk to financial failure; while, in our framework, this association occurs when certain conditions on both sides of the banking balance sheet are met. Interestingly, such conditions mainly depend on the decision variables (reserves and deposits) and the existing market structure.

Our framework combines elements of the theory of the banking firm and the theories of institutional risk management and financial crisis. *It describes how asset management allocations are related to short-term solvency and liquidity risks and to long-term solvency and profitability*. Regarding idiosyncratic liquidity risk, the framework makes explicit the conditions that certain contingent management practices (reinvestment of reserves in short-term instruments and the liquidation of illiquid investments) can assure the viability of the transformation process and the possibility of long-term profits.

The chapter is divided in five sections. Section 3.2 describes the management process considering both sides of the balance sheet and the timing of the model. Section 3.3 formalises the framework to analyse the interactions among decisions, contingent

[1] Financial fragility models focus on the behaviour of depositors, institutional risk management models focus on intermediaries' assets. See Chapter 2.

strategies and long-term viability. Section 3.4 focuses on the banking scenarios and outcomes. Section 3.5 concludes.

3.2. The banking decision process and the balance sheets

In this section, we describe the temporal dimension of the management process using the banking balance sheet. We offer an informal description of the main features of our framework related to the analysis of the linkage between risk management and financial fragility. More specifically, we consider uncertainty, contingent strategies, market structure conditions, the banking financial structure and the existence of liquidity and solvency risks. This temporal structure will allow us to analyse the management problem as a sequential decision process. In the following section, we will formalise the structure of our framework.

Assume a three period framework (T=0,1,2). At T=0, bank *i* chooses the amounts of liquid reserves (money, M_i) and illiquid portfolio investment (Loans and securities, L_i), to maximise long-term benefits. Given deposits D_i, these decisions must take into account that idiosyncratic liquidity shocks can occur in the second period (T=1), and that the returns derived from its portfolio investment are unknown until the last one (T=2). So banks face uncertainty on both sides of their balance sheets.

Decisions about deposits are also made in the first period. Each bank in the banking system needs long-term deposits from the public to finance its activities. Deposit decisions are taken considering firm interactions (imperfect competition) in the deposit market and the characteristics of the deposit supply. Thus, in equilibrium, long-term deposit returns and individual banking deposits $r_D\left(D^*\right), D_i^*$, are determined simultaneously.

Contemporary asset-liability management (ALM) practices aim to maximise profits by seeking the highest return on assets, while at the same time trying to lower risk and making adequate provisions for liquidity. Here we consider that liabilities provide reserves and liquidity to the intermediaries and the acquisition of long-term assets.

Thus, in our framework, liability management practices are fundamental to understand intermediaries' behaviour.

Liability management practices depend on the features of deposit contracts and depositors' behaviour. Deposit contracts offer depositors the option to withdraw early according to their time preference. As in Diamond and Dybvig (1983), ex-ante depositors are uncertain about their time preference.[2] Following the standard assumption in the financial crisis literature, we have early and mature depositors. Their proportions are *x* and 1-*x* respectively. Their type is revealed at the beginning of the middle period (T=1), accordingly to their liquidity requirements. Thus, random deposit withdrawals exist because the proportion of depositors that will require liquidity ex-ante is unknown. Early depositors receive the amount that they invested xD_i^*, while mature ones receive the higher return $(1-x)D_i^* r_D\left(D^*\right)$. [3]

Each bank uses its deposits to hold reserves and to purchase an investment portfolio. The portfolio includes long term illiquid earning-assets (loans, securities) with gross return *y*. This portfolio is worth yL_i in the first period (T=0). This is an uncertain value because portfolio returns are unknown in the moment at which investment decisions are made. Regarding reserves M_i, these are kept from one period to another to provide a safety net against idiosyncratic liquidity requirements. If, the outflow of early deposits either exactly matches or is less than gross reserve returns $M_i = xD_i$, then there is an adequate provision of liquidity in T=1. However, liquidity shortages are always possible.

The availability of contingent liquidity-risk strategies allows banks to overcome liquidity shocks under certain conditions. In case of liquidity shortages, a bank can liquidate illiquid resources at a cost. In our framework, unexpected liquidity demands

[2] It is worthy to point out that we *do not* derive the optimal contracts for depositors. Notice that we are not concerned with depositors' welfare, but with banking practices. Liability management practices aim to support the intermediary firm goals. Notice then that our approach is completely different to the one adopted by the traditional fragility literature in which the protection of depositors is the main concern [Diamond and Dybvig (1983)].

are costly not only in terms of future revenue loss, but also in terms of the amount of illiquid resources that need to be liquidated to satisfy them. Shortages must be sufficiently small to assure the viability of the asset transformation process. Otherwise, liquidity shortages will lead to an immediate insolvency either because the amount of liquidated resources may not satisfy the liquidity requirements or because the remaining assets may not guarantee enough revenues. Nevertheless, liquidity surpluses may not imply long-term profitability. When there are liquidity surpluses, the bank holds excess reserves that yield a low return relatively to its portfolio. Then liquidity surpluses can threaten the viability of the asset transformation process if final assets cannot match the bank's second period liabilities.

In the beginning of the last period, long-term investment returns, y, determine the financial situation of the bank. Solvency or insolvency outcomes will be obtained accordingly to the magnitudes of y and the break-even returns. We assume that, in case of failure, the intermediary has bankruptcy costs (B).[4] Otherwise, banking profits are calculated as the difference between long-term investment revenues and final net liabilities (which include the promised returns to mature depositors).

The following table summarises the timing of the banking framework.

[3] It can be argued that short-term fixed returns are unrealistic. However, offering a fixed return does not affect the qualitative analysis developed in the next chapters. Moreover, it reduces by one the parameters of the model.

[4] The bankruptcy costs rationalise risk management. These costs might be associated to the loss of the right to perform banking activities in the future and the loss of credibility. Alternative rationales for risk management in the context of financial intermediaries are managerial self-interest, non-linear taxes and capital market imperfections. However, several authors agree that the costs of financial distress offer the best alternative. See Allen and Santomero (1997), Scholtens and Wensdeen (2000).

Table 3.1 Timing in the Basic Framework

	First Period (T=0)	Second Period (T=1)	Third Period (T=2)
Individual Bank	- Competition determines the amount of funds available to finance a bank's transformation activities - Portfolio investment (Li) and liquid reserve (Mi) decisions are made	- When the process is not viable, liquidity problems derive into financial failure and the bank has losses (B) - When the process is viable, contingent banking decisions are taken. Reserves are reinvested or illiquid assets are liquidated	- Long-term outcomes become known. - If the bank makes profits mature repayments are made - If there is bankruptcy, the intermediary makes losses (B)
Variables Determined	Mi*/Di*, $r_D(D^*)$, D* determined	- x is known - Given the idiosyncratic shock, long-term viability is determined - Banking solvency break-even returns are determined	- y is known
Notes: The banking decision variables are *Di* (Deposits of the i-bank), *Li* (Long-term assets of the i-bank), and *Mi* (reserves of the i-bank). Other banking variables are *B* (Bankruptcy costs) and $r_D(D^*)$ (Equilibrium long-term deposit return). The random variables are *x* (Proportion of early depositors) and *y* (Long-term asset return).			

3.3. Analytical framework, contingent banking strategies and long-term viability

In this section, we formalise the sequential decision process described in the previous section. Moreover, we also focus on the relationship between contingent strategies and final outcomes in order to make clear the reserve management problem.

Assume that the banking system comprises N symmetric banks $i = 1,2,3,...,N$. Imperfect competition among banks prevails in the deposit market. Each bank is a monopolistically competitive intermediary that buys an investment portfolio and sells deposits in the markets. Reserves (M_i) and investment portfolio (L_i), comprise the asset-side of the banking balance sheet, deposits (D_i) the liability-side one. Banks are

risk neutral and limited liability applies. Moreover, we assume null management costs and banks do not hold equity.[5]

The bank's problem is to determine the ex-ante optimal decisions that maximise profits taking into account: (a) imperfect competition in the deposit market, (b) uncertainty due to both the behaviour of depositors and investment returns,(c) liquidity risk management strategies, (d) short and long term solvency risks, and (e) the existence of a trade-off between liquidity insurance and profitability. Its decision variables are individual reserves and deposits (investment portfolio is endogenous given our assumptions). These decisions are taken in T=0 after the level of deposits becomes known.

Deposit decisions are taken in the first period. If deposits are withdrawn in the short term (T=1), the bank pays a unitary gross return. Otherwise the bank pays the higher return, $r_D(D)$, in T=2. We assume that

$$r_D = r_D(D),\ r_D'(D) > 0\ , D = \sum_i^n D_i$$

Ex-ante, all depositors are identical, but subject to i.i.d liquidity shocks. However at T=1 the liquidity requirements become known as early depositors withdraw their deposits. The outflow of early deposits is a proportion *x* of the total liabilities. We assume that the proportion of short-term deposits is a continuous random variable $\tilde{x}$ with known density function *f(x).*

$\tilde{x} \sim [0,1]$

Uncertainty is not only related to the depositors' behaviour. As previously indicated, the bank invests in a long-term risky portfolio (loans, other banking assets). The investment portfolio offers a gross return $\tilde{y}$ per unit of investment in T=2. We assume that $\tilde{y}$ is a continuous random variable with a known density function *g(y).*

$\tilde{y} \sim [0,y_F]$

Notice that reserves provide insurance against unexpected deposit withdrawals that may cause financial failure. However, reserves also reduce potential banking profits

[5] Equity contracts are not important because moral hazard issues are not considered in the model. Introducing equity contracts will add complexity without adding further insights on the risk management

because reserves reduce the portfolio investment. *Managerial strategy is pursued to allocate reserves and portfolio investment in an optimal way to maximise profits, but also to prevent financial distress given uncertainty on both sides of the banking balance sheets.*

3.3.1. Early deposit outflows and contingent banking strategies

Liquidity management requires that the bank has sufficient reserves to meet its obligations with depositors. Reserves ($M_i = D_i - L_i$) are held to cope with early deposit withdrawals in period 2. Reserves are invested in short-term instruments with unitary gross return. We define the level of reserves, M_i, that exactly matches deposit outflows xD_i, as

$$x_M\left(M_i, D_i\right) = \frac{M_i}{D_i} \tag{3.1}$$

Given $x_M\left(M_i, D_i\right)$, reserves and payments to early depositors are identical and long-term banking outcomes will depend on portfolio investment only. However, this is unlikely because the probability mass of $x_M\left(M_i, D_i\right)$ is zero.

We introduce costly liquidation to allow the bank to honour its obligations with depositors in case of unexpected liquidity shortages. However banks might not face only shortages, surpluses are also a possibility. Thus, we also allow the bank to hold excess reserves. Reinvestment opportunities and costly liquidation contingent liquidity-risk strategies must be accounted for evaluating the management process.

If the initial reserve provision does not match early withdrawals, the availability of contingent strategies must be considered. Inadequate reserve provisions can be managed through the liquidation of illiquid assets while reinvesting remaining reserves is the option for liquidity surpluses. If the realised proportion of early withdrawals is higher than the threshold value ($x > x_M\left(M_i, D_i\right)$), there is a liquidity shortage ($CB_i > 0$, $CB_i = \tilde{x}D_i - M_i$). In the opposite case ($x < x_M\left(M_i, D_i\right)$), there will be a

problem. See Mishkin (2000) for an introduction to moral hazard and principal-agent problems in the

liquidity excess. Remaining reserves ($-CB_i, CB_i < 0$), are held until the last period. In any case, contingent strategies allow the bank to deal with uncertain liquidity shocks. Formalising the above description, we define the unexpected liquidity shocks, that determine the associate contingent banking strategies, as:

$$CB_i = \tilde{x}D_i - M_i = [\tilde{x} - x_M(M_i, D_i)]D_i \qquad (3.2)$$

Liquidity surpluses occur when $\tilde{x} \le x_M(M_i, D_i) \Rightarrow M_i \ge \tilde{x}D_i$ In this case reserves are higher than liquidity requirements. The bank is left with a liquidity surplus ($CB_i < 0$). The related contingent strategy allows the bank to hold excess reserves ($-CB_i$).

The third-period additional revenue from remaining reserves is:

$$K_{1i}(M_i, D_i) = [-Min(0, CB_i)]$$
$$K_{1i}(M_i, D_i) = [-Min(0, (\tilde{x}D_i - M_i))]$$

The above expressions indicate that in case of liquidity shortages ($CB_i > 0$, $CB_i = \tilde{x}D_i - M_i$), reinvested reserves and any associated revenue will be zero. While for the surpluses case ($CB_i < 0$), they indicate that the associated return of remaining reserves will be positive.

Liquidity shortages occur when $\tilde{x} \ge x_M(M_i, D_i) \Rightarrow M_i \le \tilde{x}D_i$. Under this situation, banks liquidate their illiquid portfolio investment in order to satisfy early depositors. This liquidation strategy is costly and has to be done at T=1. The provision of liquidity in the short term has a negative effect on future profits because it reduces investment.

Notice then that net long-term investment is:

$$LTR_i(x, M_i, D_i) = [D_i - M_i - c_l[Max(0, CB_i)]]$$
$$LTR_i(x, M_i, D_i) = [D_i - M_i - c_l[Max(0, \tilde{x}D_i - M_i)]] \qquad (3.3)$$
$$c_l > 1$$

where c_l denotes the liquidation cost.

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context of the banking financial structure.

The above expressions indicate that liquidity surpluses ($CB_i < 0$, $CB_i = \tilde{x}D_i - M_i$), will not reduce long-term investment. Furthermore, they indicate that liquidity shortages ($CB_i > 0$), will reduce long-term investment to satisfy liquidity requirements. Moreover they indicate that the amount of investment reduced will be bigger than the shortage because liquidation is costly. In banking institutions these liquidity costs are related to selling securities, calling in or selling off loans. Therefore what the expressions describe is the linkage between liquidity provisions and potentially profitable assets.

The existence of long-term investment guarantees the viability of the transformation process. Thus, we can define asset liquidation condition as:

$$D_i - M_i - c_l\left[\tilde{x}D_i - M_i\right] > 0 \qquad (3.4)$$

What this condition means is that, when a liquidity shortage occurs, transformation activities are viable in the long-tem if net portfolio investment remains positive. It can also be interpreted as the limiting condition for liquidating illiquid assets given a liquidity shortage. The above condition defines the proportion of early withdrawals that exhaust the illiquid resources of the bank given deposits and a specific asset allocation. We call this threshold as the asset-liquidation cut-off:

$$x_L\left(M_i, D_i\right) = \frac{D_i - M_i\left[1 - c_l\right]}{c_l D_i} \leq 1 \qquad (3.5)$$

Notice that when the idiosyncratic liquidity shock is larger or equal to the asset-liquidation cut-off, liquidated resources are not sufficient to satisfy the short-term deposit demand. The asset transformation process ends because liquidity requirements exhaust the banking assets. Also, notice that liquidity cut-offs are a function of reserves and deposits. Moreover, because the asset liquidation cut-off cannot be higher than one, deposits cannot be smaller than reserves.

3.3.2. Idiosyncratic liquidity shocks and long-term solvency

The middle-term financial strategies followed by the bank, in addition with the returns derived from its initial investment activities, determine the scenarios and outcomes of the model related to banking viability and profitability. Profitability is analysed considering the difference between assets and liabilities. Given our assumptions, *the non-negative long-term banking profit function* is:

$$\hat{\tilde{\pi}}_i = \left[L_i - c_l\left[Max\left(0, CB_i\right)\right]\right]\tilde{y} + \left[-Min\left(0, CB_i\right)\right] - \left[(1-\tilde{x})D_i r_D\left(D\right)\right] \qquad (3.6)$$

Here the banking revenues are the sum of net investment returns plus the return of remaining reserves when applicable. The costs of the bank are given by the sum of mature payments.

Contingent banking strategies do no not exclude the possibility of financial failure. Given the uncertainty associated with its long-term investment returns, the bank will fail if the return y, is below a banking solvency threshold. This break-even value will correspond to the minimum investment return necessary for the banking firm to meet its long-term obligations. However, given that these liabilities depend on idiosyncratic liquidity shocks and associated contingent strategies, we need to evaluate banking solvency values for liquidity shortages and surpluses. Thus we define, y_L^*, y_H^* as the break even return values given both initial low and high reserves (liquidity shortages and surpluses). This suggests that it is possible to define a banking solvency function for a given level of deposits and alternative asset allocations.

We can define the banking solvency function given that banking profits should not be negative. Given the uncertainty in the financial markets, banking provisions should consider that solvency must be achieved even without favourable circumstances. The minimum portfolio return necessary to achieve the required solvency would depend on the uncertainty associated with the demand for withdrawals.

Asset management considerations would lead the bank to acquire a long-term portfolio with an acceptable level of risk. Up to this moment, we have indicated that the bank might fail if the return y, is below the break-even values, without explicitly defining

such values. Minimum portfolio break even returns depend on uncertain withdrawal considerations. Thus, what we need to evaluate are the *banking solvency set of threshold return values* $y_H^*(x, M_i, D_i), y_L^*(x, M_i, D_i)$, that bound the set of solvent investment returns given a proportion of reserves. Investment returns below these values will distinguish the insolvent scenarios from solvent ones while idiosyncratic shocks will separate the shortage scenarios from the surplus ones. Notice then, how solvency risk relates with former and contingent liquidity-risk management decisions.

The function $y_L^*(x, M_i, D_i)$ determines the values of $\tilde{y}$ such that profits vanish, given liquidity shortages (low initial reserves). Given the initial asset allocation, deposits and the idiosyncratic shock, the intermediary is insolvent if the portfolio return is below the corresponding $y_L^*(x, M_i, D_i)$ threshold value. We obtain this banking solvency function by assuming liquidity shortages, setting (3.6) equal to zero and solving for the break point portfolio return.

$$y_{Li}^*(x, M_i, D_i) = \frac{(1-x)D_i r_D(D)}{[D_i - M_i - c_l[xD_i - M_i]]} \tag{3.7a}$$

The analogous function $y_H^*(x, M_i, D_i)$ determines the value of $\tilde{y}$ such that the profits vanish given middle-term liquidity surpluses (high reserves). This is evaluated assuming liquidity surpluses and using (3.6) as before.

$$y_{Hi}^*(x, M_i, D_i) = \frac{(1-x)D_i r_D(D) + [xD_i - M_i]}{[D_i - M_i]} \tag{3.7b}$$

Notice that both functions depend on the uncertain liquidity shock and the decision variables. Also notice that, *any* asset allocation and deposit decision have associated a banking solvency function.

3.3.3. Profitability, the banking solvency function and the viability of the asset transformation process

Next we define the conditions that assure the viability of the asset transformation process. Notice that portfolio investment per se does not guarantee banking solvency. The asset transformation process requires achievable solvency values. Otherwise,

bankruptcy will be the long-term outcome. These considerations set more strict conditions to the viability of the asset-transformation process than the mere existence of minimum portfolio investment returns. More specifically, they require that such break-even values cannot exceed the maximum long-term return.

Assuming liquidity shortages, the asset transformation viability condition implies that there is a maximum proportion of early withdrawals for which it is viable to continue with the transformation process, and is denoted as $x_l(M_i, D_i)$. This is the proportion of early withdrawals that avoids bankruptcy outcomes given a liquidity shortage and the maximum banking solvency value y_F. Thus, the asset-transformation viability condition for liquidity shortages can be written as:

$$y^*_{Li}(x, M_i, D_i) \leq y_F \quad x_M(M_i, D_i) < x < x_l(M_i, D_i) \tag{3.8}$$

The maximum proportion of early withdrawals is obtained from equating the shortage solvency function (3.7a) with the maximum feasible long-term return. This asset-transformation cut-off is:

$$x_l(M_i, D_i) = \frac{[D_i - M_i(1-c_l)]y_F - D_i r_D(D)}{D_i[y_F c_l - r_D(D)]} \tag{3.9}$$

The above condition not only delimits early withdrawals, but also establishes inter-temporal profitability and viability relationships between assets and liabilities (the risk management process itself), when liquidity shortages occur.

The relationship among portfolio returns, liquidation costs and deposit returns can be analysed considering that the asset-liquidation cut-off cannot be smaller than the asset-transformation one:

$$x_L(M_i, D_i) - x_l(M_i, D_i) \geq 0$$

$$x_L(M_i, D_i) - x_l(M_i, D_i) = r_D(D)\frac{[D_i - M_i](c_l - 1)}{D_i c_l[y_F c_l - r_D(D)]} \geq 0 \Leftrightarrow r_D(D) < y_F c_l$$

Therefore, the long-term return ratio between deposits and portfolio investment cannot exceed liquidity costs.

The necessity of a long-term return spread can be derived comparing $x_l(M_i, D_i)$ with $x_M(M_i, D_i)$ and assuming that the former cannot be smaller than the latter one.

$$x_l(M_i, D_i) > x_M(M_i, D_i), \frac{M_i}{D_i} \leq 1 \Rightarrow \quad y_F > r_D(D)$$

Next, we define the asset transformation condition for surpluses. Notice that liquidity surpluses can induce financial fragility because they require higher long-term break-even revenues in order to satisfy mature deposit claims. Under these circumstances liquidity surpluses do not only set boundaries to the solvency function, but also can threat the long-term viability of the asset transformation process.

Assuming liquidity surpluses, the asset transformation viability condition implies that there is a minimum proportion of early withdrawals for which it is viable to continue with the transformation process, and is denoted as $x_h(M_i, D_i)$. This is the proportion of early withdrawals that avoids bankruptcy outcomes given a liquidity surplus and the maximum banking solvency value. The asset-transformation viability condition for liquidity surpluses can be written as:

$$y^*_{Hi}(x, M_i, D_i) \leq y_F \quad x_h(M_i, D_i) < x < x_M(M_i, D_i) \tag{3.10}$$

Analogously, equating (3.7b) with the maximum feasible return we find that the minimum asset transformation cut-off is:

$$x_h(M_i, D_i) = \frac{[D_i - M_i]y_F + M_i - D_i r_D(D)}{D_i[1 - r_D(D)]} \tag{3.11}$$

The above condition not only delimits early withdrawals, but also establishes the necessity of a deposit return that is higher than one, given the long-term return spread and that the reserves cannot exceed deposits. This result can be obtained evaluating $x_h(M_i, D_i)$ and comparing it with the $x_M(M_i, D_i)$ threshold value assuming that the former cannot be higher than the latter.

$$x_h(M_i, D_i) < x_M(M_i, D_i), 1 \geq \frac{M_i}{D_i}, y_F > r_D(D) \Rightarrow \quad r_D(D) > 1$$

The above result can also be derived considering that the asset-transformation cut-off cannot be smaller than zero.

Finally, it is important to notice that profitability and the viability of the asset transformation process depend on the banking solvency function. If long-term investment returns lie between the solvency thresholds the bank generates profits; otherwise the bank is insolvent. Therefore, *the differentiation between solvency and insolvency is clarified through the joint analysis of assets and liabilities*. Moreover, given that such thresholds depend on liquidity shocks, they also set the temporal dimension between solvency and liquidity. *Thus, the inter-temporal relationship between liquidity and solvency risks, i.e. the management process, can be evaluated through liquidity and solvency thresholds.*

3.4. Banking scenarios and outcomes

The banking profit function and the break even solvency returns define the set of possible long-term scenarios that the bank might face given the uncertainty on both sides of its balance sheet. These scenarios are the surplus-solvent, shortage-solvent, surplus-insolvent and shortage-insolvent ones. They are named accordingly to all possible conditions that at T=2 the bank might face after both shocks are realised. We proceed to describe them below.

- ***Surplus-Solvent scenario***; $x_h(M_i, D_i) \leq \tilde{x} \leq x_M(M_i, D_i), \tilde{y} \geq y^*_{Hi}$

Here, a liquidity surplus $(CB_i \leq 0)$ occurred at T=1, and depositors at T=2 get their funds back. Long-term banking profits are:

$$\pi_i = \tilde{y}L_i + [-CB_i] - [(1-\tilde{x})D_i r_D(D)] \qquad (3.12a)$$

- ***Shortage-Solvent scenario***; $x_l(M_i, D_i) \geq \tilde{x} \geq x_M(M_i, D_i), \tilde{y} \geq y^*_{Li}$

Here, a liquidity shortage $(CB_i \geq 0)$ occurred at T=1, and depositors at T=2 get their funds back. Long-term banking profits are:

$$\pi_i = \left[L_i - c_l\left(CB_i\right)\right]\tilde{y} - \left[\left(1-\tilde{x}\right)D_i r_D\left(D\right)\right] \qquad (3.12b)$$

Notice that there are no asset liquidation cut-off that bound this scenario. Long-term feasibility induces us to consider instead the asset-transformation viability cut-off for liquidity shortages. The latter must be smaller than the former one.

- ***Surplus-Insolvent scenario***; $x_h(M_i, D_i) \le \tilde{x} \le x_M(M_i, D_i), \tilde{y} < y^*_{Hi}$

Here, a liquidity surplus occurred at T=1, and the aggregate gross portfolio return was below y^*_H at T=2. Thus, the bank faces bankruptcy due to solvency risk. Financial loss is equal to: $\pi_i = \tilde{y}L_i + \left[-CB_i\right] - \left[\left(1-\tilde{x}\right)D_i r_D\left(D\right)\right] < 0$

We assume that the bank is forced to bear bankruptcy costs equal to B:

$$\pi_i = -B, B > 0 \qquad (3.12c)$$

- ***Shortage-Insolvent scenario***; $x_l(M_i, D_i) > \tilde{x} > x(M_i, D_i), \tilde{y} < y^*_{Li}$

Here, a liquidity shortage occurred at T=1, and the aggregate gross portfolio return is below y^*_L at T=2. Thus, the bank faces bankruptcy and financial losses.

$\pi_i = \left[L_i - c_l\left(CB_i\right)\right]\tilde{y} - \left[\left(1-\tilde{x}\right)D_i r_D\left(D\right)\right] < 0$

As before, the losses that bank is forced to bear are equal to B:

$$\pi_i = -B, B > 0 \qquad (3.12d)$$

- ***Surplus-Failure scenario***; $\tilde{x} \le x_h(M_i, D_i), y^*_{Hi} > y_F$

Here, a liquidity surplus occurred at T=1. Long-term liabilities are higher than expected portfolio returns. In fact, they are so high that even under the maximum portfolio return and also using excess reserves, revenues will not be enough to satisfy mature depositors. The asset transformation process is interrupted and the bank fails (early termination). In this case, financial failure derives from liquidity risk. Banking losses are B:

$$\pi_i = -B, B > 0 \qquad (3.12e)$$

- ***Shortage-Failure scenario***; $\tilde{x} \geq x_l(M_i, D_i), y^*_{Li} > y_F$

Here, a liquidity shortage occurred at T=1. The demand for early withdrawals was so high that even with the highest possible long-term return, net revenues are not going to satisfy mature claims. The asset transformation process is interrupted and the bank fails (early termination). As before, banking failure derives from liquidity risk.

$$\pi_i = -B, B > 0 \qquad (3.12f)$$

The scenarios described above are summarised in the following table:

Table 3.2 Banking Scenarios (Summary)

Scenario	Main Features	Banking Strategy	Banking Profit	Outcome
Surplus-Solvent	$x_h < x < x_M$, $CB_i < 0$, y is greater or equal to y^*_H	Reserve Reinvestment	$\pi_i = yL_i + [-CB_i] - [1-x]\, r_D\, D_I$	π is greater or equal to 0, depending on y
Shortage-Solvent	$x_l > x > x_M$, $CB_i > 0$, y is greater or equal to y^*_L	Illiquid Asset Liquidation	$\pi_i = y[L_i - c_l\, CB_i] - [1-x]\, r_D\, D_i$	π is greater or equal to 0, depending on y
Surplus-Insolvent	$x_h < x < x_M$, $CB_i < 0$, $y^*_H > y$	Reserve Reinvestment	$\pi_i = -B < 0$	Long-term insolvency due to high liabilities
Shortage-Insolvent	$x_l > x > x_M$, $CB_i > 0$, $y^*_L > y$	Illiquid Asset Liquidation	$\pi_i = -B < 0$	Long-term insolvency due to low net investment
Surplus-Failure	$x_h > x > 0$, $CB_i > 0$,	Early Termination	$\pi_i = -B < 0$	Failure due to high excess reserves
Shortage-Failure	$x_l < x < 1$, $CB_i > 0$,	Early Termination	$\pi_i = -B < 0$	Failure due to low reserves

3.5. Conclusions and discussion

Here we have developed a microeconomic framework to study the inter-temporal behaviour of a bank that manages short-term and long-term assets. We have defined the possible short and long-term scenarios that banks may face given their management decisions taking into account imperfect competition in the deposit market, multiple uncertainty, liquidity and solvency risks and the availability of liquidity-risk management strategies.

Analytically, the framework describes how the sequence of banking decisions, define the scenarios and outcomes that the intermediaries could face in the financial system. Specifically, the inter-temporal relationships between liquidity and solvency risks and between the viability of the asset transformation process and profitability are clarified within this framework. It also emphasises the relationship between asset and liability management practices and the benefit-oriented decision process.

This framework is suitable for the study of the long-term benefit maximisation problem of a non-competitive banking firm. From an industrial organisation perspective, the advantage of using a balance-sheet approach is that it makes explicit the decisions that intermediaries make to deal with their fragility-prone financial structure and to maximise their expected long-term benefits. Moreover, it also suggests linkages among management practices, banking stability and competition in the banking markets. Notice that the interaction among the random variables the banking firm will not only affect the deposit decisions and mature liabilities, but also the benefits associated to the asset revenues and management practices.

We conclude this chapter by indicating that the individual and joint effects of asset and liability uncertainty and the influence of market structure on the optimal risk management decisions will be examined in the next chapter. Here we have only established the basis for the microeconomic analysis of institutional risk management, fragility and market structure of banking firms.

CHAPTER 4
COMPETITION, UNCERTAINTY AND BANKING DECISIONS

4.1. Introduction

In this chapter, we study the profit maximising behaviour of banks that manage short-term and long-term assets and face uncertainty on both sides of their balance sheets and imperfect competition in the deposit market. We analyse the ex-ante optimal banking decisions focusing on the effects of the number of monopolistically competitive institutions in the banking system and the effects of uncertainty. We develop the analysis using the basic microeconomic framework, presented in the previous chapter, and two simplified monopolistic versions of it. Specifically, we use the former to study monopolistic competition effects on banking stability while the two variations are used to study the specific effects of asset and liability uncertainty on banking decisions.[1]

The main questions that we study in this chapter are the following: What is the relationship between competition and banking fragility? Does market structure influence the allocation of resources in banking institutions? What are the inter-temporal effects of asset and liability uncertainty on management decisions? Is there a trade-off between managing liquidity risk and preventing insolvency (asset and liability management) because of the existence of multiple uncertainty? How valid is the traditional academic claim that asset and liability management practices should be analysed as independent issues? [2]

The above questions have relevance for academic and policy purposes. Particularly, the analysis of market structure has been recognised as a key issue to consider when

[1] In the models developed in this chapter, we use the terms *monopolistically competition* and *competition* for simplicity. We use *monopolistically competition* to avoid the less common, but more adequate expression, of *monopsonistically competition in the deposit-factor market*. Regarding *competition*, we mean increases in the number of intermediaries.

[2] The debate regarding the independence of asset-liability management practices relies on certain results derived from the analyses of Klein (1971) and Monti (1972). Specifically, these results suggest that global asset-management practices are irrelevant because optimal management banking policies are characterised by a separation between the pricing of assets (loans) and liabilities (deposits) [Freixas and Rochet (1997)]. However, such results have been questioned under theoretical and empirical basis [See Prisman, Slovin and Sushka (1986), Heffernan (1996) and Mishkin (2000)].

dealing with banking fragility problems and policies [Goodhart and Illing (2002)]. As indicated before, there is no consensus around the nature of the relationship between market structure and stability [See Chapter 2].[3] Here we investigate this issue introducing monopolistically competitive intermediaries in the deposit market. Interestingly, what we find is that optimal liquidity ratios depend on the market structure and size of deposit markets and that these ratios increase as the number of intermediaries increases. Thus, what our findings suggest is that *institutional competition, among monopolistically competitive intermediaries, enhances banking stability when the market size is relatively big*.

We investigate the behaviour of the basic model, developed in the previous chapter, analytically and numerically. Analytically, we characterise the optimal reserves/deposits ratio that makes compatible the prevention of financial distress with profit maximisation. Moreover, what we show is that this ratio depends on market size. Numerically, calibrations show that increases in the number of banks, bankruptcy or liquidation costs will increase the optimal ratios, and that the associated banking benefits will be reduced. Regarding increases in the deposit-supply elasticity or in the quality of long-term investment portfolios, calibrations show that they will have the opposite effects.

Traditionally, the effects of banking uncertainty on each side of the balance sheet have been analysed in the context of the separability property, the irrelevance of ALM practices and associated regulation policies. [4] Our simplified monopolistic models corroborate the claim that the Monti-Klein independence or separability property does not hold when uncertainty is introduced.[5] Furthermore, both simplified models show that market conditions and uncertainty determine the optimal banking decisions.

[3] Historically, it has been considered that competition in the banking markets enhances financial fragility [Friedman and Schwartz (1963)]. However, some others have claimed that competitive banking systems can "mitigate the risks of financial crises" [Claessens and Klingebiel (2001: p. 19)].

[4] The Monti-Klein model states: "If management costs are additive, the bank's decision problem is separable: the optimal deposit rate is independent of the characteristics of the loan market, and the optimal loan rate is independent of the characteristics of the deposit market" [Freixas and Rochet (1997: p. 59)]. This conclusion, known as the separability property, is obtained for a monopolistic banking model without any uncertainty. Interestingly, this property suggests that deposit regulations applied on the liability side of the balance sheet will not have effects on banking assets.

[5] Prisman, Slovin and Sushka (1986), find this result introducing liquidity risk in the Monti-Klein model.

Therefore, our models *not only justify ALM practices* based the existence of risks, but also suggest that deposit regulations *will have direct effects* on competition and asset management practices and *indirect effects* on banking stability.

The monopolistic models simplify the microeconomic framework assumptions. In one of the models, we only assume only risky long-term assets; while in the other, we only assume idiosyncratic liquidity shocks.[6] While, the first model shows that long-term asset uncertainty determines long-term solvency and profitability; the second one, shows how the viability of the asset transformation process and the distinction between short-term solvency and liquidity risks depend on random deposit withdrawals. Interestingly, the comparison between the calibration comparative-static analyses shows that both models are *complementary* in the sense that their optimal behavioural decisions show qualitative similar patterns. Moreover, these patterns are similar with the ones associated to the basic model. Therefore, there is no inconsistency among liquidity, asset and liability goals regarding the maximisation of banking profits and the minimisation of bankruptcy costs.

From a theoretical perspective, the basic model can be seen as the asset management banking firm counterpart of the traditional liquidity insurance and financial fragility models in which depositors play the main role. Its main contribution lies in the analysis of how banking competition enhances banking stability when we introduce multiple uncertainty and when strategies to deal with liquidity and solvency risks are available. Regarding the monopolistic models, they suggest that the time-consistency dilemma between short-term and long-term management goals does not necessarily exist. Therefore, *the maximisation of long-term profits and the minimisation of financial distress seem to be complementary and compatible objectives*.

[6] Evidently, the conclusions obtained from the simplified models are similar to the ones associated to Dermine (1986) and Prisman, Slovin and Sushka (1986). However, the models exposed here exhibit important differences from those models. First, we introduce liquidity and bankruptcy costs in both models to rationalise the need of management practices. Second, we introduce liquidity risk in terms of unknown proportions or early deposit withdrawals [like Diamond and Dybvig (1983)]. Traditional models introduce liquidity risk assuming stochastic demands for loans [Prisman, Slovin and Sushka (1986)] or subjecting the volume of deposits to random shocks and considering liquidity shortages solely [Freixas and Rochet (1997)]. The advantage of our modelling structure is that we can not only

The chapter is divided in six sections. Section 4.2 summarises the main assumptions, defines the optimisation program and characterises the optimal decisions for the microeconomic framework described on Chapter 3. In Section 4.3, the behaviour of the basic monopolistically competitive model is studied analytically and numerically. The comparative static analysis and numerical exercises are presented focusing on the relationship between market structure and banking stability. Section 4.4 analyses the two simplified monopolistic models, namely one with only long-term investment uncertainty and another with only random deposit withdrawals. Comparative static numerical analyses are done for both models. In Section 4.5 we compare the behaviour of the three models. The final section concludes.

4.2. Model structure and optimal banking allocations

In this section, the basic banking model is studied analytically. We start by summarising the main assumptions of the basic microeconomic model and by defining the expected benefit function (the expected difference between profits and bankruptcy costs). We define the expected objective function under multiple uncertainty. Then we build the optimisation program and characterise the optimal solution. Finally this section concludes by establishing how the optimal risk-management allocations relate to the market structure prevailing in the deposit markets.

4.2.1. Main assumptions and the expected benefit function with multiple uncertainty

The main assumptions of the microeconomic model are:

1.- Monopolistically competition among identical banks prevails in the deposit markets.[7]

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analyse the inter-temporal linkages between solvency and liquidity risks; but also we can include the prevention of financial distress as a risk management goal in addition to profit maximisation.

[7] We consider that monopolistically competition exists in this framework because the industry structure shares elements associated to competition and monopoly. Notice that each bank is a return-taker intermediary firm in the asset markets, so it sells at a price and output combination on its demand curve. Each firm maximises its expected benefits, given the supply curve facing it. As we will see later, entry forces the expected profits and benefits of each firm down to zero. These features in our framework are relatively similar to the ones of traditional monopolistically competitive models [See Varian (2003)].
Evidently, it can be argued that because deposits are not differentiated, the framework can be understood in terms of Cournot competition. However, we *do not* focus on the strategic interactions among firms and monopolistically competition models *do not* necessarily require product differentiation to define them. Martin (1993) shows that Chamberlinian monopolistically competition results arise in

2.- Liquid liabilities D_i, and illiquid long-term assets L_i induce banking fragility

3.- Reserves M_i and deposits D_i are the decision banking variables.

4.- Ex-ante decisions are taken at T=0.

5.- Banking reserves are held to satisfy idiosyncratic liquidity needs.

6.- Liquidity shocks, x, are realised at T=1.

7.- Reserve reinvestment and costly asset liquidation are available (contingent liquidity-risk strategies).

8.- Bankruptcy is always a possibility and bankruptcy costs are fixed.

9.- Solvency depends mainly in portfolio investment returns, y, that become known at T=2.

The *expected final benefit function of the bank* is defined by taking into consideration the existence of multiple uncertainty, all possible banking scenarios with respect to liquidity and solvency, and all associated outcomes. The banking solvency function and the break-even thresholds define the boundaries of each probabilistic scenario. This benefit function is defined as:

$$\overline{\pi}_i(M_i, D_i) = \int_{x_h}^{x_M} \int_{y_{Hi}^*}^{y_F} [yL_i - (xD_i - M_i) - (1-x)D_i r_D(D)] g(y) f(x) dy dx +$$

$$\int_{x_M}^{x_l} \int_{y_{Li}^*}^{y_F} [(L_i - c_l(xD_i - M_i))y - (1-x)D_i r_D(D)] g(y) f(x) dy dx$$

$$- \left[\int_{x_h}^{x_M} \int_{0}^{y_{Hi}^*} Bg(y) f(x) dy dx + \int_{x_M}^{x_l} \int_{0}^{y_{Li}^*} Bg(y) f(x) dy dx + \int_{0}^{x_h} \int_{0}^{y_F} Bg(y) f(x) dy dx + \int_{x_l}^{1} \int_{0}^{y_F} Bg(y) f(x) dy dx \right] \tag{4.1}$$

This expected benefit function comprises the profits and losses associated to the decisions taken by the bank. The double integrals show the expected outcomes associated to the Surplus-Solvent, Shortage-Solvent, Surplus-Insolvent, Shortage-Insolvent, Surplus-Failure and Shortage-Failure scenarios respectively.

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models in which standardised products and Cournot quantity-setting firms exist in the market. Interestingly, such monopolistic results depend on assumptions regarding fixed costs and adjustments in the number of firms that force them to earn zero profits. We point out these assumptions because in the next chapter we will introduce them to analyse the degree of banking competition.

4.2.2. The maximisation program and the characterisation of the optimal solution

The maximisation problem for the microeconomic model is the following.

$$\pi_i(M_i, D_i) = Max\{0, \overline{\pi}_i(M_i, D_i)\} \tag{4.2}$$

Banking firms will participate in the financial system only when the expected benefits of participation are not negative. Thus, our model allows intermediation activities under value addition considerations.[8]

The program is defined with the expected benefit function and the explicit banking solvency and break-even return functions given our assumptions about returns, deposits and liquidations costs. Assuming uniform density functions, the program can be written as:

$$\overline{\pi}_i(M_i, D_i) = MAX \frac{1}{y_F} \int_{x_h}^{x_M} \int_{y^*_{Hi}}^{y_F} \left[(D_i - M_i)y - (xD_i - M_i) - (1-x)D_i r_D(D)\right] dy dx +$$

$$\frac{1}{y_F} \int_{x_M}^{x_l} \int_{y^*_{Li}}^{y_F} \left[(D_i - M_i - c_l(xD_i - M_i))y - (1-x)D_i r_D(D)\right] dy dx$$

$$-\frac{1}{y_F}\left[\int_{x_h}^{x_M}\int_{0}^{y^*_{Hi}} B dy dx + \int_{x_M}^{x_l}\int_{0}^{y^*_{Li}} B dy dx + \int_{0}^{x_h}\int_{0}^{y_F} B dy dx + \int_{x_l}^{1}\int_{0}^{y_F} B dy dx\right]$$

s.t. (4.3)

$$y^*_{Li}(x, M_i, D_i) = \frac{(1-x)D_i r_D(D)}{\left[D_i - M_i - c_l\left[xD_i - M_i\right]\right]}$$

$$y^*_{Hi}(x, M_i, D_i) = \frac{(1-x)D_i r_D(D) + \left[xD_i - M_i\right]}{\left[D_i - M_i\right]}$$

$$x_l(M_i, D_i) = \frac{\left[D_i - M_i(1-c_l)\right]y_F - D_i r_D(D)}{D_i\left[y_F c_l - r_D(D)\right]}$$

$$x_h(M_i, D_i) = \frac{\left[D_i - M_i\right]y_F + M_i - D_i r_D(D)}{D_i\left[1 - r_D(D)\right]}$$

$$x_M(M_i, D_i) = \frac{M_i}{D_i}$$

[8] Formally, value added is the "amount by which a production process increases the value of a good or service. It is computed by sales revenue less the cost of inputs used to produce the good / service. In banking, the sales revenue will equal explicit charges plus the interest margin (what a bank charges to borrowers and pays out to depositors)" [Heffernan (1996: p. 31)]. Notice that, in our framework, non-negative banking benefits satisfy such criterion.

Notice that the constraints that define the boundaries of the banking set do not depend on the explicit probabilistic density functions. These constraints, which determine the profitability and the viability of the asset transformation process, mainly depend on the decision variables. Specifically, the first two constraints define the banking solvency function necessary to achieve long-term profitability. The subsequent two define the asset transformation conditions given a specific asset allocation. Such allocation is defined by the last constraint.

We proceed by evaluating the first order conditions, (FOC), of the optimisation program assuming interior solutions [See Appendix for chapter 4, Section 2.A.]. The first order condition for reserves shows that, *at the optimum, marginal profits from reserves must be identical to marginal bankruptcy costs*.

$$\frac{\partial}{\partial \mathrm{M_i}} \overline{\pi}_i \left(M_i^*, D_i^*\right) = 0$$

$$\int_{x_h}^{x_M} \int_{y_{Hi}^*}^{y_F} (y-1)\,dy\,dx + \int_{x_M}^{x_l} \int_{y_{Li}^*}^{y_F} y(1-c_l)\,dy\,dx$$

$$= \frac{BD_i^*}{\left(D_i^* - M_i^*\right)^2} \left[\int_{x_h}^{x_M} \left(1 - r_D\left(D^*\right)\right)(1-x)\,dx - \left[\int_{x_M}^{x_l} \frac{(1-x)(1-c_l) r_D\left(D^*\right)}{\left[D_i^* - M_i^* - c_l\left(xD_i^* - M_i^*\right)\right]^2} dx \right] \left(D_i^* - M_i^*\right)^2 \right] \tag{4.4a}$$

The first order condition for deposits can be written in terms of the supply-elasticity.[9] Moreover, assuming that this elasticity is constant we can define the following equation [See Appendix for chapter 4, Section 2.B.]:

[9] The deposit-supply elasticity is defined as:

$$\varepsilon_D = r_D \frac{D'(r_D)}{D(r_D)} = \frac{r_D(D)}{r_D'(D)D} > 0$$

$$\frac{\partial}{\partial D_{\mathrm{i}}}\overline{\pi}_i\left(M_i^*, D_i^*\right)=0$$

$$\int_{x_h}^{x_M}\int_{y_{Hi}^*}^{y_F}\left[y-x-(1-x)r_D\left(D^*\right)\right]dydx+\int_{x_M}^{x_l}\int_{y_{Li}^*}^{y_F}\left[y(1-c_l x)-(1-x)r_D\left(D^*\right)\right]dydx$$

$$-\frac{r_D\left(D^*\right)}{N\varepsilon_D}\left[\int_{x_h}^{x_M}\int_{y_{Hi}^*}^{y_F}(1-x)dydx+\int_{x_M}^{x_l}\int_{y_{Li}^*}^{y_F}(1-x)dydx\right]$$

$$-\frac{Br_D\left(D^*\right)}{N\varepsilon_D}\left[\int_{x_h}^{x_M}\frac{(1-x)}{\left(D_i^*-M_i^*\right)}dx+\int_{x_M}^{x_l}\frac{(1-x)}{\left[D_i^*-M_i^*-c_l\left(xD_i^*-M_i^*\right)\right]}dx\right]$$

=

$$\frac{BM_i^*}{\left(D_i^*-M_i^*\right)^2}\left[\int_{x_h}^{x_M}\left(1-r_D\left(D^*\right)\right)(1-x)dx-\left[\int_{x_M}^{x_l}\frac{(1-x)(1-c_l)r_D\left(D^*\right)}{\left[D_i^*-M_i^*-c_l\left(xD_i^*-M_i^*\right)\right]^2}dx\right]\left(D_i^*-M_i^*\right)^2\right]$$

(4.4b)

The above expression allows us to study the relationship between market structure and banking decisions. Notice that *the model can be interpreted as a model of imperfect competition with two limiting cases*: N=1 (monopsony) and N=+∞ (perfect competition). This feature of the model will allow us to study the relationships among risk management decisions, institutional competition and banking stability.

Before continuing, we define the following auxiliary definitions:

$$u_1=\int_{x_h}^{x_M}\int_{y_{Hi}^*}^{y_F}\left[y-x-r_D\left(D^*\right)(1-x)\right]dydx+\int_{x_M}^{x_l}\int_{y_{Li}^*}^{y_F}\left[y(1-c_l x)-r_D\left(D^*\right)(1-x)\right]dydx \quad (4.5a)$$

$$u_2=\left[\int_{x_h}^{x_M}\frac{(1-x)}{\left(D_i^*-M_i^*\right)}dx+\int_{x_M}^{x_l}\frac{(1-x)}{\left[D_i^*-M_i^*-c_l\left(xD_i^*-M_i^*\right)\right]}dx\right] \quad (4.5b)$$

$$u_3=\left[\int_{x_h}^{x_M}\int_{y_{Hi}^*}^{y_F}(1-x)dydx+\int_{x_M}^{x_l}\int_{y_{Li}^*}^{y_F}(1-x)dydx\right] \quad (4.5c)$$

$$v=\left[\int_{x_h}^{x_M}\int_{y_{Hi}^*}^{y_F}(y-1)dydx+\int_{x_M}^{x_l}\int_{y_{Li}^*}^{y_F}y(1-c_l)dydx\right] \quad (4.5d)$$

We can get an expression for the optimal proportion of reserves to deposits (optimal liquidity ratios) by observing that the RHS expressions of the first order conditions are almost identical. Dividing (4.4b) by (4.4a) and rewriting the ratio using auxiliary definitions, (4.5a)-(4.5d), we obtain the optimal proportion of reserves to deposits.

Thus, the *risk management optimal allocation under imperfect competition (RMOA$_{IC}$)* can be defined in terms of the following liquidity ratio:

$$RMOA_{IC} \equiv \frac{M_i^*}{D_i^*} = \frac{u_1}{v} + \frac{r(D^*)}{N\varepsilon_D}\left[-\frac{Bu_2 + u_3}{v}\right] \tag{4.6}$$

Equation (4.6) shows that *the optimal proportion of liquid assets is equal to an independent term plus an additional one that depends on the size of the deposit market*.[10] Also it shows that the unknown signs associated to the auxiliary definitions, u_1 and v, are identical because feasible proportions cannot be negative. In general, we find that risk management, financial fragility and market structure issues are interdependent processes.

4.3. Banking decisions with uncertainty on both sides of the balance sheet

In this section, the behaviour of the monopolistically competitive model is studied analytically and numerically. First, we focus on the optimal management allocation and the ambiguous effect of reserves on marginal profits to justify the necessity of numeric analysis. Latter, we do a calibration exercise for different parameter configurations and specific probability distributions to evaluate how changes in the exogenous parameters modify the optimal reserve decisions and expected benefits. Finally, we focus on the relationship between institutional competition and banking stability.

4.3.1. Optimal decision allocations, indeterminacy and time-consistency

The optimal liquidity ratio determines how deposits must be allocated between short-term liquid reserves and long-term illiquid investment to avoid banking crises. Moreover, it characterises the criterion that makes compatible the provision of liquidity to depositors and the maximisation of banking profits under multiple uncertainty. Furthermore, it offers an inter-temporal risk sharing solution for the time-

[10] We use the term *market size* instead of *market power* to emphasise the monopolistically competitive nature of the banking system. Evidently, the intermediaries have some market power in the sense that they can set deposit-returns, rather than passively accept the market ones. Moreover, the market size expression is similar to the Lerner index.

consistency dilemma associated with the banking financial structure. Thus, this ratio provides a risk management criterion to deal with financial fragility and profit maximisation goals considering the number of banking competitors and the availability of strategies to deal with liquidity and solvency risks.

Mathematically, the absence of an explicit form solution for the optimisation program makes difficult to analyse the behaviour of the model. Notice that the optimal liquidity ratio does not provide closed form solutions for the optimal decision variables. Thus the comparative static analysis cannot be done directly.[11] Moreover this analytical difficulty extends to the optimal liquidity ratio itself. As we will show below, the latter problem relates to the analytical characterisation of the auxiliary definitions that define the optimal liquidity ratio.

The main problem relates to the determination of the sign associated to the auxiliary definitions. Despite the knowledge that the sign associated to the auxiliary equations u_1 and v [(4.5a) and (4.5(d), respectively], must be identical, we cannot determine it

[11] It can be argued that assuming that the first order conditions of the maximisation program possess continuous derivatives the implicit function theorem allows to derive the comparative-static derivatives. Considering this possibility, we delineate such derivatives. The comparative-static derivatives for each parameter $\left(PARAMETER = B, c_l, \varepsilon_D, N, y_F\right)$, are:

$$\begin{bmatrix} \dfrac{\partial M_i^*}{\partial PARAMETER} \\ \dfrac{\partial D_i^*}{\partial PARAMETER} \end{bmatrix} = -\frac{1}{|J|}\begin{bmatrix} \dfrac{\partial}{\partial D_i}F^2 & -\dfrac{\partial}{\partial D_i}F^1 \\ -\dfrac{\partial}{\partial M_i}F^2 & \dfrac{\partial}{\partial M_i}F^1 \end{bmatrix}\begin{bmatrix} \dfrac{\partial}{\partial PARAMETER}F^1 \\ \dfrac{\partial}{\partial PARAMETER}F^2 \end{bmatrix},$$

Mathematically, the comparative static analysis derivatives are obtained taking the total differential of each first-order condition identity below, fixing the differential of the non-analysed parameters to zero and solving the remaining system of equations.

$$\mathrm{F}^1\left(M_i^*, D_i^*; B, c_l, \varepsilon_D, N, y_F\right) \equiv 0$$

$$\mathrm{F}^2\left(M_i^*, D_i^*; B, c_l, \varepsilon_D, N, y_F\right) \equiv 0$$

Notice that the first-order-condition functions are defined as:

$$\mathrm{F}^1\left(M_i, D_i; B, c_l, \varepsilon_D, N, y_F\right) = \frac{\partial}{\partial M_i}\overline{\pi}_i\left(M_i, D_i\right) = 0$$

$$\mathrm{F}^2\left(M_i, D_i; B, c_l, \varepsilon_D, N, y_F\right) = \frac{\partial}{\partial D_i}\overline{\pi}_i\left(M_i, D_i\right) = 0$$

$$\mathrm{M}_\mathrm{i}^* = M_\mathrm{i}^*\left(B, c_l, \varepsilon_D, N, y_F\right)$$

$$\mathrm{D}_\mathrm{i}^* = D_\mathrm{i}^*\left(B, c_l, \varepsilon_D, N, y_F\right)$$

$$|\mathrm{J}| = |\text{Former Program Hessian}| > 0$$

with certainty. The reason is that both expressions are integrated by two integrals with a net effect that cannot be easily determined. This sign indeterminacy is important because equation (4.5d) appears in both terms of the optimal liquidity ratio. Thus, in first instance, this problem does not allow us to conclude decisively regarding the effects of market structure on the optimal risk management allocation of resources.

We are aware that this conclusion is counter-intuitive. Even simpler than equation (4.5a) and with a straightforward economic interpretation, equation (4.5d) cannot be analytically signed. The evaluated integral involves logarithmic expressions whose sign cannot be determined under the given conditions. [12] Moreover, economic

[12] We justify the above conclusion by evaluating equation (4.5d):

$$v = \int_{x_h}^{x_M}\int_{y_{Hi}^*}^{y_F}(y-1)\,dy\,dx + \int_{x_M}^{x_l}\int_{y_{Li}^*}^{y_F} y(1-c_l)\,dy\,dx =$$

$$\frac{1}{6}\frac{D_i^* - M_i^*}{D_i^*\left[r_D(D^*)-1\right]^3 c_l}\left[\theta_3(\cdot)r_D^3(D^*) + \theta_2(\cdot)r_D^2(D^*) + \theta_1(\cdot)r_D(D^*) + (2y_F c_l - 3)(y_F c_l)^2\right]$$

Where

$$\theta_1(\cdot) = -3y_F c_l (y_F c_l - 2)(2c_l - 1)$$

$$\theta_2(\cdot) = c_l \ln(D_i^* - M_i^*)^{12} + 6y_F c_l^3 + c_l^2 \ln(c_l - 1)^6 + c_l^2 \ln\left(\frac{1}{(D_i^* - M_i^*)^6}\right) - 12y_F c_l^2$$
$$+ c_l^2 \ln(D_i^* - M_i^*)^6 + 6y_F c_l - 9c_l^2 + c_l \ln\left(\frac{1}{r_D^{12}(D^*)}\right) + c_l \ln(r_D(D^*) - y_F c_l)^{12} + 6c_l$$
$$+ c_l \ln\left(\frac{1}{(c_l - 1)^{12}}\right) + c_l^2 \ln(r_D^6(D^*)) + c_l \ln\left(\frac{1}{(D_i^* - M_i^*)^{12}}\right) + c_l^2 \ln\left(\frac{1}{(r_D(D^*) - y_F c_l)^6}\right)$$
$$+ \ln\left(\frac{r_D^6(D^*)(c_l - 1)^6}{(r_D(D^*) - y_F c_l)^6}\right)$$

$$\theta_3(\cdot) = c_l \ln(D_i^* - M_i^*)^{12} + c_l^2 \ln(D_i^* - M_i^*)^6 + c_l \ln\left(\frac{1}{(D_i^* - M_i^*)^{12}}\right) + c_l^2 \ln(r_D(D^*) - y_F c_l)^6$$
$$+ c_l^2 \ln\left(\frac{1}{(D_i^* - M_i^*)^6}\right) + c_l \ln(r_D^{12}(D^*)) + c_l^2 \ln\left(\frac{1}{(c_l - 1)^6}\right) + c_l \ln(c_l - 1)^{12} - 2c_l^3 +$$
$$+ c_l \ln\left(\frac{1}{(r_D(D^*) - y_F c_l)^{12}}\right) - 6c_l + c_l^2 \ln\left(\frac{1}{r_D^6(D^*)}\right) + 9c_l^2 + \ln\left(\frac{(r_D(D^*) - y_F c_l)^6}{r_D^6(D^*)(c_l - 1)^6}\right)$$

The difficulty to establish the sign of the evaluated integral relates to the logarithmic expressions accompanying the deposit-return polynomial term. They may be positive or negative depending on the absolute magnitude of the terms in each expression. Without the characterisation of the sign and magnitude of these expressions, the term between brackets and the whole integral cannot be signed. Even if this problem could be solved, the characterisation of the logarithmic expressions may not be

reasoning does not allow us to infer the sign because equation (4.5d) are the expected marginal profits due to reserves evaluated at the optimum [See (4.4a)]. Intuitively, it can be argued that reserves reduce profits because they reduce total investment, but also it can be counter-argued that because they increase the viability of the transformation process, they directly contribute to long-term profitability. Thus, in first instance, the sign indeterminacy of the equation reflects the traditional time-consistency dilemma that underlies banking debates.

Sign indeterminacy suggests the use of numeric strategies to understand the behaviour of the model. Despite that this approach limits the analytical strength of our results, it offers concrete solutions for the indeterminacy problem discussed above. Moreover, it allows to deal with the more general problem associated to the change of the optimal banking decisions when the exogenous parameters change. This is because this type of analysis can provide us with concrete behavioural patterns when the structure of the optimisation program is consistent.

4.3.2. Behavioural calibration exercises and comparative static analysis

Here we work out several calibration exercises to investigate the behaviour of the banking model. Using a specific deposit supply function with constant elasticity, we investigate how changes in bankruptcy and liquidation costs, the deposit-supply elasticity and the quality of investment portfolios affect the optimal decisions, the optimal asset allocation and expected banking profits of individual banking firms. Moreover, we investigate the robustness of our results considering different institutional settings to verify their consistency.[13]

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sufficient to evaluate the integral due to the possibility of sign inconsistency (negative values for the expressions for which the logarithmic operation applies). Mathematically, sign inconsistency in logarithmic first order conditions can be associated to the existence of corner solutions. Notice that in our optimisation problem, this is a possibility that we cannot dismiss under certain parametrical and market conditions.

[13] We use the terminology *institutional setting* to describe sets of market environments in which the number of banking institutions in the deposit-factor market is constant. Given that traditional microeconomics uses the number of firms to characterise market structures, an *institutional setting* describes the number of monopolistically competitive intermediaries that define the banking industry. In the next chapter we will use the expression *perfectly competitive* to indicate that the number of individual firms in a specific industry is the maximum that the size of the market can hold without having negative benefits (v.g., in our framework, an monopolistically competitive institutional setting integrated by one institution relates to a banking monopsony. Particularly, an institutional perfectly competitive setting involving one bank corresponds to a "natural" monopsony).

Assume that that the deposit-supply functional form is $r_D(D) = aD^{\frac{1}{\varepsilon_D}}$ Let the benchmark parameter configuration be: $a = 1.1, B = 2, c_l = 1.5, \varepsilon_D = 2, y_F = 10$. Finally, we let the institutional settings to include one, two or three banks in the financial system. [14]

Comparative static numerical exercises show consistent behavioural patterns for changes in the parameters on the optimal decision variables.[15] The exercises show that increases in bankruptcy and liquidation costs or in the number of banks will reduce the individual amount of optimal deposits, while increases in the deposit-supply elasticity or in the quality of the portfolio will have the opposite effects. They also show that increases in bankruptcy costs or the number of intermediaries will reduce the total amount of liquid reserves. These findings allow us to determine that the comparative static derivative signs are:

$$\frac{\partial D_i^*}{\partial B} < 0, \frac{\partial D_i^*}{\partial c_l} < 0, \frac{\partial D_i^*}{\partial \varepsilon_D} > 0, \frac{\partial D_i^*}{\partial N} < 0, \frac{\partial D_i^*}{\partial y_F} > 0$$

$$\frac{\partial M_i^*}{\partial B} < 0, \frac{\partial M_i^*}{\partial c_l} > 0, \frac{\partial M_i^*}{\partial \varepsilon_D} > 0, \frac{\partial M_i^*}{\partial N} < 0, \frac{\partial M_i^*}{\partial y_F} > 0$$

Comparative-static calibrations show defined patterns regarding risk-taking behaviour and expected profitability. Specifically, regarding risk-taking incentives, numerical results show that increases in liquidation or in bankruptcy costs will increase optimal reserve ratios, while increases in the deposit-supply elasticity or in the quality of long-term banking portfolios will have the opposite effects. Regarding expected benefits, our results show that increases in liquidation or in bankruptcy costs will reduce expected benefits, while increases in the deposit-supply elasticity or in the quality of

[14] Computational limitations did not allow us to study more general cases. However, the consistency of our results makes us believe that our findings will not be altered for higher numbers of intermediaries.

[15] Numerical optimisations were done applying the double-point Brent-Powell computational method over multiple starting points of the expected benefit function. The logic underlying this multiple starting procedure was to verify the consistency of the optimisation findings and to distinguish between local and global values. The multiple starting procedure was done for each parameter configuration and institutional setting analysed. The computer programs were written using Mathematica software version 4.2. The computer optimisation follows the mathematical programming guidelines suggested by Huang and Crooke (1997). In Wolfram (1999), a more detailed explanation of the numerical methods and computer commands can be found.

long-term investment will increase them. Moreover, these results are independent of the competitive configuration setting analysed (See Figures 4.1.a, 4.1.b and 4.1.c).

The relationship between competition and banking stability is crucial for academic and policy purposes. Although, we have shown that the comparative static analyses for almost all the parameters are consistent for different institutional settings, we have not indicated the effects of the number of institutions on the behaviour of intermediaries. Comparative static calibrations show that increases in the number of institutions will increase optimal liquidity ratios and will reduce expected benefits (See Figure 4.2).

We summarise all the previous qualitative findings, in the following table:

Table 4.1 Comparative Static Analysis for the Basic Banking Model (Calibration Numeric Exercises)

Parameter Variation (Positive)	Optimal Deposits ΔD_i^*	Optimal Reserves ΔM_i^*	Liquidity Ratios $\Delta (M_i^*/D_i^*)$	Expected Benefits $\Delta \pi_i^*$
ΔB	Negative	Negative	Positive	Negative
Δc_l	Negative	Positive	Positive	Negative
$\Delta \varepsilon_D$	Positive	Positive	Negative	Positive
ΔN	Negative	Negative	Positive	Negative
Δy_F	Positive	Positive	Negative	Positive

Evidently, the most relevant findings are associated to the relationships among market structure parameters and banking stability. Numerical calibrations show that intermediaries allocate proportionally fewer resources to long-term risky assets when the number of intermediaries increases or when the deposit-supply elasticity decreases. In other words, the higher the response of the supply of deposits to a given change in interest rates or the higher the concentration in the deposit markets, the higher the

short-term fragility likelihood of banking institutions will be. Particularly, what our findings suggest is that *institutional competition enhances banking stability when market size allows non negative benefits to all the intermediaries*.

4.4. Asset and liability decisions on simplified monopolistic models

In this section we analyse the effects of uncertainty on the banking balance sheet. More precisely, we build two simplified monopolistic models to study the specific effects of asset and liability uncertainty on banking decisions. Following the approach used for the basic model, for each simplified model we define its associated inter-temporal scenarios and the ex-ante optimisation program. Also we characterise the ex-ante banking decisions that maximise their long-term benefits. Finally, we proceed with the numerical calibration analysis to study the behaviour of both models indicating the main findings regarding the specific effects of uncertainty.

4.4.1. Behavioural decisions with long-term investment uncertainty

Here we simplify the basic microeconomic framework assuming that a monopolistic bank exists in the financial system and that the proportion of early depositors is known. These assumptions make individual deposits the only decision variable because reserves become endogenous. They also make explicit that long-term solvency and profitability depend on long-term investment and that the behaviour of the intermediary is determined by value-added incentives. Notice then, that inter-temporal considerations are almost absent in this model.

We begin the analysis defining the banking profit function for this simplified variation. In the absence of liquidity risk, the corresponding function takes the following form:

$$\hat{\pi} = \tilde{y}L - \left[(1 - x_K)Dr_D(D)\right] \qquad (4.7)$$

x_K: Known proportion of early depositors

We can define the banking solvency function taking into consideration that y_H^* determines the value of the banking return $\tilde{y}$ such that profits vanish. This is

equivalent to (3.7a) and (3.7b) in the previous chapter. However, given individual deposits and x_K, both expressions can be simplified to one simple equation:

$$y_H^*(x_K, M, D) = \frac{(1-x_K)Dr_D(D)}{[D-M]} = r_D(D) \quad x_K = \frac{M}{D} \tag{4.8}$$

Long-term profits will be achieved with investment returns higher than long-term deposit ones. Analytically, asset and liability decisions cannot be taken independently one from the other. Moreover, asset-liability management (ALM) practices are justified in the model: The independence property does not hold.

The long-term scenarios and outcomes of the simplified model can be evaluated as before. Again the banking profit function and the break-even solvency return define the set of possible scenarios that the bank might face. In this case, the only relevant scenarios are the long-term solvent and insolvent ones. The scenarios are the following:

- Solvent scenario; $x_K, \tilde{y} \geq y_{Hi}^*$

Here, the firm repays at T=2. Long-term banking profits are:

$$\pi = \tilde{y}L - [(1-x_K)Dr_D(D)] \tag{4.9a}$$

- Insolvent scenario; $x_K, \tilde{y} < y_{Hi}^*$

Here, the aggregate gross portfolio return was below y_H^* at T=2. Thus, the bank faces bankruptcy. As before, we assume that the losses that the bank is forced to bear are B

$$\pi = -B, B > 0 \tag{4.9b}$$

The maximisation program must comprise the expected profits and losses associated to the decision taken by the bank. Under our simplified assumptions, the program is relatively simple. We can write it as follows:

$$\overline{\pi}(D) = MAX \frac{1}{y_F} \int_{y_H^*}^{y_F} [(1 - x_K)(y - r_D(D))D] dy - \frac{1}{y_F} \int_0^{y_H^*} B dy$$

s.t. (4.10)

$$y_H^*(x_K, D) = r_D(D)$$

The first order condition is the following:

$$\frac{\partial}{\partial D} \overline{\pi}(D^*) = 0$$

$$\frac{1}{y_F} \int_{r_D(D^*)}^{y_F} \left[(1 - x_K) \left(y - r_D(D^*) - D^* \frac{\partial}{\partial D} r_D(D^*) \right) \right] dy = \frac{B}{y_F} \frac{\partial}{\partial D_i} r_D(D^*)$$

Simplifying and introducing the elasticity definition we obtain an expression of optimal deposits in terms of the parameters and deposit-returns:

$$\frac{\partial}{\partial D} \overline{\pi}(D^*) = 0$$

$$D^* = B \frac{r_D(D^*)}{\varepsilon_D \int_{r_D(D^*)}^{y_F} \left[(1 - x_K) \left(y - r_D(D^*) \left(1 + \frac{1}{\varepsilon_D} \right) \right) \right] dy} \quad (4.11)$$

The above expression has no closed form solution. The decision variable appears on both sides of the equation. We can evaluate the comparative static derivatives from the derivative of the benefit function and by applying the Young's theorem. However, we cannot do the comparative static analysis of such derivatives because the signs of such derivatives are ambiguous. [16]

[16] Such derivatives are the following:

$$\frac{dD^*}{db} = \frac{1}{B \frac{(\varepsilon_D - 1)}{\varepsilon_D D^*} - \left(\left(y - r_D(D^*) \right) \left(1 + \frac{1}{\varepsilon_D} \right) - \frac{r_D(D^*)}{\varepsilon_D} \right) (1 - x_K)}$$

$$\frac{dD^*}{dx_K} = \frac{\left(\frac{\varepsilon_D}{2} (y_F - r_D(D^*)) - r_D(D^*) \right) (y_F - r_D(D^*))}{B \frac{r_D(D^*)(\varepsilon_D - 1)}{\varepsilon_D (D^*)^2} - \frac{r_D(D^*)}{D^*} \left(\left(y - r_D(D^*) \right) \left(1 + \frac{1}{\varepsilon_D} \right) - \frac{r_D(D^*)}{\varepsilon_D} \right) (1 - x_K)}$$

$$\frac{dD^*}{dy_F} = \frac{(\varepsilon_D (y_F - r_D(D^*)) - r_D(D^*))(1 - x_F)}{B \frac{r_D(D^*)(\varepsilon_D - 1)}{\varepsilon_D (D^*)^2} - \frac{r_D(D^*)}{D^*} \left(\left(y - r_D(D^*) \right) \left(1 + \frac{1}{\varepsilon_D} \right) - \frac{r_D(D^*)}{\varepsilon_D} \right) (1 - x_K)}$$

Given the sign indeterminacy we analyse the simplified model numerically. As before, we assume that that the deposit-supply functional form is $r_D(D) = aD^{\frac{1}{\varepsilon_D}}$. Let the benchmark parameter configuration be: $a = 1.1, B = 2, x_K = 0.5, \varepsilon_D = 2, y_F = 10$. Again, comparative static numerical exercises show consistent behavioural patterns: Increases in bankruptcy costs or in the known proportion of early depositors will reduce expected benefits, while increases in the deposit-supply elasticity or in the quality of long-term investment will increase them. Regarding optimal liquidity ratios and reserves, our assumptions imply that they are equal to the known proportion of early depositors (See Figure 4.3).

We summarise the above findings in the following table:

Table 4.2 Comparative Static Analysis for the Model with Asset Uncertainty (Calibration Numerical Exercises)

Parameter Variation (Positive)	Optimal Deposits ΔD_i^*	Optimal Reserves ΔM_i^*	Liquidity Ratios $\Delta (M_i^*/D_i^*)$	Expected Benefits $\Delta \pi_i^*$
ΔB	Negative	Negative	Constant	Negative
Δx_K	Negative	Positive	Positive	Negative
$\Delta \varepsilon_D$	Positive	Positive	Constant	Positive
Δy_F	Positive	Positive	Constant	Positive

The most interesting findings are associated with liquidity requirements, long-term solvency and profitability. Given that the calibrations show us that the benefits of intermediaries increase when the known proportion of early depositors decreases, we can conclude that banking systems with high liquidity requirements are not as profitable as the ones in which such requirements are low. Therefore, *it is an inverse relationship between liquidity requirements and long-term banking goals even when*

liquidity risk is absent. Regarding the other comparative static patterns, their consistency with the ones associated to the basic model with multiple uncertainty, make us believe that such patterns are motivated by value-added incentives. Thus, what our findings suggest is that *long-term solvency and profitability depend on long-term assets and mature deposit liabilities*.

4.4.2. Behavioural decisions with random deposit withdrawals

Now we simplify the basic microeconomic framework by assuming that there is a single bank in the financial system and that its long-term investment returns are known. These assumptions allow us to focus on the inter-temporal relationships among idiosyncratic shocks, liquidity and short-term solvency risks and the viability of the asset transformation process. Notice that all the assumptions regarding withdrawals, contingent banking policies and the differentiation between liquidity risk and short-term failure hold in this simplified model.

We begin by defining the banking profit function for the simplified variation. When asset returns are known, the corresponding function takes the following form:

$$\hat{\tilde{\pi}}_i = \left[L - c_l\left[Max\left(0, CB\right)\right]\right]y_K + \left[-Min\left(0, CB\right)\right] - \left[(1-\tilde{x})Dr_D\left(D\right)\right] \qquad (4.12)$$

y_K: Known long-term investment return

We can define the conditions that assure the viability of the asset transformation process. Such conditions are equivalent and identical to the break-even values defined by (3.9) and (3.11) in the previous chapter:

$$x_l\left(M, D\right) = \frac{\left[D - M(1-c_l)\right]y_K - Dr_D\left(D\right)}{D\left[y_K c_l - r_D\left(D\right)\right]} \qquad (4.13a)$$

$$x_h\left(M, D\right) = \frac{\left[D - M\right]y_K + M - Dr_D\left(D\right)}{D\left[1 - r_D\left(D\right)\right]} \qquad (4.13b)$$

The viability of the asset transformation process depends on idiosyncratic liquidity shocks, and on asset and liability returns. Once more, the independence property does not hold.

The scenarios and outcomes of the simplified model can be evaluated as before. The asset transformation conditions and the banking decisions define the set of possible scenarios that the bank might face. These scenarios are the Surplus-Solvent, the Shortage-Solvent, the Surplus-Failure and the Shortage-Failure.[17]

- Surplus-Solvent scenario; $x_h(M,D) \le \tilde{x} \le x_M(M,D), y_K$

Here, a liquidity surplus $(CB \le 0)$ occurred at T=1, and firms repay at T=2. Long-term banking profits are:

$$\pi = y_K L + [-CB] - [(1-\tilde{x})Dr_D(D)] \qquad (4.14a)$$

- Shortage-Solvent scenario; $x_l(M,D) \ge \tilde{x} \ge x_M(M,D), y_K$

Here, a liquidity shortage $(CB \ge 0)$ occurred at T=1, and firms repay at T=2. Long-term banking profits are:

$$\pi = [L - c_l(CB)]y_K - [(1-\tilde{x})Dr_D(D)] \qquad (4.14b)$$

Long-term feasibility makes us consider the asset-transformation viability cut-off boundary for liquidity shortages. This is like in the basic model.

- Surplus-Failure scenario; $\tilde{x} \le x_h(M,D)$

Here, a liquidity surplus occurred at T=1. Long-term liabilities are higher than expected. Moreover, they are so high that even with the given portfolio return and remaining reserves, revenues will not be enough to satisfy mature depositors. The asset transformation process is interrupted and the bank fails before the third period (early termination). Financial failure derives from liquidity risk and the banking losses are equal to B.

$$\pi = -B, B > 0 \qquad (4.14c)$$

[17] These scenarios are similar to the ones for the basic model. However, the absence of the banking solvency function eliminates the scenarios associated with long-term failure.

- Shortage-Failure scenario; $\tilde{x} \geq x_l(M,D)$

Here, a liquidity shortage occurred at T=1. Early withdrawals are sufficiently high that with the known long-term asset return, net revenues will not satisfy mature claims. The asset transformation process is interrupted and the bank fails before the third period (early termination). As before, banking financial failure derives from liquidity risk.

$$\pi_i = -B, B > 0 \tag{4.14d}$$

The maximisation program must comprise the expected profits and losses associated to the banking decisions. Under our simplified assumptions, the program is simpler than the basic one. We can write it as follows:

$$\overline{\pi}(M,D) = MAX \int_{x_h}^{x_M} \left[(D-M)y_K - (xD-M) - (1-x)Dr_D(D)\right]dx +$$

$$\int_{x_M}^{x_l} \left[\left((D-M) - c_l(xD-M)\right)y_K - (1-x)Dr_D(D)\right]dx - \left[\int_0^{x_h} Bdx + \int_{x_l}^{1} Bdx\right]$$

s.t. (4.15)

$$x_l(M,D) = \frac{\left[D - M(1-c_l)\right]y_K - Dr_D(D)}{D\left[y_K c_l - r_D(D)\right]}$$

$$x_h(M,D) = \frac{\left[D-M\right]y_K + M - Dr_D(D)}{D\left[1 - r_D(D)\right]}$$

$$x_M(M,D) = \frac{M}{D}$$

The integrals show the expected outcomes associated to the Surplus-Solvent, Shortage-Solvent, Surplus-Failure and Shortage-Failure scenarios respectively. The first two constraints define the boundaries of the solvency banking set. Finally, the last one defines the maximum proportion of resources that can be withdrawn without the bank facing liquidity problems.

We proceed to analyse the simplified model numerically. As before, we assume that that the deposit-supply functional form is $r_D(D) = aD^{\frac{1}{\varepsilon_D}}$. Let the benchmark parameter

configuration be: $a = 1.1, B = 2, c_l = 1.5, \varepsilon_D = 2, y_K = 10$. Again, comparative static numerical exercises show consistent behavioural patterns: Increases in bankruptcy or in liquidation costs will increase the optimal reserve ratios, reducing long-term benefits; while increases in the deposit-supply elasticity or in long-term asset returns will have the opposite effects (See Figure 4.4).

We summarise these findings in the following table:

Table 4.3 Comparative Static Analysis for the Model with Liability Uncertainty (Calibration Numeric Exercises)

Parameter Variation (Positive)	Optimal Deposits ΔD_i^*	Optimal Reserves ΔM_i^*	Liquidity Ratios $\Delta (M_i^*/D_i^*)$	Expected Benefits $\Delta \pi_i^*$
ΔB	Negative	Positive	Positive	Negative
Δc_l	Negative	Positive	Positive	Negative
$\Delta \varepsilon_D$	Positive	Positive	Negative	Positive
Δy_K	Positive	Positive	Negative	Positive

The most interesting findings are associated with reserves, the optimal liquidity ratios and the viability of the asset transformation process. Numerical calibrations show that intermediaries' reserve ratios increase when short-term costs increase and that they decrease when long as long-term revenues increase. In other words, liquidity ratios change to guarantee the viability of the asset transformation process. Thus, our findings suggest that *banking stability and the viability of the asset transformation process can be promoted increasing short-term costs or improving the quality of long-term assets.*

4.5. Market structure, uncertainty and behavioural banking decisions

In this section we analyse the effects of market structure and uncertainty on the banking behavioural decisions. Particularly, we focus on the relationships between the intuition behind our results and real management practices. Considering that the risk management goals are related to short-term fragility avoidance and long-term profitability, we summarise and compare liquidity ratios and expected benefits in the three models. In order to facilitate such analysis, the following table summarises our findings regarding optimal behavioural decisions. Notice that we include only a single column for expected benefit ratios because the comparative static patterns are identical for the common variables analysed in the three models.

Table 4.4 Comparative Static Analysis for the Banking Models (Behavioural Comparison)

Parameter Variation (Positive)	Multiple Uncertainty $\Delta (M_i^*/D_i^*)$	Asset Uncertainty $\Delta (M_i^*/D_i^*)$	Liability Uncertainty $\Delta (M_i^*/D_i^*)$	Expected Benefits $\Delta\pi_i^*$
ΔB	Positive	Constant	Positive	Negative
Δc_l	Positive		Positive	Negative
$\Delta \varepsilon_D$	Negative	Constant	Negative	Positive
ΔN	Positive			Negative
Δx_K		Positive		Negative
Δy_F	Negative	Constant		Positive
Δy_K			Negative	Positive

Table 4.4 shows consistent optimal behavioural patterns among the three models. Behavioural comparisons show that increases in bankruptcy costs will always reduce expected benefits, without reducing optimal the liquidity ratios; such effects will be the opposite to the ones associated to increases in the deposit-supply elasticity in all the models. Given that such parameters are not related to uncertainty, these findings reinforce our belief that value-added considerations induce specific behavioural patterns.

The effects of liquidity can be compared through the comparison of the parameters of liquidation costs and the known proportion of early withdrawals. Specifically, the table shows that increases in these parameters will reduce expected benefits, increasing the optimal liquidity ratios. These findings show that the provision of short-term liquidity can be costly for banking profitability in the long-term, even in the absence of liquidity risk.

The effects of long-term asset returns can be compared through the parameters associated to the maximum feasible and the known asset return on portfolio investment. Specifically, the table shows that increases in these parameters will increase expected benefits, without increasing the optimal liquidity ratios. These findings suggest that the long-term opportunity costs of providing liquidity are always minimised by intermediaries pursuing to maximise long-term profits.

Interestingly, the comparison between the calibration comparative-static analyses shows that the monopolistic models are *complementary* in the sense that their optimal behavioural decisions show qualitative similar patterns regarding long-term management goals. Moreover, these patterns are similar with the ones associated with the basic model.

Multiple uncertainty allows us to understand the inter-temporal linkages among the viability of the asset transformation process, long-term solvency and profitability. Notice that the banking solvency function and the asset transformation conditions separate the short and long-term scenarios through cut-off values. Such values define the probabilities of short-term liquidity and short and long-term solvency risks in

terms of multiple uncertainty and the specific banking decisions. Without a multiple uncertainty approach, these inter-temporal linkages among solvency and liquidity risks, banking behaviour and risk management goals will be hidden.

The above justifies the validity of a multiple uncertainty approach to analyse the relationship between risk management practices and fragility. Notice that one monopolistic model focuses on the long-term risks associated with bank investments; while the other focuses in the short-term risks that can threat the viability of the intermediation process. The fact that the common parameters have similar effects on the optimisation goals reinforces the view that both models complement each other. However, it does not suggest that the analysis of basic model should be disregarded. As indicated above, the basic model offers insights on the inter-temporal linkages between uncertainty, intermediaries' behaviour and management practices.

It is important to point out that *market conditions and uncertainty determine the optimal decisions* in all models. Even in the most analytically tractable model (the one with asset uncertainty), the Lerner index influences the optimal decisions. This fact suggests that the market structure in the deposit market relates to the risk management allocation decision. Thus*, the necessity of an integrated analysis to study management practices, fragility and market structure is justified*.

The above findings must have support on intuitive reasoning and practitioners' experience. Such support is essential for academic and policy purposes. It relates to the consistency of the management goals regarding the maximisation of banking profits and the minimisation of bankruptcy costs. We analyse the specific comparative-static patterns in terms of the intuition underlying them and in terms of specific banking experiences to clarify the effects of uncertainty and market structure on intermediaries' behaviour.

The most important goal from the point of view of the intermediary firm relates to profit maximisation. Asset management practices contribute to achieve this goal via the acquisition of acceptable levels of risky assets. Intuition suggests that as the quality of long-term investment improves, lower reserves will be necessary to defend the bank

against a panic resulting from a loss of confidence on the part of depositors. Calibrations reflect this behaviour. Notice that, in the models with liability uncertainty, as long as the mean quality of the long-term investment portfolio increases, long-term investment increases. Moreover, even without liability uncertainty, acceptable levels of risk and asset diversification avoid reductions on long-term investment. This intuitively explains why liquidity ratios cannot increase and why profits increase when investment returns increase in the banking models.

The models with liability uncertainty validate conventional banking wisdom. "Excess reserves are insurance against the costs associated with deposit outflows. The higher the costs associated with deposit outflows, the more excess reserves banks will want to hold. …, a bank is willing to pay the cost of holding excess reserves (the opportunity cost forgone by not holding income-earning assets such as loans or securities) in order to insure against losses due to deposit outflows." [Mishkin (2000: p. 223)]. In our behavioural models, high liquidity costs and short-term bankruptcy ones are associated with high levels of reserves held by banks, and low expected benefits. Thus, our models do not only reflect the trade-off inherent to intermediary firms, but also agree with the prescriptions suggested by advisors regarding the management of financial institutions.

The financial practice of setting targets for asset growth through the expansion of liabilities issue is explained in our models due to the presence of uncertainty. Conventionally, this practice is based on the idea that liability management practices should provide sources of funding and liquidity to support profitability. The behavioural models suggest that this makes sense. Particularly, the models' prediction, that reserve/deposit ratios will decrease when elasticity increases, reflects what happens in practice. In the US banking system, it has been considered that liability management practices have increased the proportion of banking assets held in loans, "from 46% of bank assets in 1960 to 66% in 1999" [Mishkin (2000: p. 225)]. Moreover, modelled benefits increase in line with the objectives of liability management goals. Thus, our results are consistent with real experiences regarding the management of financial institutions.

Our findings support the hypothesis that competition can mitigate financial fragility under certain conditions. In the basic model, numerical exercises show that increases in the number of symmetric banks will increase liquidity insurance ratios and that individual benefits will fall. Intuitively, this risk-averse behaviour can be explained because of the nature of profits and systemic bankruptcy costs. Notice that, in the model, *individual expected profits decrease and systemic expected bankruptcy costs increase when intermediaries increase*. According to this explanation, financial stability can be enhanced through high bankruptcy costs and by eliminating entry barriers to the banking markets.[18] Although this is controversial, the model suggests that *financial stability can be enhanced through market discipline*. It is worthy to observe that some studies support this conclusion [Claessens and Klingebiel (2001)].

Finally, we conclude by indicating that the above findings and facts suggest that the interdependence among management practices, fragility and market structure relates to the existence of uncertainty. Thus, decisions regarding them cannot be analysed independently nor without considering the effects of uncertainty, at least in the context of financial intermediaries.

4.6. Conclusions and discussion

Banking management concerns are related to liquidity, asset, liability and capital management considerations (General principles of banking management). The goals pursued with these banking management strategies are the maximisation of profits and the minimisation of financial distress. Here we have dealt with these concerns through the study of the behaviour of banks that manage short-term and long-term assets facing uncertainty on both sides of their balance sheets and imperfect competition in the deposit market.

We have developed the banking behavioural analysis using the basic framework and two simplified monopolistic versions of it. Theoretically, the basic model can be seen as the asset management banking firm counterpart of the traditional liquidity insurance

[18] This conclusion implies that the sign of equation (4.5d) is positive. That is because the signs associated to equations (4.5b) and (4.5c) are positive without any doubt and because (4.5a) must share the same sign as (4.5d) for consistency.

and financial fragility models in which depositors play the main role. Its main contribution consists in the analysis of how institutional competition can enhance stability when monopolistic intermediaries, multiple uncertainty and the availability of strategies to deal with liquidity and solvency risks are introduced. Regarding the monopolistic models their main contributions relate not only to the viability of the asset transformation process and the inter-temporal relationships among risks but also to the clarification that the maximisation of long-term profits and the minimisation of financial distress are complementary and compatible management objectives.

Traditionally, the effects of banking uncertainty on each side of the balance sheet have been analysed in the context of the separability property, the irrelevance of ALM practices and associated regulation policies. Our models corroborate the academic claim that the Monti-Klein independence or separability property does not hold when uncertainty is introduced. Furthermore, they show that market structure always influences the optimal banking decisions. Therefore, our models *not only justify ALM practices* based on the existence of risks, but also suggest that market regulations *will have direct effects* on competition and asset management practices and *indirect effects* on banking stability.

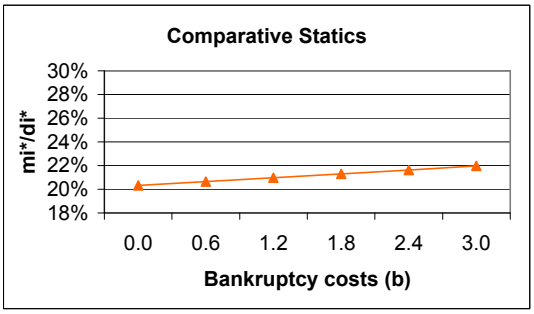
The above considerations show that further research can be developed along the lines of financial regulation. Notice that our models suggest that market structure issues play a crucial role regarding the stability of the financial system and the success of any financial reform. Particularly, regarding the deposit-supply elasticity comparative-static exercises, our findings seem to support the belief that in financial systems exist a trade-off between moral hazard and the availability of resources in the financial markets. Regarding stability issues, our findings support the belief that risk-taking incentives can be modified by competition regulations. Traditionally, both arguments have been put forward to justify the necessity of regulation during financial reform processes. That is why we will continue our research along these policy-oriented lines.

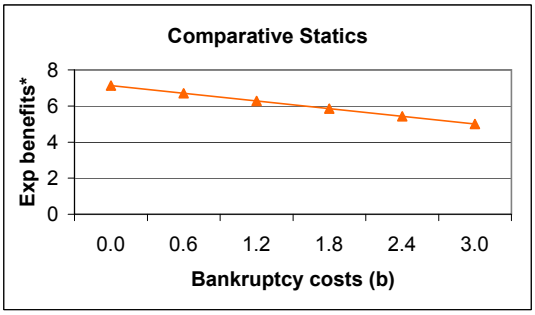
In the next chapter we will study the effects of banking regulation policies on the optimal management decisions and associated liquidity and solvency risks. Specifically, the risk effects, due to interest rate ceilings and liquidity ratios, will be

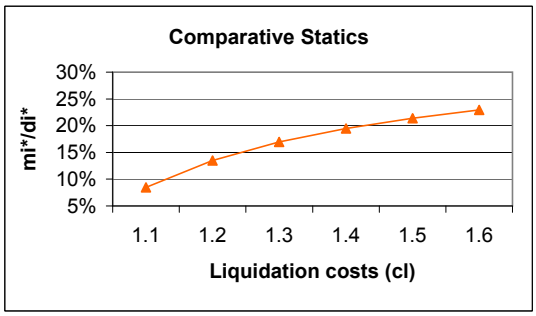
analysed with our basic framework considering different institutional settings. The goal will be then to offer insights about the relationships among banking regulations, financial stability and the degree of banking competition.

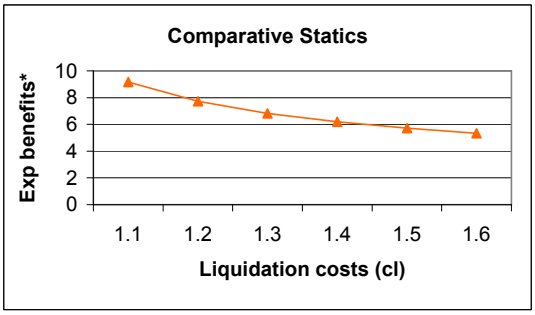
Fig. 4.1.a. Optimal Asset Allocation and Individual Banking Benefits

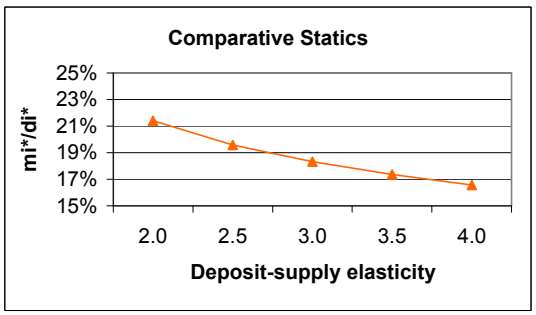
Monopolistically Competitive Intermediaries (n=1)

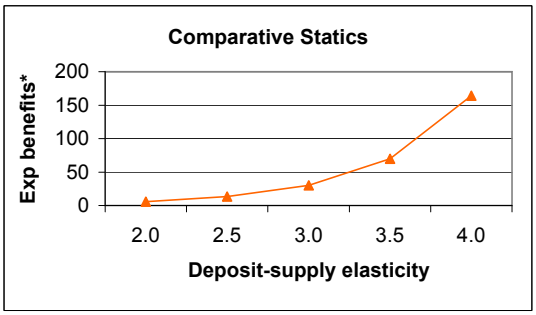


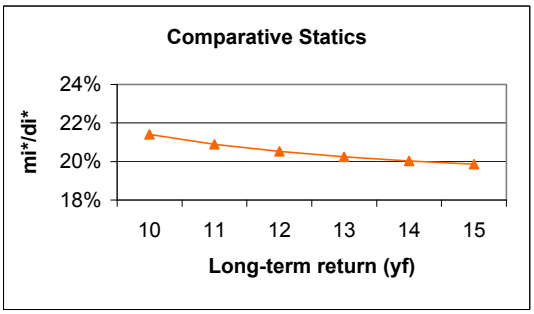












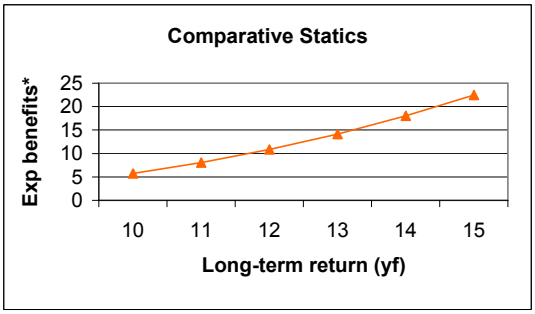
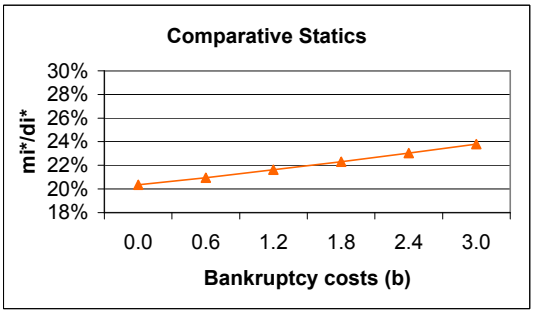
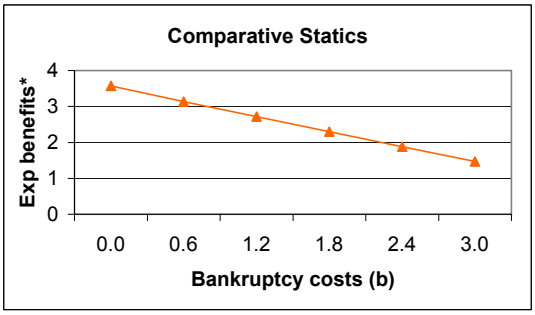
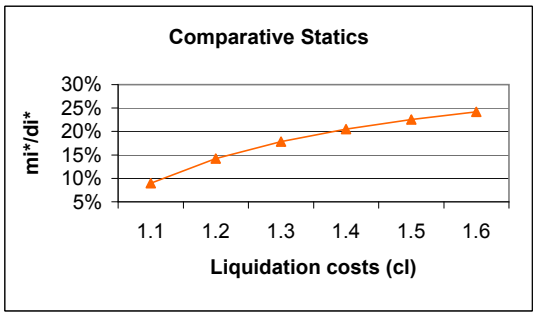


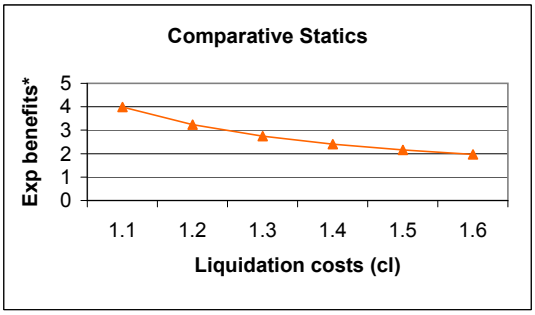
Fig. 4.1.b. Optimal Asset Allocation and Individual Banking Benefits

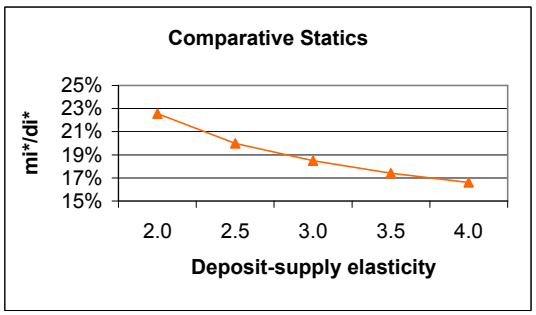
Monopolistically Competitive Intermediaries (n=2)

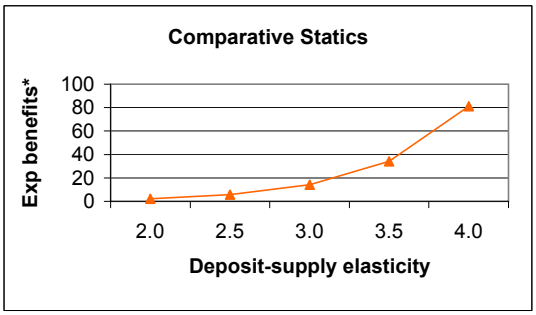


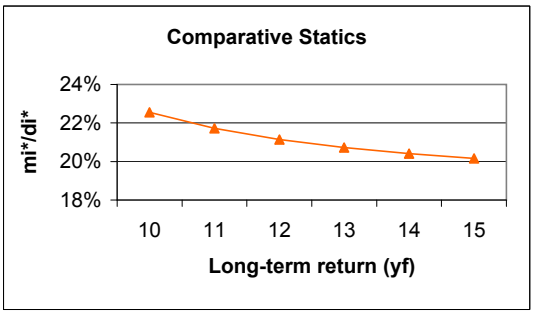












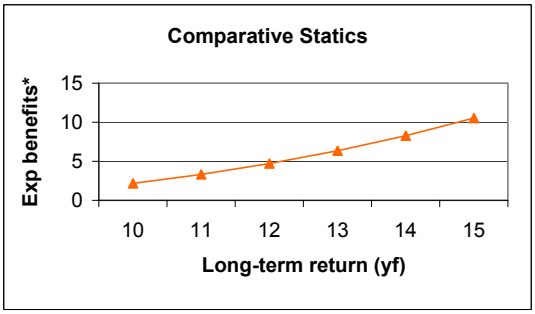
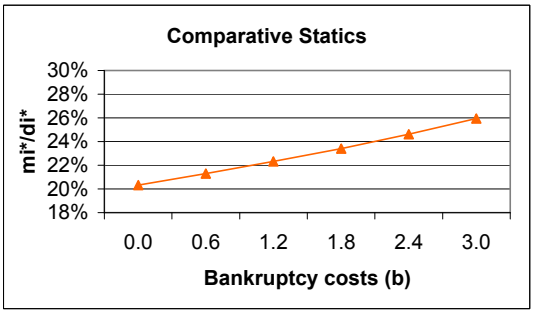
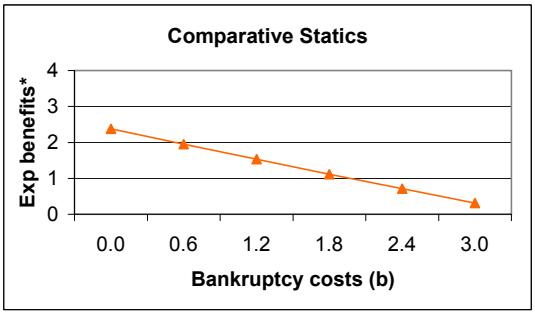
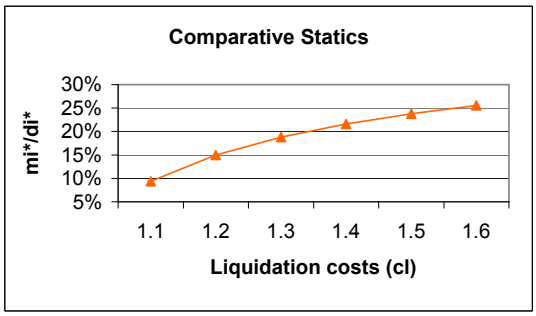


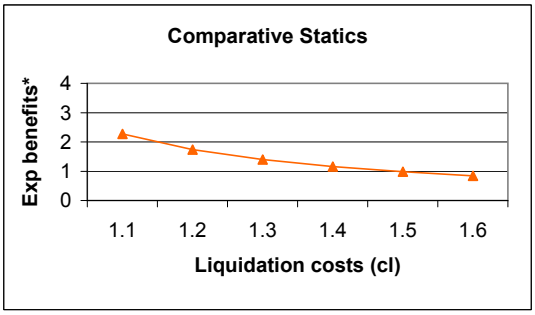
Fig. 4.1.c. Optimal Asset Allocation and Individual Banking Benefits

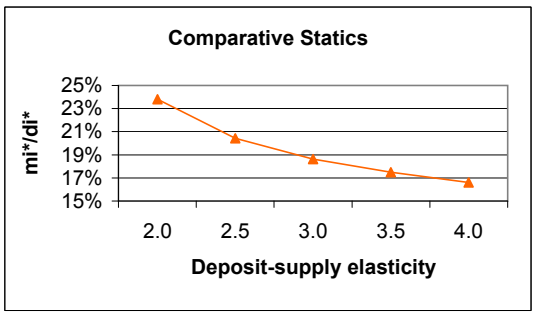
Monopolistically Competitive Intermediaries (n=3)

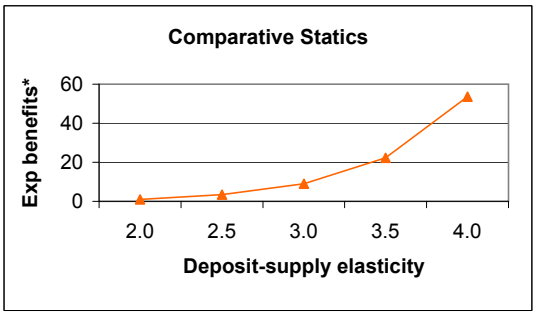


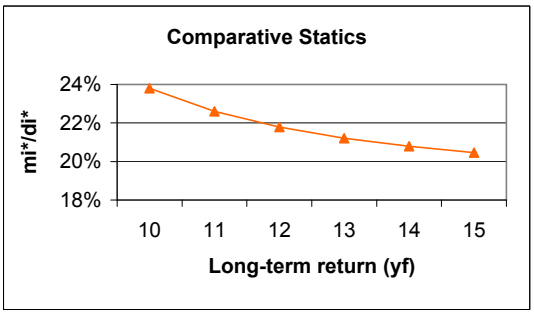












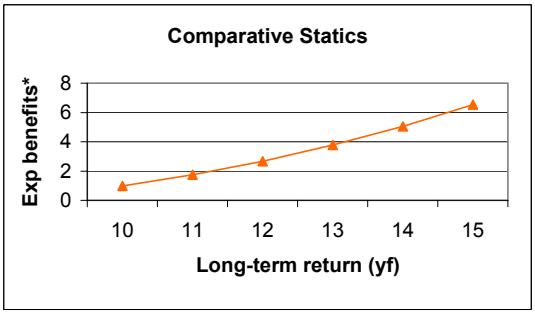
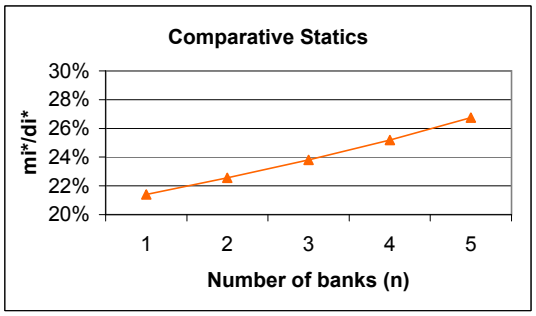


Fig. 4.2. Optimal Asset Allocation and Individual Banking Benefits

Monopolistically Competitive Intermediaries
Institutional Setting Comparison



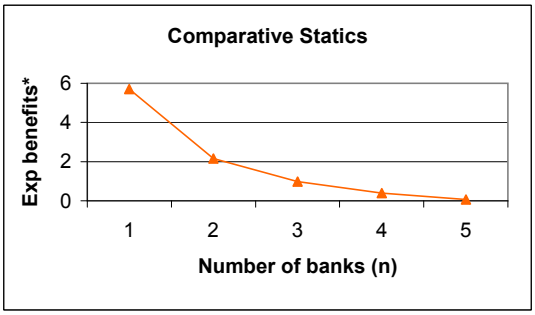
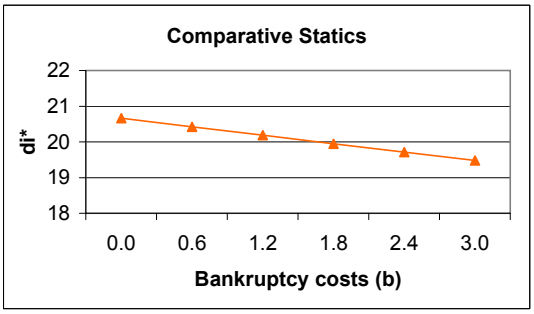
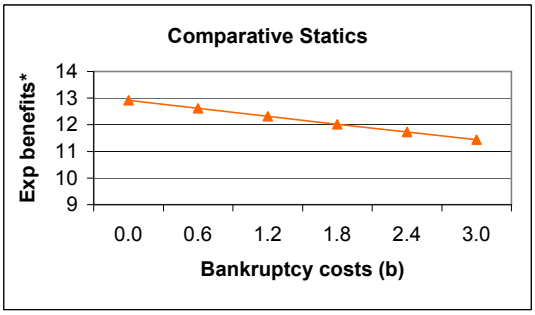
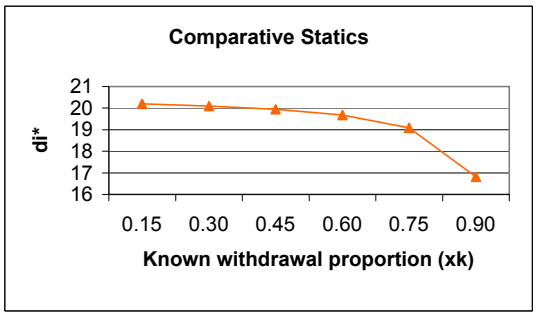


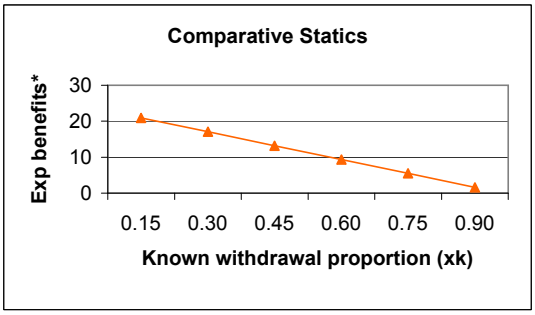
Fig. 4.3. Optimal Asset Allocation and Monopolistic Banking Benefits

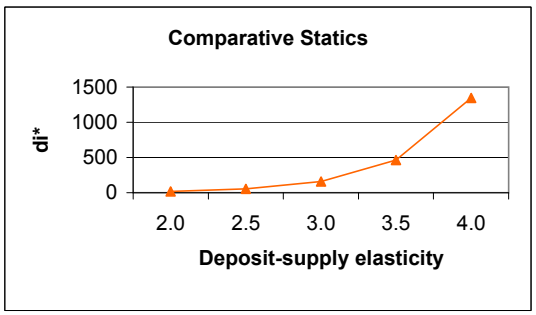
Simplified model with uncertain investment returns

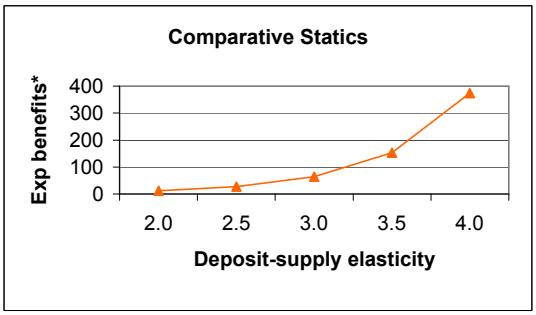


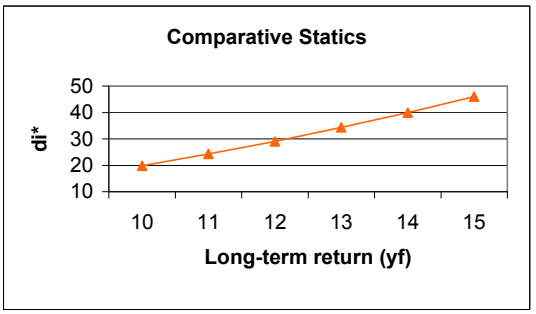












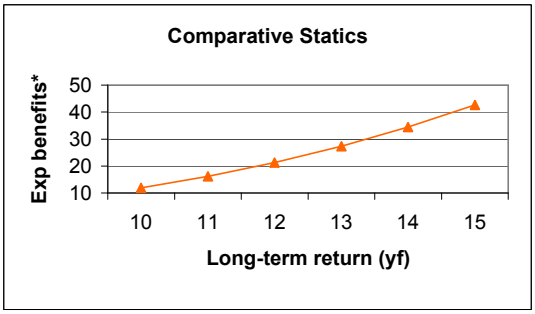
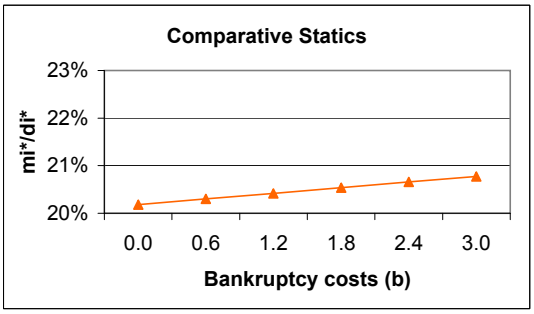
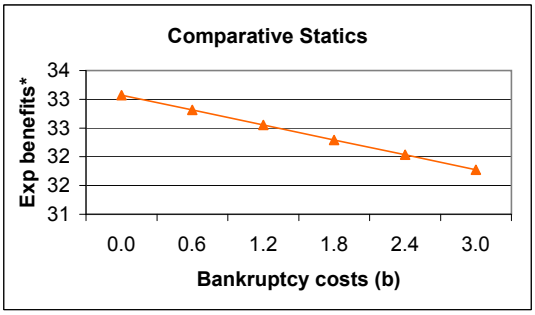
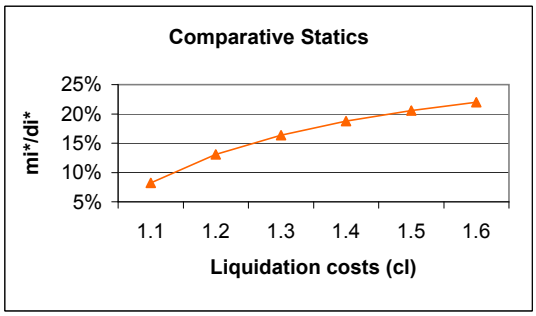


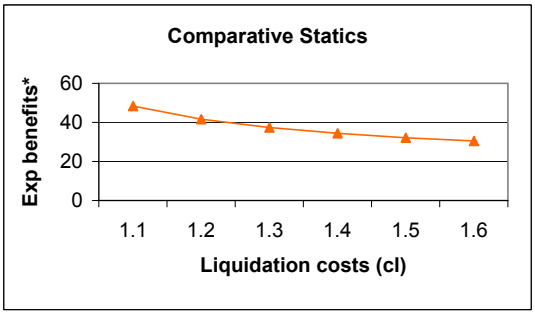
Fig. 4.4. Optimal Asset Allocation and Monopolistic Banking Benefits

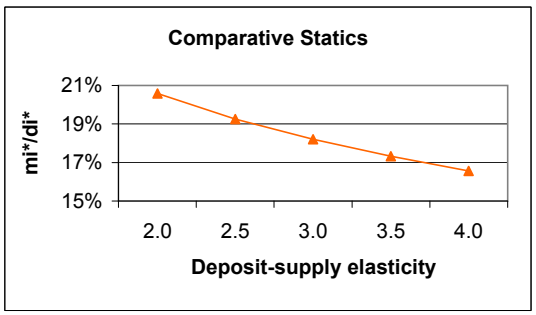
Simplified model with random deposit withdrawals

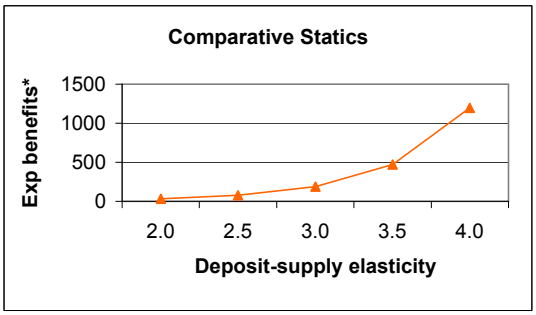


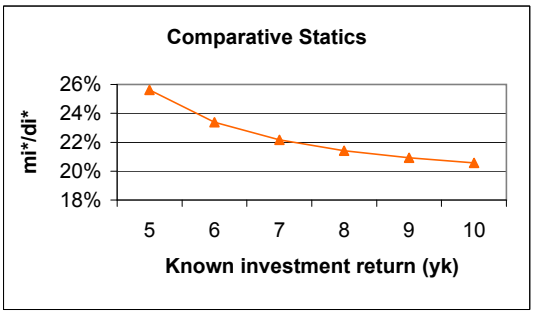


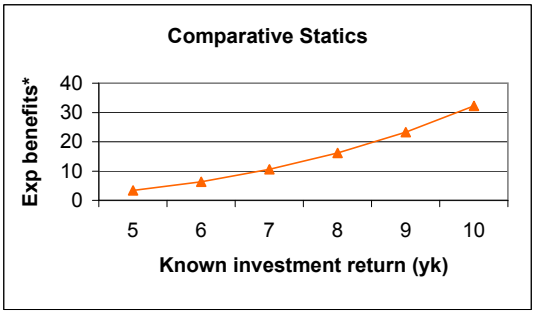












CHAPTER 5
REGULATIONS, STABILITY AND THE DEGREE OF BANKING COMPETITION

5.1. Introduction

In this chapter we analyse the effects on the intermediation process of two regulatory instruments commonly used in the banking industry: Portfolio restrictions and deposit interest rate regulations.[1] More specifically, we study the effects on liquidity and solvency risks caused by reserve-ratio and deposit-return requirements, under alternative market environments. We investigate the effects of such regulations on banking intermediaries using two variations of the basic framework developed in the previous chapters. Concretely, we use one variation to analyse the effects of required reserve ratios, on the optimal behavioural banking decisions, the likelihood of liquidity and solvency risks and the viability and long-term profitability of the asset transformation process. Regarding the second variation, we use it to analyse the corresponding effects of deposit-rate requirements. Both variations are analysed under perfectly and monopolistically competitive settings.

The motivation underlying the analysis relies on the idea that the focus of banking regulation should be on *risks*, not on the rules per se. Our emphasis is not on the details about such regulations; but on the likelihood of financial fragility, the banking behavioural incentives and the feasibility of the management and asset transformation processes when certain rules are implemented.[2] Particularly, we are concerned with the effects of regulations under different market environments. That is why we focus on how such regulations affect the behavioural banking decisions and the inter-temporal liquidity and solvency probabilities of regulated intermediaries considering two extreme degrees of banking competition.

[1] The other main regulatory types of instruments are entry, branching, network and merger restrictions; deposit insurance; capital requirements; and regulatory monitoring.

[2] The emphasis exposed has relevance for policy-makers and academics alike. Regarding the former, it relates directly with financial stability concerns. While for the latter, it relates to specific debates regarding the role of government intervention. Particularly, in the context of the banking industry, it has been pointed out that "While the reasons for bank regulation are well known, the possible impacts of regulation on the industry are in dispute" [Rose (2002: p. 36)].

Conventionally, the main reasons for public regulation in the banking sector are associated to the protection of customers against monopolistic exploitation, the provision of protection to smaller and less informed banking clients and to ensure banking systemic stability [Goodhart, et. al. (1998)]. However, as some economists have pointed out, these factors, and particularly bank failures, do not necessarily justify financial regulation and supervision [See Dowd (1996a) and (1996b), Benston and Kaufman (1996)]. According to their views, many banking crises and financial problems can be attributed to indirect effects of regulatory efforts. This situation has established a debate regarding the effects of regulations on the banking industry.[3] This situation has also encouraged the development of empirical research because existing international comparative evidence does not allow us to achieve any consensus. The required micro indicator panels necessary to analyse the effects of regulations are not available.[4] Thus, we still need to determine the nature of the regulation practices that can contribute to promote the stability of banking institutions.

Here we investigate the effects of regulation on intermediaries' decisions, the likelihood of liquidity and solvency risks and the viability and long-term profitability of the asset transformation process under diverse competitive environments. Specifically, we analyse regulations involving minimum liquidity ratios and deposit-return ceilings for intermediaries. We focus on these two regulation instruments because liquidity requirements probably are the most common type of regulation along the world; [5] and because deposit interest rate regulations directly deal with policy debates regarding the relationship between competition and banking fragility. [6]

[3] See Freixas and Santomero (2004) for a review on the debates around banking regulation.

[4] The most extensive database available to analyse banking regulations contains cross-section data for 107 countries [Barth, Caprio and Levine (2001a)]. To our knowledge, this database has been used to develop the most comprehensive empirical study on the relationships among bank regulation/supervision and bank performance and stability under certain assumptions [See Barth, Caprio and Levine (2001b)]. However, the study assumes that the international regulatory framework did not change during the eighties and nineties. Evidently this is an extreme assumption, but provides an important step to empirically analyse the relationships between banking regulations and stability in an international context. The database is available at the following address http://www.worldbank.org/research/interest/intrstweb.htm .

[5] Barth, Caprio and Levine (2001a) show that liquidity requirements have been adopted in 77 countries. Only the minimum capital-to-asset-ratio Basle guideline has been adopted by more countries; a hundred in total.

[6] Historically, it has been considered that competition in the banking markets enhances financial fragility and that certain regulations, like interest rate deposit ceilings, promote stability [Friedman and Schwartz (1963)]. However, other economists completely disagree with this view regarding experience and policy [Claessens and Klingebiel (2001)]. Based on the experience of various countries, the latter

Particularly, because our framework recognises the interdependence among management practices, multiple uncertainty and the structure prevailing in the deposit markets, it allows us to study the inter-temporal effects of regulations.

The questions that we study in this chapter are the following: How liquidity and deposit-return instruments affect the risk management decisions of the intermediaries under different market environments? What are the effects of behavioural decisions and regulatory instruments in terms of changes of liquidity and solvency risk probabilities? How does the nature of regulation influence the inter-temporal risk-likelihood under different institutional settings? Does the previous analysis hold for different competitive environments? Under which conditions such regulatory instruments can promote stability?

The methodological approach to analyse the effects of regulations is similar for both banking variations: First, we build the optimisation program for a monopolistically competitive bank, assuming that a specific regulatory instrument applies. Then we characterise and describe the ex-ante optimal behavioural decisions analytically and numerically. Later, we shift our interest from the intermediary and its optimal decisions, to the specific risk effects associated to changes in the behavioural decision variables and regulatory instruments (*behavioural-risk* and *control-risk effects*, respectively). Specifically, we evaluate how changes on the banking decision variables and instruments modify the inter-temporal likelihood of liquidity and solvency risks. Finally, we investigate the inter-temporal risk effects of regulation (*regulatory-risk effects*), under different market environments using calibration exercises. We do this by computing the probabilities associated to the viability, solvency and profitability of non-regulated and regulated intermediaries operating in monopolistically and perfectly competitive environments.

Our main findings regarding the variation models have implications for academic and policy purposes. Regarding both types of regulations, the models show that the expected benefit curves, associated to the binding regulatory controls, have an inverse U-shape whose maximum corresponds to the case when there is no regulation. This

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ones argue that a competitive banking system can mitigate the risks of financial crises and that ceilings have "negative side effects" [Claessens and Klingebiel (2001: p. 22)].

finding implies that the long-term effects of increases in compulsory requirements are *ambiguous*. Regulatory controls may, or may not, enhance the long-term solvency and profitability of the intermediaries depending on the optimal non-regulated decision. Furthermore, they suggest that flexible regimes based on regulatory controls can have *differentiated* effects on the solvency and viability of the asset intermediation process.

Calibrations confirm this intuition regarding the existence of differentiated effects among regulatory regimes. More specifically, using the model with compulsory deposit-returns (deposit-return control model), calibrations suggest that deposit-return controls may reduce the risk-taking incentives associated to increases in the quality of long-term investment. Interestingly, they also suggest that deposit rate ceilings will enhance the short-term stability of intermediaries, at the cost of reducing their long-term solvency and profitability. Moreover, they also suggest that high controlled interest rates will generate risk-taking incentives for the intermediaries without enhancing their profitability. Regarding the model with required reserve ratios (reserve-ratio control model), calibrations suggest that minimum reserve requirements will reduce banking deposits and expected long-term benefits.

The behavioural and control-risk analysis shows differentiated effects depending on the regulatory regime and the market structure prevailing in the banking markets. Interestingly, the analysis shows that *the differences among the reserve-ratio and deposit-return control models depend on the size of the deposit markets*. Specifically, it suggests that the qualitative effects caused by the decisions taken by bankers and regulators in both models may be identical when the elasticity-supply and the number of intermediaries are small enough. In both cases, increases in the decision and control variables will reduce the likelihood of fragility at a cost. Such a cost will be expressed in the reduced likelihood of the overall viability of the transformation process and in increases of solvency risks in the case of liquidity surpluses. Finally, the analysis shows that the traditional time-consistency dilemma between liquidity insurance and profitability can be *extended* to include an inverse relationship between liquidity insurance and the viability of the intermediation process when regulations apply.

The evaluation of the regulatory-risk effects necessarily needs to refer to the risk likelihood of non-regulated intermediaries. Not surprisingly, calibrations show that the

degree of banking competition affects the stability of the banking firms even when the intermediaries are not regulated. Specifically, calibrations suggest that *if the banking system is perfectly competitive (implying that expected benefits are zero), fragility is enhanced when the number of intermediaries increases and the financial system is not regulated*, e*ven when the deposit-supply elasticity expands enough to guarantee non-negative expected benefits.* Otherwise, assuming monopolistically competitive intermediaries, stability is enhanced.

Numerical calibrations show that, in monopolistically and perfectly competitive environments, restrictive reserve regulations will reduce the likelihood of liquidity risk and early termination, increasing the probabilities that the intermediaries will have enough reserves. However, this mitigation in short-run risk does not hold in the long run. Calibrations show that *restrictive liquidity regulations will reduce the likelihood of solvency risk when the intermediaries are perfectly competitive. Otherwise, regulation will have the opposite effects.*

The analysis of the regulatory-risk effects of deposit-return ceilings yields different results relative to the analysis of minimum liquidity ratios. Numerical exercises show consistent regulatory-risk effects among different institutional settings *even* when the competition environment changes. Differentiated risk effects *do not* appear. The calibrations show that restrictive deposit-return ceiling regulations will reduce the likelihood of liquidity risk and early termination, increasing the probabilities that the intermediaries will have enough reserves. Interestingly, they show that restrictive regulations will reduce the likelihood of failure (solvency risk), increasing the one of solvency and profitability.

Finally, our findings point out that the inter-temporal regulatory-risk effects depend on the nature of the regulations imposed and the competitive environment. Calibrations show that restrictive regulations will have *differentiated* risk effects on the likelihood of the viability and the occurrence of alternative banking scenarios. However, while *these effects seems not to be differentiated in the short run*, when idiosyncratic shocks appear; *they are clearly evident in the long run*, when solvency, profitability or failure may occur. Intuitively, we believe that the specific nature of regulatory instruments introduces particular behavioural incentives that modify the market environment.

The chapter is divided in seven sections. Section 5.2 describes the reserve-ratio control model and characterises the optimal banking behaviour under regulation. Then, the interactions among regulation and managerial decisions, short and long term scenarios and outcomes are analysed. Section 5.3 develops the same analysis for the deposit-return control model. Section 5.4 studies the behavioural and control-risk effects in both control models. Section 5.5 develops the numerical analysis for both models considering competitive and non-competitive settings. Liquidity and solvency risk probabilities are computed and the economic analysis is done. Section 5.6 analyses how the degree of banking competition and regulations affect the probabilities associated to the viability of the asset transformation process and the banking scenarios. Section 5.7 summarises and discusses the main results. Finally, the appendix of the chapter analytically evaluates the behavioural and control-risk derivatives.

5.2. Reserve-ratio control regulations

In this section we analyse the effects of portfolio restrictions on intermediaries´ behaviour. We do this after simplifying the basic framework by assuming that the regulatory authorities set the reserve/deposits ratio, m, that banking firms must hold. This assumption makes portfolio investment and reserves endogenous. It also makes explicit the effects of liquidity ratio regulations.[7] Then, we study analytically and numerically the regulated banking model. Given the similarities with the models described in the previous chapters, we focus on the new features of the model.

5.2.1. Reserve-ratio control regulations and banking scenarios

We begin the analysis defining the banking profit function for the simplified variation. Given multiple uncertainty, the function is similar to the one in the basic model:

$$\hat{\tilde{\pi}}_i = \left[L_i - c_l\left[Max\left(0, CB_i\right)\right]\right]\tilde{y} + \left[-Min\left(0, CB_i\right)\right] - \left[(1-\tilde{x})D_i r_D\left(D\right)\right] \qquad (5.1)$$

Like in previous models, we define the banking solvency function.

[7] Evidently, a more realistic assumption is when the regulatory authorities set a lower limit to the reserve/deposits ratio. In such case, if banks want to hold more reserves than the ones required, they can do it. Here we assume that the required reserve ratio always binds to simplify the analytical problem. However, we study the latter case in sections 5.5 and 5.6.

$$y^{*}_{Li}(x, D_i) = \frac{(1-x)r_D(D)}{[1-m-c_l[x-m]]} \quad x_M(D_i) = m \le x \tag{5.2a}$$

$$y^{*}_{Hi}(x, D_i) = \frac{(1-x)r_D(D)+[x-m]}{[1-m]} \quad x \le x_M(D_i) = m \tag{5.2b}$$

Again, the functions y^{*}_{Li} and y^{*}_{Hi} determine the break-even values given liquidity shortages and surpluses, respectively.

The conditions that assure the viability of the asset transformation can be defined in this variation of the model in terms of the idiosyncratic liquidity shock. These conditions, which are equivalent to equations (3.9) and (3.11), are:

$$x_l(D_i) = \frac{[1-m(1-c_l)]y_F - r_D(D)}{[y_F c_l - r_D(D)]} \tag{5.3}$$

$$x_h(D_i) = \frac{[1-m]y_F + m - r_D(D)}{[1-r_D(D)]} \tag{5.4}$$

Once more, the asset transformation conditions and the banking decisions define the set of possible scenarios that the bank might face. These scenarios are the Surplus-Solvent, Surplus-Insolvent, Shortage-Solvent, Shortage-Insolvent, Surplus-Failure and Shortage-Failure ones. Interestingly, such scenarios are the ones corresponding to the basic banking model. Therefore, regulation does not simplify the objective function like in the previously developed variations. Such scenarios are the following:

- Surplus-Solvent scenario: $x_h(D_i) \le \tilde{x} \le x_M(D_i) = m, \tilde{y} \ge y^{*}_{Hi}$

Here, a liquidity surplus $(CB_i \le 0)$ occurred in T=1, and firms repay in T=2. Long-term banking profits are:

$$\pi_i = \tilde{y}L_i + [-CB_i] - [(1-\tilde{x})D_i r_D(D)]$$

- Shortage-Solvent scenario: $x_l(D_i) > \tilde{x} \ge x_M(D_i) = m, \tilde{y} \ge y^{*}_{Li}$

Here, a liquidity shortage $(CB_i \ge 0)$ occurred in T=1, and firms repay in T=2. Long-term banking profits are:

$$\pi_i = [L_i - c_l(CB_i)]\tilde{y} - [(1-\tilde{x})D_i r_D(D)]$$

- Surplus-Insolvent scenario: $x_h(D_i) \leq \widetilde{x} \leq x_M(D_i) = m, \widetilde{y} < y^*_{Hi}$

Here, a liquidity surplus occurred in T=1, and the aggregate gross portfolio return was below y^*_H in T=2. Thus, the bank faces bankruptcy due to solvency risk. Losses are B

$\pi_i = -B, B > 0$

- Shortage-Insolvent scenario; $x_l(D_i) > \widetilde{x} > x_M(D_i) = m, \widetilde{y} < y^*_{Li}$

Here, a liquidity shortage occurred in T=1, and the aggregate gross portfolio return was below y^*_L in T=2. Analogously, the bank faces bankruptcy due to solvency risk.

$\pi_i = -B, B > 0$

- Surplus-Failure scenario; $\widetilde{x} \leq x_h(D_i)$

Here, a liquidity surplus occurred a T=1. Long-term liabilities are higher than expected. The asset transformation process is interrupted and the bank fails before the third period (early termination). Financial failure derives from liquidity risk and banking losses are B.

$\pi_i = -B, B > 0$

- Shortage-Failure scenario; $\widetilde{x} \geq x_l(D_i)$

Here, a liquidity shortage occurred a T=1. Early withdrawals were so demanded that even with the maximum long-term return, long-term liabilities are higher than assets. As before, a failure derives because of liquidity risk and banking losses are B.

$\pi_i = -B, B > 0$

5.2.2. Optimisation program, solution characterisation and banking behaviour

The maximisation program can be written following the methodology followed in the previous chapter. Such program, that comprises the expected profits and losses associated to the banking decisions, is written as follows:

$$\overline{\pi}_i(D_i) = MAX \frac{1}{y_F} \int_{x_h}^{x_M} \int_{y^*_{Hi}}^{y_F} \left[(D_i - mD_i)y - (xD_i - mD_i) - (1-x)D_i r_D(D) \right] dydx +$$

$$\frac{1}{y_F} \int_{x_M}^{x_l} \int_{y^*_{Li}}^{y_F} \left[(D_i - mD_i - c_l(xD_i - mD_i))y - (1-x)D_i r_D(D) \right] dydx$$

$$- \frac{1}{y_F} \left[\int_{x_h}^{x_M} \int_{0}^{y^*_{Hi}} B dydx + \int_{x_M}^{x_l} \int_{0}^{y^*_{Li}} B dydx + \int_{0}^{x_h} \int_{0}^{y_F} B dydx + \int_{x_l}^{1} \int_{0}^{y_F} B dydx \right]$$

s.t. (5.5)

$$y^*_{Li}(x, D_i) = \frac{(1-x) r_D(D)}{[1 - m - c_l(x-m)]}$$

$$y^*_{Hi}(x, D_i) = \frac{(1-x) r_D(D) + [x-m]}{[1-m]}$$

$$x_l(D_i) = \frac{[1 - m(1-c_l)] y_F - r_D(D)}{[y_F c_l - r_D(D)]}$$

$$x_h(D_i) = \frac{[1-m] y_F + m - r_D(D)}{[1 - r_D(D)]}$$

$$x_M(D_i) = m$$

Again, the double integrals show the expected outcomes associated to the short and long term scenarios. Notice that the former constraints define the boundaries of the solvency banking set; while the last one defines the reserve-ratio control imposed by the regulatory authorities.

Now we characterise the optimal program solution. Given the deposit-supply elasticity definition and symmetric banks, the FOC derivative for deposits can be written as:

$$\frac{\partial}{\partial D_i} \overline{\pi}_i(D_i^*) = 0$$

$$\int_{x_h}^{x_M} \int_{y^*_{Hi}}^{y_F} \left[(1-m)y - (x-m) - (1-x) r_D(D^*) \left(1 + \frac{1}{N \varepsilon_D} \right) \right] dydx$$

$$+ \int_{x_M}^{x_l} \int_{y^*_{Li}}^{y_F} \left[(1 - m - c_l(x-m))y - (1-x) r_D(D^*) \left(1 + \frac{1}{N \varepsilon_D} \right) \right] dydx \quad (5.6)$$

$$= \frac{B}{(1-m)} \frac{r_D(D^*)}{N \varepsilon_D D_i^*} \left[\int_{x_h}^{x_M} (1-x) dx + (1-m) \int_{x_M}^{x_l} \frac{(1-x)}{1 - m - c_l(x-m)} dx \right]$$

The expression shows that marginal bankruptcy costs and marginal profits depend on the supply-elasticity and the intermediaries in the financial system. This is relatively similar to the expression (4.4b) in the previous chapter.

We define the following auxiliary definitions

$$v_1 = \int_{x_h}^{x_M} \int_{y_{Hi}^*}^{y_F} \left[(1-m)y - (x-m) - (1-x) r_D(D^*) \left(1 + \frac{1}{N\varepsilon_D} \right) \right] dy dx \tag{5.7a}$$

$$v_2 = \int_{x_M}^{x_l} \int_{y_{Li}^*}^{y_F} \left[(1-m-c_l(x-m))y - (1-x) r_D(D^*) \left(1 + \frac{1}{N\varepsilon_D} \right) \right] dy dx \tag{5.7b}$$

$$u = \int_{x_h}^{x_M} (1-x) dx + (1-m) \int_{x_M}^{x_l} \frac{(1-x)}{1-m-c_l(x-m)} dx \tag{5.7c}$$

We can obtain an expression for optimal individual deposits from the FOC derivative. Using (5.7a), (5.7b) and (5.7c), we can define such expression as:

$$D_i^* = \frac{B}{(1-m)} \frac{r_D(D^*)}{N\varepsilon_D} \frac{u}{v_1 + v_2} \tag{5.8}$$

The characterisation of the optimal solution depends on liquidity regulatory controls and market size.[8] Well-defined optimal deposit decisions directly depend on the regulatory authorities and the features of the deposit market. Thus, the optimal risk management decisions and the regulatory goals depend on market structure.

We analyse the monopolistically competitive model numerically. We assume that the deposit-supply functional form is $r_D(D) = aD^{\frac{1}{\varepsilon_D}}$ and the benchmark parameter configuration: $a = 1.1, B = 2, c_l = 1.5, \varepsilon_D = 2, m = m^*, y_F = 10$.[9] Like in the previous

[8] It is important to recall that (5.8) does not show a closed form expression for the decision variable. Notice that individual deposits are included in the deposit-return function.

[9] The liquidity ratio benchmarks are the optimal ratios obtained for the basic banking model calibrations [Chapter 4. Section 4.3]. We do this for comparison purposes. Evidently, deposits, reserves and expected benefits for the benchmark configurations in the reserve-ratio control and non-regulated basic models are identical. However, the interpretation of such ratios is different. While in the basic model these values are the optimal ratios when deposit and reserve decisions are taken freely under specific configurations; here, such values are reserve-ratio controls by the regulatory authorities. So, while in the basic model these liquidity ratios change as the parameters change; here they are fixed unless the authorities determine otherwise.

models, the numeric exercises show consistent behavioural patterns: Comparative static results show that increases in liquidation or in bankruptcy costs will decrease benefits, while increases in the deposit-supply elasticity or in the quality of long-term banking portfolios will have the opposite effects. Again, these results are independent of the institutional setting analysed (See Figures 5.1.a, 5.1.b and 5.1.c). Evidently, increases in the number of intermediaries will reduce expected benefits (See Figure 5.2). These results are qualitatively similar to the ones of the basic model.

Interestingly, the optimal deposit and expected benefit curves with respect to the liquidity requirements have an inverse U-shape. When the required reserve ratio coincides with the non-regulated optimal liquidity ratio, the maximum is reached. This suggests that liquidity regulations may have direct effects on long-term profitability, and confirms the idea that "required reserves on which no interest is paid impose a tax on financial intermediation" [Fry (1995: p. 133)].

We summarise the above findings in the following table:

Table 5.1 Comparative Static Analysis for the Regulation Model (Calibration Numeric Exercises with Reserve-ratio controls)

Parameter Variation (Positive)	Optimal Deposits ΔD_i^*	Optimal Reserves ΔM_i^*	Reserve-ratio controls $\Delta (M_i^*/D_I^*)$	Expected Benefits $\Delta \pi_i^*$
ΔB	Negative	Negative	Constant	Negative
Δc_l	Negative	Negative	Constant	Negative
$\Delta \varepsilon_D$	Positive	Positive	Constant	Positive
Δm	Depends on m**	Depends on m**	Positive	Depends on m**
ΔN	Negative	Negative	Constant	Negative
Δy_F	Positive	Positive	Constant	Positive

** The variation sign depends on the equivalent non-regulated optimal decision.

We conclude this section emphasising that the effects of increases in reserve-ratio requirements on banking profitability and the intermediation process are *ambiguous*. Certain controls will increase the scope of banking services and the profitability of banking firms. Others will have the opposite effects. Particularly, assuming that restrictive minimum reserve requirements apply (which imply that reserve-ratio controls are above the optimal non-regulated liquidity ratios), calibrations show that deposits and benefits will decrease. This suggests the existence of a trade-off between short and long-term regulatory goals. Evidently the real problem consists in the determination of the optimal liquidity ratio. [10]

5.3. Deposit-return control regulations

In this section we simplify the basic framework assuming that regulation authorities set the deposit-return, $\bar{r}_D$, that banking firms must pay to mature depositors. This assumption makes reserves the only decision variable and makes explicit the effects of deposit-return regulations. Then, following the approach developed in previous models, we study analytically and numerically the regulated banking model.

5.3.1. Deposit-return control regulation and the deposit-supply function

The structure of the model with deposit-return controls is similar to the one of the basic model [See chapters 3 and 4]. The main difference is that individual deposits depend on deposit-return controls. The banking profit function, scenarios, liquidity and viability thresholds remain the same from the perspective of the intermediaries. We do not write them again. Instead we focus on the deposit supply function

$$D_i = D_i\left(\bar{r}_D\right)$$

Given the regulatory controls, individual deposits are fixed. Thus, the banking solvency function and the asset viability conditions depend only on reserve decisions.

[10] There is an extensive literature regarding the determination of the optimal reserve requirements [See Fry (1995)]. In the context of our model, we can make an analogy with the Laffer-curve effect. Then, intuition suggests us that the positive effects of regulatory controls will be when the elasticity of portfolio investment with respect to deposits is relatively inelastic. See Varian (2003) for a microeconomic analysis of the Laffer curve.

5.3.2. Optimisation program, solution characterisation and banking behaviour

The maximisation program is similar to the one written in the previous chapter for the basic model. However, now reserves is the only decision variable. Such program, that comprises the expected profits and losses associated to the banking decisions, is written as follows:

$$\overline{\pi}_i(M_i) = MAX \frac{1}{y_F} \int_{x_h}^{x_M} \int_{y_{Hi}^*}^{y_F} [(D_i(\bar{r}_D) - M_i)y - (xD_i(\bar{r}_D) - M_i) - (1-x)D_i(\bar{r}_D)\bar{r}_D]dydx +$$

$$\frac{1}{y_F} \int_{x_M}^{x_l} \int_{y_{Li}^*}^{y_F} [(D_i(\bar{r}_D) - M_i - c_l(xD_i(\bar{r}_D) - M_i))y - (1-x)D_i(\bar{r}_D)\bar{r}_D]dydx$$

$$-\frac{1}{y_F}\left[\int_{x_h}^{x_M}\int_{0}^{y_{Hi}^*} Bdydx + \int_{x_M}^{x_l}\int_{0}^{y_{Li}^*} Bdydx + \int_{0}^{x_h}\int_{0}^{y_F} Bdydx + \int_{x_l}^{1}\int_{0}^{y_F} Bdydx\right]$$

s.t. (5.9)

$$y_{Li}^*(x, M_i) = \frac{(1-x)D_i(\bar{r}_D)\bar{r}_D}{[D_i(\bar{r}_D) - M_i - c_l[xD_i(\bar{r}_D) - M_i]]}$$

$$y_{Hi}^*(x, M_i) = \frac{(1-x)D_i(\bar{r}_D)\bar{r}_D + [xD_i(\bar{r}_D) - M_i]}{[D_i(\bar{r}_D) - M_i]}$$

$$x_l(M_i) = \frac{[D_i(\bar{r}_D) - M_i(1-c_l)]y_F - D_i(\bar{r}_D)\bar{r}_D}{D_i(\bar{r}_D)[y_F c_l - \bar{r}_D]}$$

$$x_h(M_i) = \frac{[D_i(\bar{r}_D) - M_i]y_F + M_i - D_i\bar{r}_D}{D_i(\bar{r}_D)[1 - \bar{r}_D]}$$

$$x_M(M_i) = \frac{M_i}{D_i(\bar{r}_D)}$$

Again, the double integrals show the expected outcomes associated to the Surplus-Solvent, Shortage-Solvent, Surplus-Insolvent, Shortage-Insolvent, Surplus-Failure and Shortage-Failure scenarios respectively. Regarding the constraints, the former four define the boundaries of the solvency banking set; while the last one clarifies how deposit-return controls, imposed by the regulatory authorities, affect the liquidity ratio.

Now we characterise the optimal solution for the program. Specifically, the FOC derivative for reserves is:

$$\frac{\partial}{\partial \mathrm{M_i}} \overline{\pi}_i \left(M_i^*\right) = 0$$

$$\int_{x_h}^{x_M} \int_{y_{Hi}^*}^{y_F} (y-1)\,dy\,dx + \int_{x_M}^{x_l} \int_{y_{Li}^*}^{y_F} y(1-c_l)\,dy\,dx$$

$$= \frac{BD_i(\bar{r}_D)}{\left(D_i(\bar{r}_D) - M_i^*\right)^2} \left[\int_{x_h}^{x_M} (1-\bar{r}_D)(1-x)\,dx - \left[\int_{x_M}^{x_l} \frac{(1-x)(1-c_l)\bar{r}_D}{\left[D_i(\bar{r}_D) - M_i^* - c_l\left(xD_i(\bar{r}_D) - M_i^*\right)\right]^2} dx \right] \left(D_i(\bar{r}_D) - M_i^*\right)^2 \right] \tag{5.10}$$

At the optimum the expected marginal profit from reserves are identical to the expected marginal bankruptcy cost of reserves. From a regulatory point of view, (5.10) makes explicit that deposit controls influence the allocation of banking assets via expected marginal benefits. Interestingly, the equation shows that there are different ways in which deposit-return controls affect marginal profits and bankruptcy costs. It is easy to see that controls affect the joint probability of marginal bankruptcy costs *and* their total value. Notice that for marginal profit values the second effect does not occur. This confirms that risk management regulation goals must be established according to the market structure prevailing in the financial markets.

Now we analyse the monopolistically competitive model numerically. We assume that the deposit-supply functional form is $D = \left(\frac{\bar{r}_D}{a}\right)^{\varepsilon_D}$ and the benchmark parameter configuration: $a = 1.1, B = 2, c_l = 1.5, \varepsilon_D = 2, \bar{r}_D = r_D^*, y_F = 10$.[11] Again, the numeric exercises confirm that increases in liquidation or in bankruptcy costs will increase liquidity ratios, decreasing benefits and that increases in the deposit-supply elasticity will have the opposite effects (See Figures 5.3.a, 5.3.b and 5.3.c). As before, increases in the number of intermediaries will increase liquidity ratios and will reduce expected benefits (See Figure 5.4).

Interestingly, calibrations show that as the maximum long-term portfolio return increases, optimal liquidity ratios and expected benefits *increase*. This effect suggests that *deposit-return controls may reduce risk-taking incentives associated to increases in the quality of long-term investment*. This effect is new. In all the previous models, increases in portfolio's quality were followed by decreases in the optimal liquidity

[11] The deposit-return benchmarks are the optimal returns obtained for the basic model calibrations.

ratios. Moreover, this result holds independently of the configuration setting used (See Figures 5.3.a, 5.3.b and 5.3.c). Thus, what this finding suggests is that *deposit-return controls can be more effective than required reserve ratios to enhance stability, at least when the size of the deposit market is large enough.*

Finally we analyse the deposit-returns controls. Like the previous case, for liquidity ratios, the expected benefit curves have an inverse U-shape. However, it is interesting to point out that the liquidity ratios decrease as long as deposit-returns increase. This finding suggests that restrictive deposit rate ceilings will enhance the short-term stability of intermediaries, at the cost of reducing their long-term solvency and profitability. So, an inter-temporal trade-off may appear. Moreover, our findings suggest that *very high controlled interest rates will induce intermediaries to take risks without enhancing their profitability*. [12]

We summarise the above qualitative findings in the following table:

Table 5.2 Comparative Static Analysis for the Regulation Model
(Calibration Numeric Exercises with Deposit-return Controls)

Parameter Variation (Positive)	Optimal Deposits ΔD_i^*	Optimal Reserves ΔM_i^*	Liquidity Ratio $\Delta (M_i^*/D_I^*)$	Expected Benefits $\Delta \pi_i^*$
ΔB	Constant	Positive	Positive	Negative
Δc_l	Constant	Positive	Positive	Negative
$\Delta \varepsilon_D$	Positive	Positive	Negative	Positive
ΔN	Negative	Negative	Positive	Negative
Δr_D	Positive	Depends on r_D**	Negative	Depends on r_D**
Δy_F	Constant	Positive	Positive	Positive

** The variation sign depends on the equivalent non-regulated optimal decision.

[12] Fry (1995) documents the relationships between banking crises and high real interest rates.

We conclude by indicating that the exercises suggest that the effects of restrictive deposit-return controls *enhance short-term financial stability*. Deposit-return controls seem to be more adequate than liquidity ones, from the perspective of bankers, because they do not modify banking profitability except when the controls are beyond the free market ones. This conclusion seems to hold, at least, when the size of the deposit market available is relatively big.[13]

5.4. Behavioural and control risk effects, market structure and the likelihood of liquidity and solvency risks

In this section we analyse how liquidity and solvency probabilities change when the banking decision or the regulatory instrument variables change in the reserve-ratio and deposit-return control models. Specifically, we evaluate how such changes in the variables affect the viability of the asset transformation process and the solvency and profitability likelihood of the intermediaries considering specific market structure features. This goal is achieved through the evaluation of the behavioural-risk and control-risk effects.

We define *behavioural-risk effects* as the changes in the liquidity and solvency probability ranges caused by changes in the banking decision variables. Specifically, in the probabilistic ranges defined by the asset-transformation liquidity cut-offs and the banking solvency thresholds. By analogy, we define *control-risk effects* as the changes in the liquidity and solvency probability ranges caused by changes in the regulatory control requirements. Risk-effect analysis *is not* like the comparative-static one, despite that in both cases derivatives are evaluated, because it does not assume that neither the banking nor the regulatory decisions are optimal. It only tries to determine how the inter-temporal liquidity and solvency probabilities are modified because of changes in the banking decision variables or in the regulatory controls.

Analytically, we evaluate the derivatives of the probabilistic ranges that define liquidity and solvency with respect to each variable to analyse the qualitative risk effects [See Appendix for chapter 5]. Interestingly, the behavioural and control-risk

[13] We consider that a market is relatively big when the individual expected benefits of intermediation activities are positive. This criterion assumes that the market size available for an intermediary directly

derivatives show differentiated effects depending on the regulatory regime and the market structure prevailing in the banking markets. We summarise these qualitative findings in the following table:

Table 5.3 Behavioural and Control Risk Effects
(Probabilistic Effects on Liquidity and Solvency)

Probabilistic Range	Reserve-Ratio Control Model	Deposit-Return Control Model	Reserve-Ratio Control Model	Deposit-Return Control Model
	Behavioural-Risk Effects (ΔDecision Variable)		***Control-Risk Effects (ΔControl Variable)***	
Qualitative Short-term Effects: Liquidity Derivatives				
$\Delta [x_H-0]$	Positive	Positive	Positive	Positive*
$\Delta [x_M-x_H]$	Negative	Negative	Negative	Negative*
$\Delta [x_l-x_M]$	Negative	Negative	Negative	Negative*
$\Delta [1-x_l]$	Positive	Negative	Negative	Positive
Qualitative Long-term Effects: Solvency Derivatives				
$\Delta [y_F-y_L]$	Negative	Positive	Positive	Negative
$\Delta [y_F-y_H]$	Negative	Negative	Negative	Negative*

* Derivatives may show this variation sign when the markets are small enough. Otherwise, the sign is undetermined. See Appendix for chapter 5.

The above findings show similarities among the decisions taken by bankers and regulators in the deposit-return and the reserve-ratio control models (See columns 2 and 3). Interestingly, in both cases, increases in the decision variables reduce the likelihood of liquidity shortages, but they also reduce the long-term solvency and profitability in case of liquidity surpluses. These findings suggest that *there is not only*

depends on the deposit-supply elasticity and inversely on the existing number of intermediaries.

an inverse relationship between liquidity insurance and banking profitability (the traditional time-consistency dilemma). There is also an inverse one between deposit insurance and the viability of the asset transformation process. Thus, *the traditional time-consistency dilemma can be extended to include an inverse relationship between liquidity insurance and the viability of the intermediation process*.

Furthermore, the above findings show the importance of analysing the market environment before the implementation of regulations. According to our results, the qualitative effects caused by the decisions taken by bankers and regulators in the deposit-return and the reserve-ratio control models may be identical when the elasticity-supply and the number of intermediaries are small enough. In both cases, increases in the control variables will reduce the likelihood of financial fragility at a cost. Such cost will be expressed in the reduced likelihood of the transformation process viability and in increases of solvency risks when there are liquidity surpluses.

5.5. Regulatory-risk effects, banking stability and competition

In this section we investigate numerically the stability effects of financial regulations on monopolistically and perfectly competitive banking systems. Specifically, we study the regulatory-risk effects associated to minimum reserve-ratio and deposit-return ceiling regulations. We define *regulatory-risk* effects as the changes on the probabilities associated to the viability, solvency and profitability of regulated intermediaries when regulations become restrictive and the intermediaries' decisions change to keep optimality.[14] The idea is to analyse the effects of different regulations on scenario probabilities and optimal banking decisions under monopolistically and perfectly competitive banking systems.

This section is divided in three subsections. The first focuses on the methodological issues regarding the evaluation of liquidity and solvency risks under different regulatory regimes and diverse market environments. The second focuses on the risk likelihood of non-regulated intermediaries operating in monopolistically and perfectly competitive environments. More specifically, it shows how the degree of banking

[14] Regulatory-risk effects are different from the control-risk ones because now they consider that optimal behavioural decisions change when regulations change. *Optimality sets the difference* between the analyses developed in the previous section and the ones shown here.

competition affects intermediaries' stability by computing the probabilities involved on the viability and solvency of the intermediation process. The last subsection shows the results for the calibration exercises done for minimum liquidity requirements and deposit-return ceiling regulations. Regulatory-risk effects associated to restrictive regulations are analysed and compared.

5.5.1. Methodological issues

Here we describe the procedure used to develop the numerical analysis. Specifically, we focus on how we define and compute the probabilities involving risks, viability and solvency. We also focus on the conditions that differentiate between monopolistically and perfectly competitive environments. We believe that such clarifications are worthy because they provide the basis for assessing the numerical analysis, the intermediaries' behaviour, the effects of regulations and the role of banking competition. The scope and generality of the qualitative conclusions depend on such clarifications.

Methodologically, the investigation follows a procedure similar for each type of regulation analysed. It can be described as a three-stage procedure in which we evaluate and compare the probabilistic likelihood of liquidity and solvency risks for intermediaries operating in non regulated and regulated environments. Specifically, with respect to liquidity risk, we evaluate the probabilities associated to face manageable liquidity surpluses (enough reserves); the ones associated to face liquidity shortages and non-manageable liquidity surpluses (liquidity risk); and the ones associated to short-term failure (early termination). Regarding solvency risk, we evaluate the probabilities associated to long-term solvency and profitability and the ones associated to financial failure due to early termination and long-term bankruptcy (solvency risk). Finally, we focus on the viability of the asset transformation process and the banking scenario regulatory-risk effects.[15] The procedure is done for

[15] Mathematically, the probabilities of having enough reserves are defined as $\Pr\left[x : \left\| \{x_h \le \tilde{x} \le x_M\} \right.\right]$. The ones of not having enough reserves are $1 - \Pr\left[x : \left\| \{x_h \le \tilde{x} \le x_M\} \right.\right]$. The probabilities involving early termination are $\Pr\left[x : \left\| \{\tilde{x} \le x_h\} \cup \{\tilde{x} \ge x_l\} \right.\right]$. The joint probabilities of solvency and profitability are $\Pr\left[(x,y) : \left\| \{x_h \le \tilde{x} \le x_M, y_H^* \le \tilde{y} \le y_F\} \cup \{x_M \le \tilde{x} \le x_l, y_L^* \le \tilde{y} \le y_F\} \right.\right]$. The ones of failure are.

intermediaries operating in monopolistically and perfectly competitive environments under diverse institutional settings.

We use this approach to investigate the risk-effects associated with minimum liquidity requirement and deposit-return ceiling regulations. Evidently, when a liquidity requirement or a deposit ceiling applies, we are imposing a control on the banking firm. This fact will allow us to use the control regulation models developed in the previous sections to support our analysis. Reserve-ratio controls apply when the non-regulated optimal risk management ratio is below the minimum required ratio. Deposit-return controls apply when the non-regulated optimal return paid to mature depositors is above the ceiling set by the regulatory authorities.

The structure of the control models allows us to analyse how of the degree of banking competition affects the regulatory-risk effects. Notice that the structure of the control regulation models explicitly assumes monopolistically competitive intermediaries when benefits are positive. Perfectly competitive intermediaries can appear in our models by introducing a *zero-benefit condition.* Thus, a perfectly competitive banking system does not necessarily depend on the institutional setting that defines it.[16]

The analysis of regulatory risk effects is done in terms of the institutional settings and the competitive environments in which intermediaries develop their activities. Specifically, the analysis focuses in how the risk effects change when the institutional setting, that defines that banking system, changes. Furthermore, it focuses on how the regulations affect the probabilities of liquidity, solvency and profitability among monopolistically and perfectly competitive intermediaries. We do this for comparison and robustness purposes regarding the qualitative conclusions obtained.[17]

$1-\Pr\left[(x,y):\left\|\left\{x_h \le \tilde{x} \le x_M, y_H^* \le \tilde{y} \le y_F\right\} \cup \left\{x_M \le \tilde{x} \le x_l, y_L^* \le \tilde{y} \le y_F\right\}\right.\right]$. Finally, the probabilities involving manageable liquidity surpluses and shortages are $\Pr\left[x:\left\|\left\{x_h \le \tilde{x} \le x_M\right\}\right.\right]$ and $\Pr\left[x:\left\|\left\{x_M \le \tilde{x} \le x_l\right\}\right.\right]$.

[16] Interestingly, our view has similarities with the one that defines *contestability* in the financial markets. As some authors have pointed out "a competitive environment requires a contestable system – meaning one that is open to competition – but not necessarily a large number of institutions" [See Caprio and Klingebiel (2001: p. 19)]. However, this contestability definition does not coincide with the conventional one of the IO literature [See Tirole (1988) and Vives (1999)].

[17] Computational limitations restrict the robustness of our findings more than in the previous models. The programs, involving perfectly competitive intermediaries, demand an additional constraint

Methodologically, the advantage of using both analytical perspectives is that they allow for both the study of the effects of regulation on banking stability and for examining how do these effects depend on the degree of competition.

5.5.2. Banking competition and non regulated intermediaries

Here we focus on the relationships between risks and the degree of banking competition for non-regulated intermediaries. We study such relationships because the evaluation of the regulatory-risk effects necessarily needs to refer to the risk likelihood of non-regulated intermediaries. We also study them because they also provide us with further elements to analyse the relationships among management practices, the likelihood of financial fragility and the structures prevailing in the banking markets.

The analysis of risks for non-regulated intermediaries is based on the basic monopolistically competitive model exposed in the two previous chapters. Numerical analyses are done using the optimal risk management decisions under different institutional settings. The benchmark parameter configurations remain, except in what is related to the deposit-supply elasticity. As indicated above, such variations in elasticity parameter are done to differentiate between monopolistically and perfectly competitive environments. While in the monopolistically competitive settings these values are constant and identical to the ones of the previous chapter; in the perfectly competitive ones, they are adjusted to guarantee almost zero benefits. The degree of banking competition does not necessarily depend on the number of institutions, but on the existence of positive gains from intermediation activities.

Not surprisingly, calibrations show that the degree of banking competition affects the stability of the banking firms even when the intermediaries are not regulated. The comparative analysis between non-regulated monopolistically and perfectly competitive banks show differences regarding the relationship among the number of institutions in the banking system and the liquidity and solvency likelihood of the

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involving zero optimal benefits. Numerically, this constraint imposes additional computational efforts and even introduces consistency problems on certain numerical results. Indeed, the sets of institutional settings analysed for monopolistically and perfectly competitive intermediaries are not identical due to these limitations (the monopolistic sets involve one, three and five intermediaries; while the perfectly

intermediaries [See the first row of Figures 5.5 and 5.6.]. Interestingly, the calibrations show that financial fragility and size of the deposit market are directly related when the intermediaries are perfectly competitive. In summary, the model calibrations show that *increases in the number of perfectly competitive intermediaries reduce the optimal non-regulated liquidity ratios, increasing the probabilities of financial failure*. This result does not hold for monopolistically competitive intermediaries. In the latter case, liquidity ratios increase, but benefits converge to the optimal ones.

The result for perfectly competitive intermediaries complements previous ones. In the previous chapter, comparative-static exercises were done only for increases in the number of monopolistically competitive intermediaries. In the perfectly competitive environment, we have increases in the number of firms, *but also* we have increases in the deposit-supply elasticity to guarantee almost zero benefits. In the monopolistically competitive environment, increases in the number of firms are associated to reductions in expected benefits and constant deposit-supply elasticity. Particularly, in the latter case, the calibrations confirm that increases in the number of intermediaries reduce the liquidity risk probabilities, increasing the ones of solvency and profitability.

The analysis suggests certain relationships among the degree of banking competition, the stability of intermediaries and market size. Notice that, in the perfectly competitive non-regulated banking systems, increases in the deposit-supply elasticity are necessary to avoid negative benefits when the number of intermediaries increases. Keeping a constant elasticity will definitively imply financial failure.

We can summarise the above findings in the following statement: *if the banking system is perfectly competitive (implying that expected benefits are zero), fragility is enhanced when the number of intermediaries increases and the financial system is not regulated*. *Otherwise, assuming monopolistically competitive intermediaries, stability is enhanced. This conclusion holds, even when the deposit-supply elasticity expands enough to guarantee non-negative expected benefits among the perfectly competitive intermediaries.*

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competitive ones involve two, three and four intermediaries). In spite of these limitations, the qualitative patterns that describe the regulatory-risk effects are mostly consistent.

We conclude this subsection by indicating that, even for non-regulated economies, the market environment, and particularly the degree of banking competition, matters. Notice that the conclusions for the non-regulated model calibrations imply that the stability of the banking system will depend on the potential growth of the financial markets and the competitive nature of intermediaries in the financial system.

5.5.3. Minimum reserve requirements and deposit-return ceilings

Here we focus on the regulatory-risk effects of minimum reserve requirements and deposit return regulations. Specifically, we study how restrictive regulations affect the likelihood of liquidity and solvency probabilities for intermediaries operating in regulated financial systems. Particularly, we analyse the relationship between regulatory-risk effects and the competitive environments, because our previous findings suggest that regulations can have differentiated effects on the intermediaries according to the degree of banking competition in which they operate.

Numerically we analyse minimum reserve ratio regulations using the reserve control model. Specifically, we assume that the deposit-supply functional form is $r_D(D) = aD^{\frac{1}{\varepsilon_D}}$. Let the benchmark parameter configurations be: $a = 1.1, B = 2, c_l = 1.5, \varepsilon_D = \varepsilon_D{}^*, m = m^*, y_F = 10$.[18]

The regulatory analysis is done using the non-regulated optimal risk management ratio and three reserve-ratio control values for intermediaries operating in monopolistically and perfectly competitive institutional settings.[19] Specifically, reserve-ratio controls apply when the non-regulated optimal risk management ratio is below the minimum required ratio. Otherwise, the non-regulated banking decision prevails.

[18] In the institutional settings for monopolistically competitive intermediaries, the deposit-supply elasticity benchmark is 2. In the settings with perfectly competitive intermediaries, such benchmark depends on the number of intermediaries that exists in the banking system. The values are the ones associated to zero benefits when the banking decisions are optimal in the non-regulated basic model.
The benchmark liquidity ratios are the ones corresponding to the basic model assuming identical parametrical configurations.

[19] For each type of institutional setting, these control values are obtained using the difference between the extreme non-regulated ratio values and dividing the result between four. This latter value is added to each non-regulated extreme ratio in order to obtain the extreme control values. Finally, we obtain the average of both control values. The value obtained completes the set of three reserve-ratio control values used in the analysis.

The numerical exercises show consistent risk effects among different institutional settings when the competition environment does not change. However, when it changes, differentiated regulatory-risk effects appear. Specifically, numerical calibrations show that, in monopolistically and perfectly competitive environments, restrictive reserve regulations will reduce the likelihood of liquidity risk and early-termination, increasing the probabilities that the intermediaries will have enough reserves. However, this short-run risk-effect consistency does not hold in the long run. Calibrations show that *restrictive regulations will reduce the likelihood of solvency risk when the intermediaries are perfectly competitive. Otherwise, regulation will have the opposite effects* [See Figures 5.5. and 5.6.].

We analyse the risk-effects of deposit-return ceiling regulations using an equivalent procedure. Numerically we analyse such regulations using the deposit control model. Specifically, we assume that the deposit-supply functional form is $D = \left(\frac{\bar{r}_D}{a} \right)^{\varepsilon_D}$. Again, we let the benchmark parameter configurations be: $a = 1.1, B = 2, c_l = 1.5, \varepsilon_D = \varepsilon_D^*, \bar{r}_D = r_D^*, y_F = 10$.[20] The regulatory analysis is done using the non-regulated optimal risk management ratio and three reserve-ratio control values for intermediaries operating in monopolistically and perfectly competitive institutional settings.[21] Specifically, deposit controls apply when the non-regulated optimal deposit-return is above the ceiling established. Otherwise, the non-regulated banking decision prevails.

The analysis of the regulatory-risk effects of deposit-return ceilings has differences with respect to the one of minimum liquidity ratios. Deposit-returns modify the market environment in which intermediaries operate through market discipline. Particularly, when regulations involve deposit-return instruments, numerical exercises show consistent regulatory-risk effects among different institutional settings *even* when the competition environment changes. Differentiated risk effects *do not* appear. Thus,

[20] The deposit-supply elasticity benchmarks are the ones used for the monopolistically and perfectly competitive parametric configurations used before. Thus, the non-regulated benchmark configurations are identical in both regulation exercises.

[21] These deposit-return control values are obtained using a procedure equivalent to the one for the reserve-ratio control values.

calibrations suggest that the use of interest-rate regulations can be preferable than the ones involving portfolio restrictions.

Numerical calibrations show that restrictive deposit-return ceiling regulations will reduce the likelihood of liquidity risk and early termination, increasing the probabilities that the intermediaries will have enough reserves. Interestingly, they show that restrictive regulations will reduce the likelihood of solvency risk, increasing the one of solvency and profitability [See Figures 5.7. and 5.8.].

Finally, it is important to point out that the analysis of the impact of regulation on banks seems to depend on the degree of competition and the type of instruments involving such regulations. Particularly, in what concerns to minimum reserve requirements and deposit-return ceilings, the comparison among their associated regulatory-risk effects allow us to study their similarities and differences according to the competitive environment in which the intermediaries develop their activities.

We summarise the qualitative findings involving both types of regulations in the following table:

Table 5.4 Probabilistic Risk Effects on Liquidity and Solvency
(Probabilistic Effects when Regulations are Restrictive)

	Competitive Intermediaries	**Monopolistic Intermediaries**	**Competitive Intermediaries**	**Monopolistic Intermediaries**
	Minimum Liquidity-Ratio Regulations		***Deposit-return Ceiling Regulations***	
Regulation Effects on Liquidity Probabilities				
Enough Reserves	Positive	Positive	Positive	Positive
Liquidity Risk	Negative	Negative	Negative	Negative
Early Termination	Negative	Negative	Negative	Negative
Regulation Effects on Solvency Probabilities				
Solvency and Profitability	Positive*	Negative*	Positive	Positive
Solvency Risk	Negative*	Positive*	Negative	Negative
* Calibrations show this variation sign in almost all cases				

The above findings reinforce the idea that *the design of stabilisation policies cannot be done independently of the market structure in which regulations will apply*. Although this may not seem evident in what regards to liquidity risk, the calibrations suggest that the degree of banking competition is essential to determine the effects of regulation. Moreover, they suggest that market regulatory instruments have an advantage with respect to portfolio restriction ones because they eliminate the possibility of undesirable regulatory-risk effects.

5.6. Regulatory-risk effects on asset transformation viability and banking scenarios

In this section we analyse the risk effects of regulations on the viability of the asset transformation process and banking scenarios. Considering that the regulatory goals pursue to avoid short-term failures and to achieve long-term stability, we compare the

risk effects in the two regulatory variations under the two alternative competitive environments. In order to facilitate such analysis, the following table summarises our findings regarding the inter-temporal intermediation process.

Table 5.5 Probabilistic Risk Effects and Intermediation Process
(Probabilistic Effects when Regulations are Restrictive)

	Competitive Intermediaries	**Monopolistic Intermediaries**	**Competitive Intermediaries**	**Monopolistic Intermediaries**
	Minimum Liquidity Ratio Requirements		***Deposit-return Ceiling Regulations***	
Probabilistic Risk Effects on Asset Transformation Viability-ATV (Variation on Manageable Idiosyncratic Shock Probabilities)				
Liquidity Surplus	Positive	Positive	Positive	Positive
Liquidity Shortage	Negative	Negative	Negative	Positive*
Sum	Positive	Positive	Positive	Positive
Probabilistic Risk Effects on the Banking Scenarios (Variation on Outcome Joint Probabilities)				
Surplus Solvent	Positive	Positive	Positive	Positive
Shortage Solvent	Negative	Negative	Negative	Positive*
Sum	Positive*	Negative*	Positive	Positive
Surplus Insolvent	Positive	Positive	Negative	Negative
Shortage Insolvent	Negative	Negative	Negative*	Positive
Surplus Failure	Null	Null	Null	Null
Shortage Failure	Negative	Negative	Negative	Negative
Sum	Negative*	Positive*	Negative	Negative
* Calibrations show this variation sign in almost all cases				

Table 5.5 shows that inter-temporal regulatory-risk effects depend on the nature of the regulations imposed and the competitive environment. Specifically, it shows that restrictive regulations will have *differentiated* risk effects on the likelihood of the viability and the occurrence of banking scenarios. However, while *these effects seems not to be differentiated in the short run*, when idiosyncratic shocks appear; they are clearly evident in the long run, when solvency, profitability or failure may occur.

Interestingly, while calibrations show that restrictive regulations consistently reduce the likelihood of short-term financial fragility, they also show differentiated risk effects, among the liquidity shortage and surplus probabilities, depending on the type of regulation imposed and the nature of the competitive environment. This differentiation also happens for the banking scenario probabilities. Specifically, for the minimum ratio regulations, the joint probabilities associated to each scenario show that the risk effects do not depend on the competitive environment, but the sum of similar scenario probabilities depend on it. These results also appear in the deposit-return ceiling regulation, but the other way round. In the latter case, the risk effects on each scenario depend in the competitive environment, while the ones associated to the sums do not.

Finally, we conclude by indicating that the nature of the regulatory instruments and the competitive environments allow us to understand the differentiated risk effects of regulation on liquidity and solvency risks. Particularly, *when the environment is perfectly competitive or involves deposit-return instruments, differences disappear and the risk effects of regulation are qualitatively similar for both types of regulations.* Evidently then, this conclusion suggests that interest-rate regulatory instruments can have a relative advantage with respect to portfolio restriction ones because they eliminate the possibility of differentiated, and undesirable, risk-effects regarding, the viability, solvency and profitability of intermediaries.[22]

5.7. Conclusions and discussion

The design of adequate regulation practices is a generalised concern around the world. Continuously, banking regulations are proposed and debated in order to encourage

banking stability and the adequate allocation of resources. Banking regulations aim to guarantee the functioning and stability of the intermediaries defining and modifying their incentives, structure and operation modes. However, there is no consensus about the impact of regulations on banks, or about the best regulation practices that may encourage financial stability. Here we have analysed the effects of reserve-ratio and deposit-return regulations on the behaviour of the intermediaries and the likelihood of liquidity and solvency risks. Interestingly, what our findings indicate is that the effects and the design of regulation practices depend on the degree of banking competition.

We have developed the analysis using two variations of the basic framework. Theoretically, each variation can be seen as a specific banking firm counterpart of traditional regulation models in which the government plays the main role. Their main contribution consists in the analysis of how banking regulations and the degree of banking competition affect the intermediaries' likelihood of liquidity and solvency risks and the viability, solvency and profitability of the intermediation process. Furthermore, the contributions also relate to the clarification of the specific behavioural-risk, control-risk and regulatory-risk effects, associated to reserve requirements and deposit-return regulations, under diverse competitive environments.

Traditionally, the justification of banking regulation has been analysed in the context of the provision of protection to non informed clients against risks and to ensure banking stability. Our models show that banking fragility is enhanced when the number of perfectly competitive intermediaries increases in the banking system and the system is not regulated. They also show that regulations can enhance short-term stability, at least, for monopolistically competitive intermediaries. Moreover, they even suggest that regulations involving deposit-return instruments can eliminate the possibility of differentiated effects on liquidity and solvency risks. Therefore, our models not only justify regulatory practices, but also suggest the use of interest-rate instruments as regulatory devices instead of asset portfolio restrictions because they eliminate the possibility of differentiated, and undesirable, risk effects regarding the viability, solvency and profitability of intermediaries.

[22] However it can be counter-argued that deposit-return ceilings provide low revenues to savers and that using them may decrease the efficiency of banks, because they do not have to compete as hard.

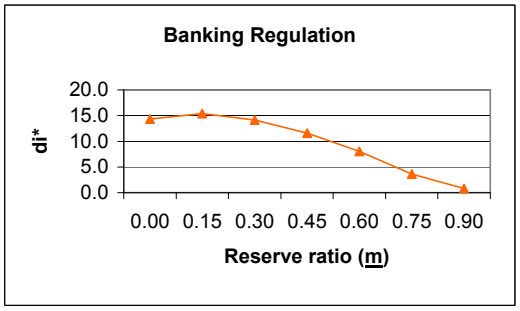
Evidently, it can be argued that this analysis has some limitations in practice: Restrictions on deposit-returns may encourage deposit withdrawals and fragility due to arbitrage assuming the existence of other, not so regulated, financial markets. Particularly, if the financial system is highly developed, the possibility that such markets could offer higher returns, cannot be dismissed. Even if they were not well developed, the access to international financial markets could be enough to trigger bank runs and systemic distress. In such cases, regulatory policies involving asset portfolio restrictions may be more adequate to induce financial stability; even if differentiated risk effects appear. Nevertheless, what seems clear is that instruments, properly used, can support regulatory goals, enhancing banking stability.

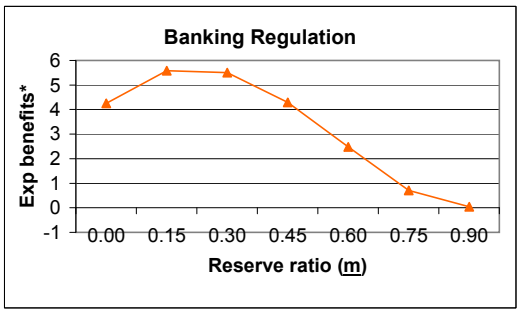
The above analysis of regulations has confirmed some ideas, but also has unveiled some others, about the relationships among risk management, financial fragility and market structure. Particularly, the analysis has highlighted that stabilisation policies should not be designed without considering the competitive environment prevailing in the financial markets. Moreover, it also has suggested that the existence of non-pursued regulation risk effects can be associated to the joint effects of the structure and development prevailing in the financial systems. Interestingly, what follows up from this analysis is that further research can be carried along the lines of the economic theory of comparative financial systems [Allen and Gale (1997), (2000a) and (2001)]. The reason is because this theory provides us with the conceptual basis to empirically analyse the relationships between development and management practices using financial development and structure indicators.

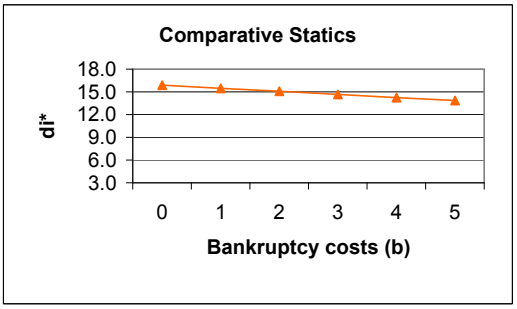
In the next chapter we will econometrically investigate the relationships among risk management practices, financial fragility and market structure using financial and banking micro-macro data for a sample of 47 economies during the 1990-97 period. Concretely, the analysis pursues to shed light on the determinants and the financial structure features that may encourage banking stability. It aims to unveil empirical relationships among risk management, banking fragility and market structure and among the ones regarding inter-temporal risk smoothing, financial structure and development; for theoretical and policy purposes.

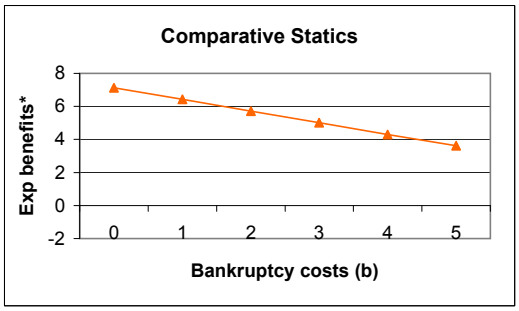
Fig. 5.1.a. Liquidity Regulations and Individual Banking Decisions

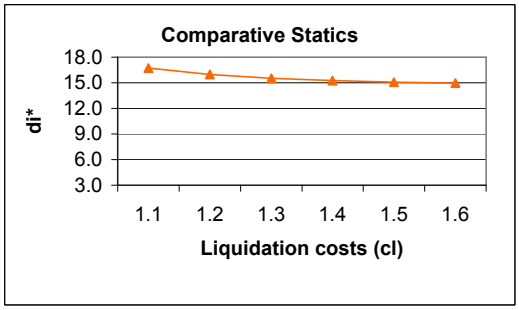
Monopolistically Competitive Intermediaries (n=1) and Reserve-Ratio Controls

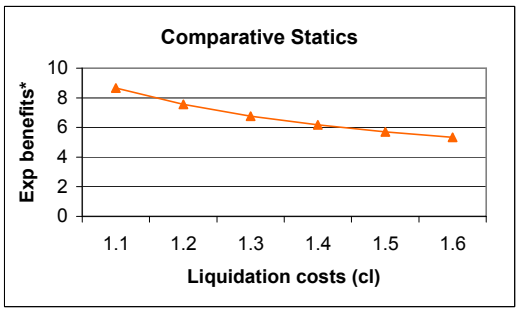


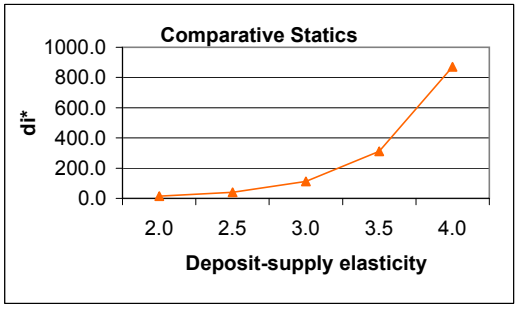


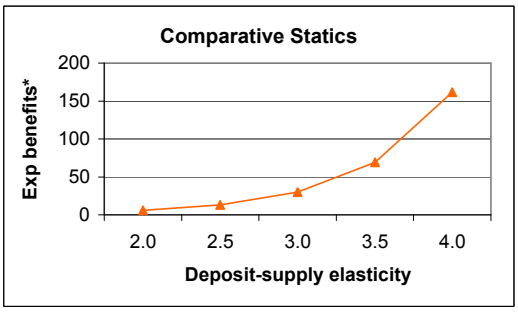


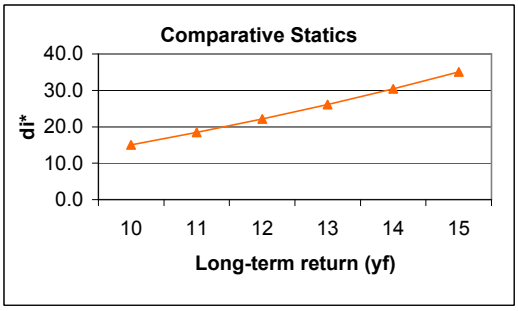












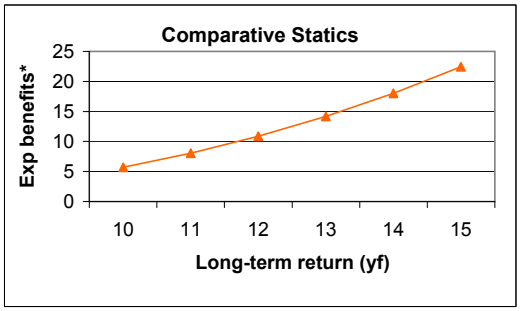
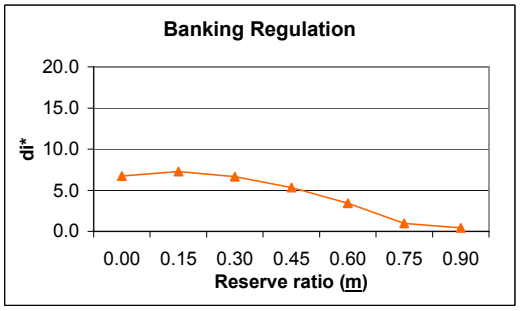
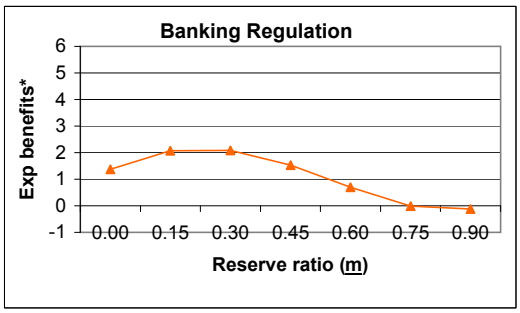
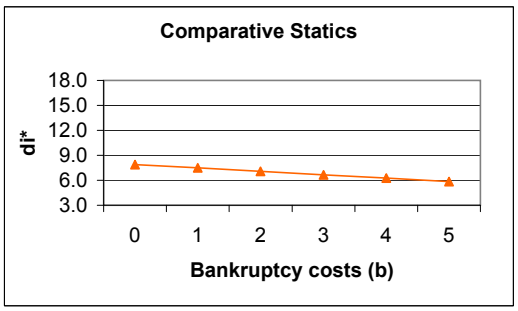


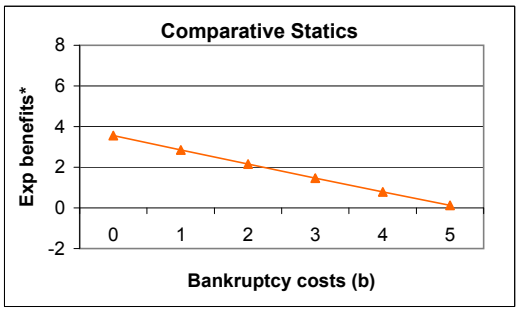
Fig. 5.1.b. Liquidity Regulations and Individual Banking Decisions

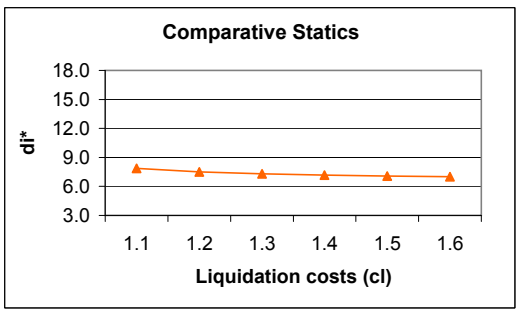
Monopolistically Competitive Intermediaries (n=2) and Reserve-Ratio Controls

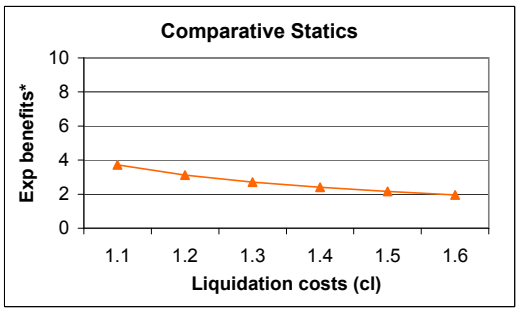


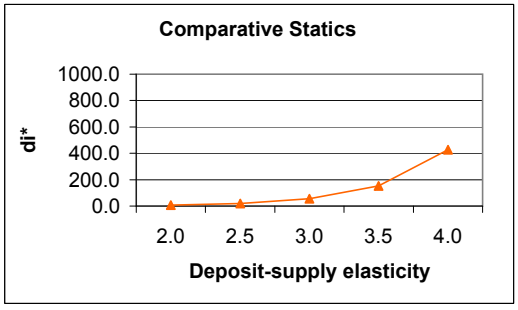


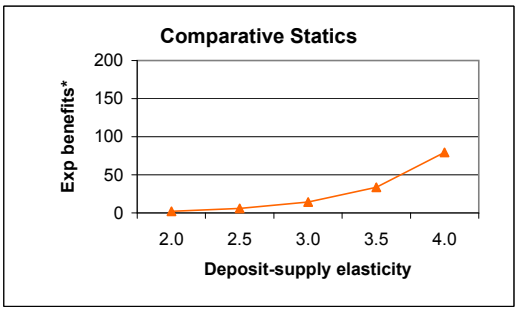


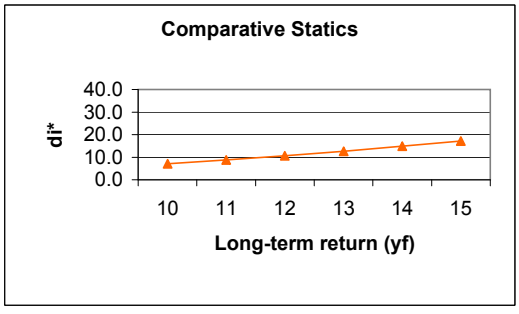












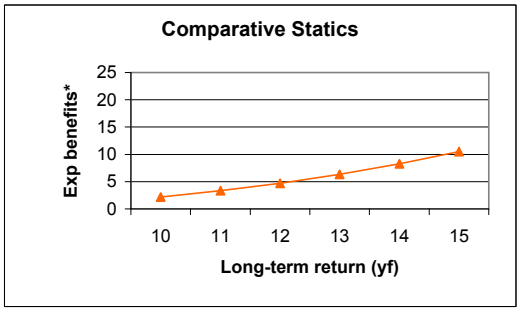
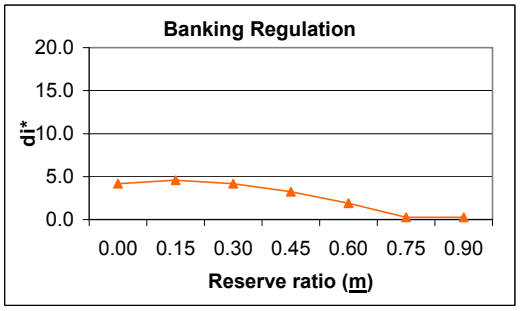
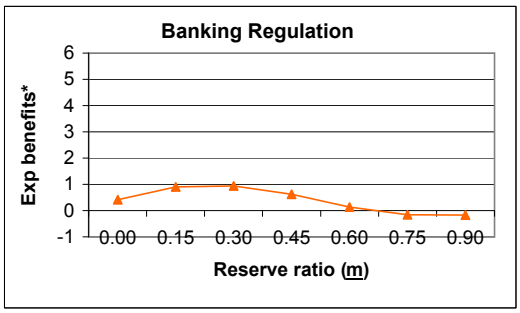
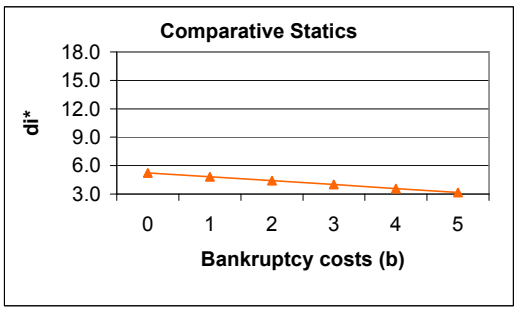


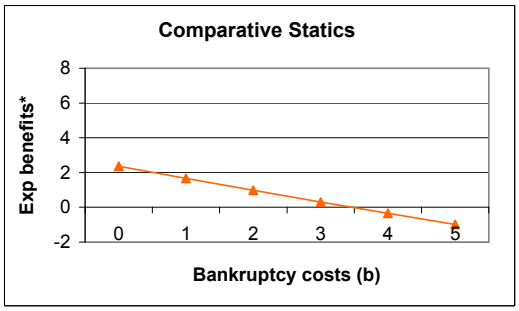
Fig. 5.1.c. Liquidity Regulations and Individual Banking Decisions

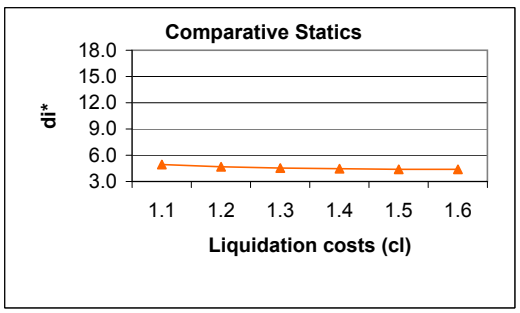
Monopolistically Competitive Intermediaries (n=3) and Reserve-Ratio Controls

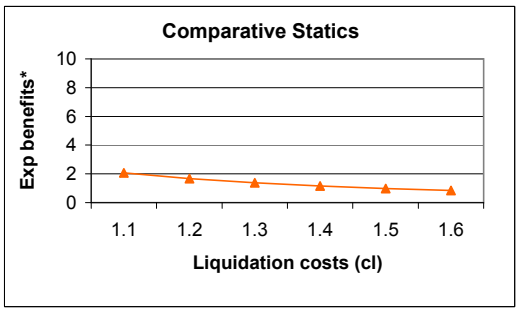


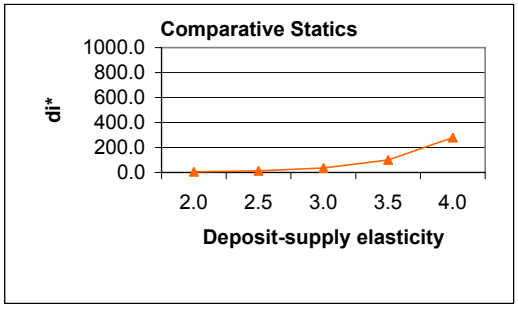


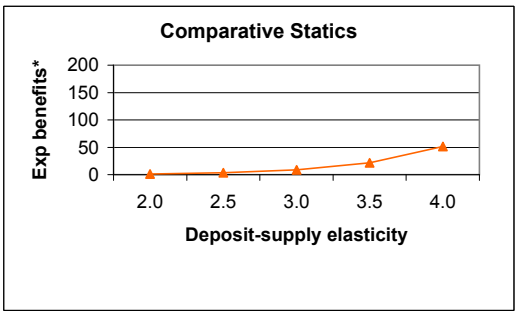


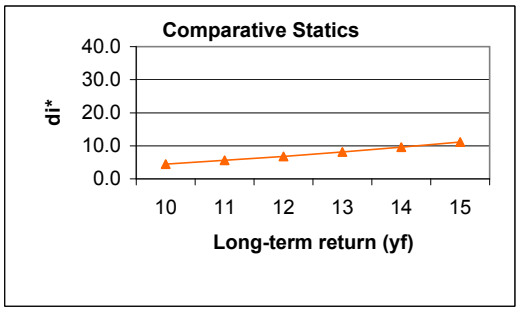












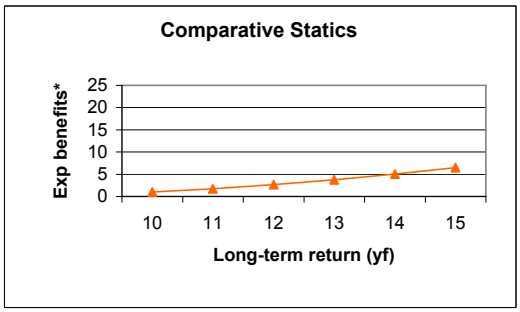
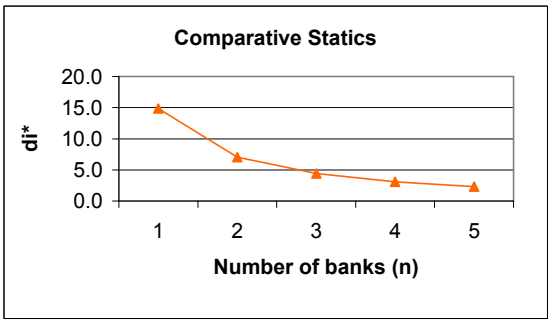


Fig. 5.2. Liquidity Regulations and Individual Banking Decisions

Monopolistically Competitive Intermediaries and Reserve-Ratio Controls
Institutional Setting Comparison



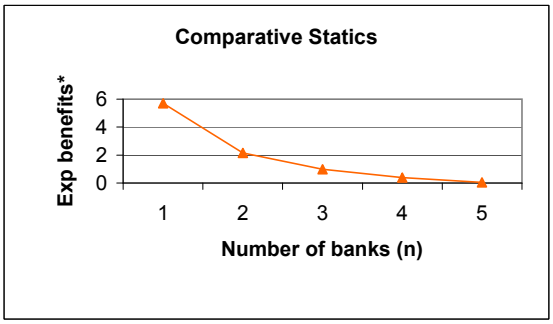
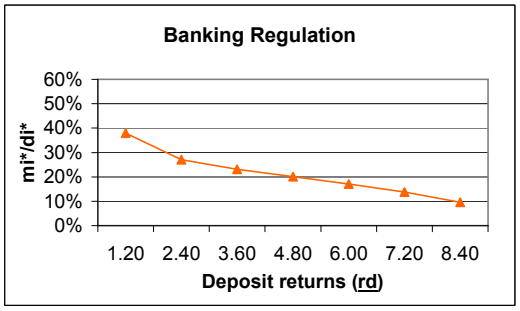
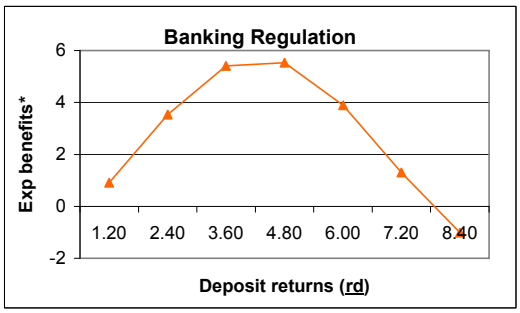
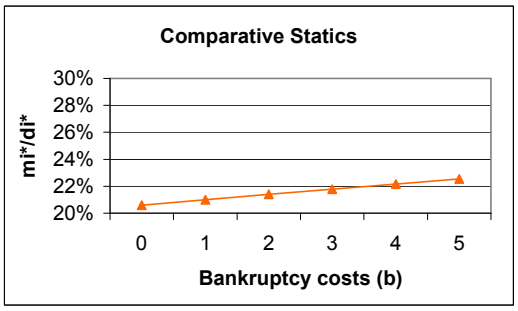


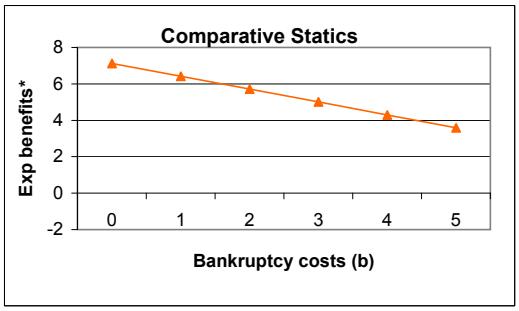
Fig. 5.3.a. Deposit Return Regulations and Individual Banking Decisions

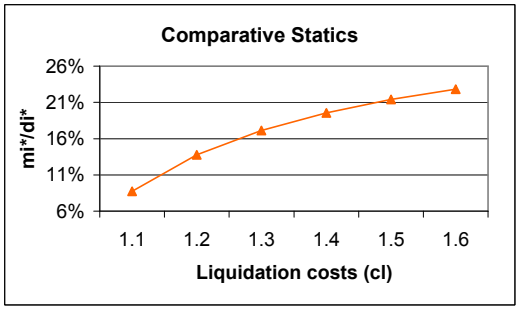
Monopolistically Competitive Intermediaries (n=1) and Deposit-Return Controls

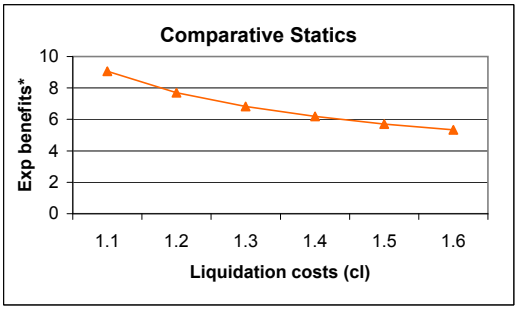


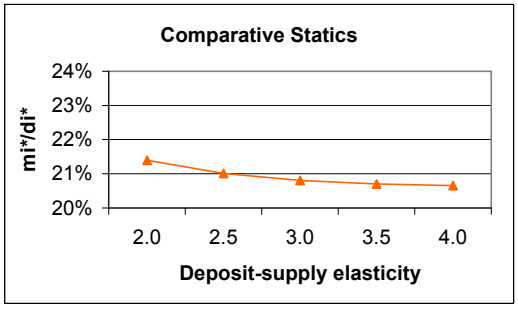


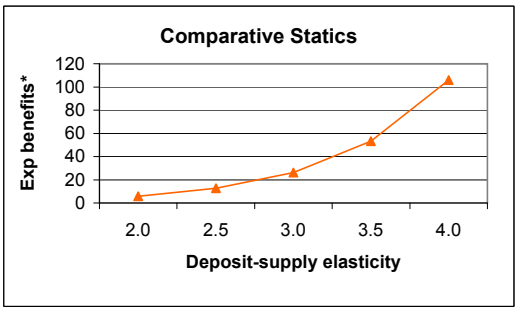


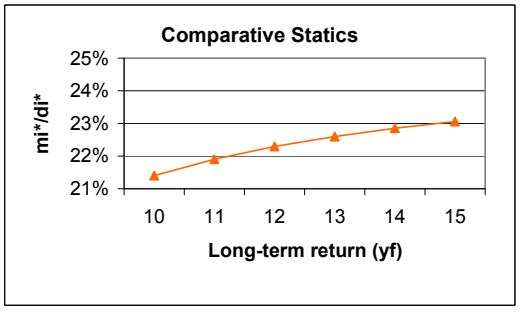












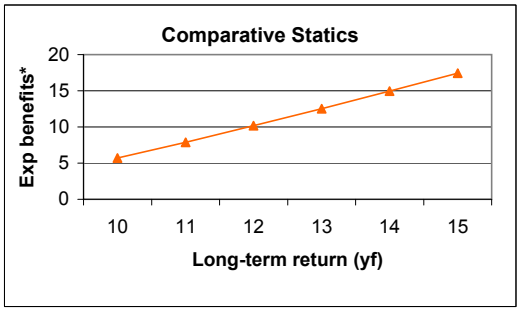
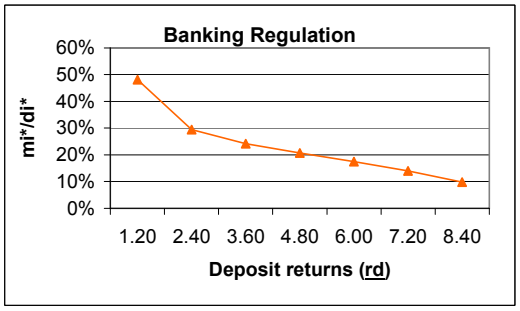
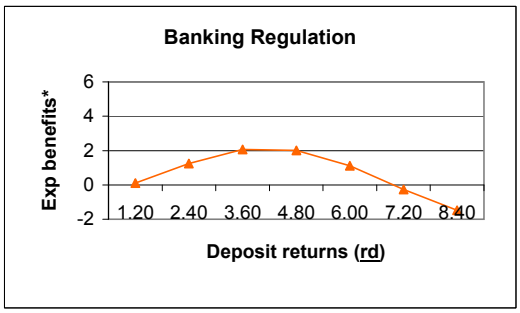
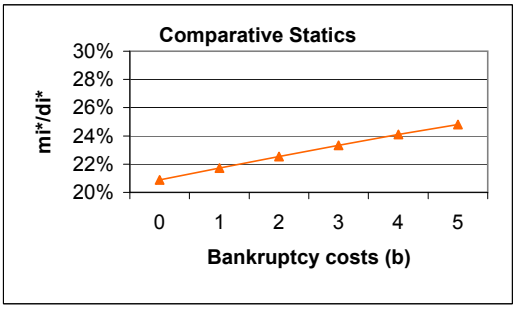


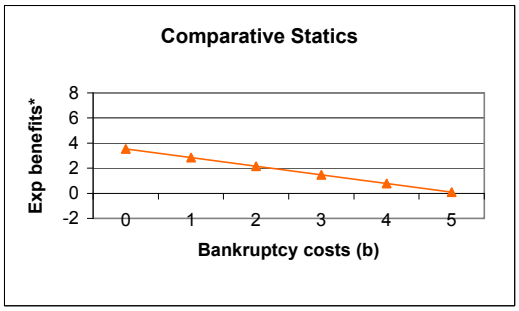
Fig. 5.3.b. Deposit Return Regulations and Individual Banking Decisions

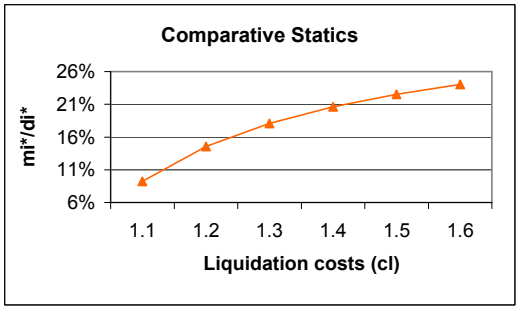
Monopolistically Competitive Intermediaries (n=2) and Deposit-Return Controls

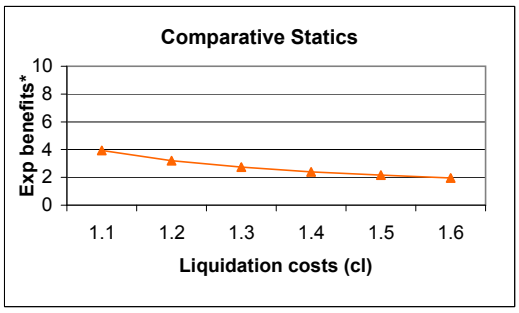


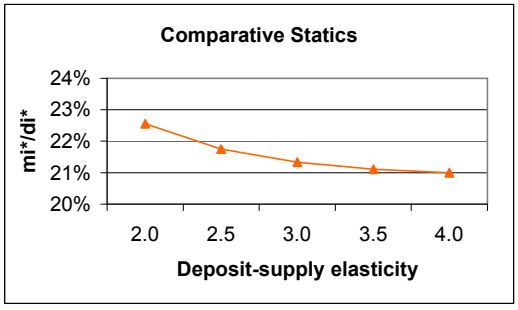


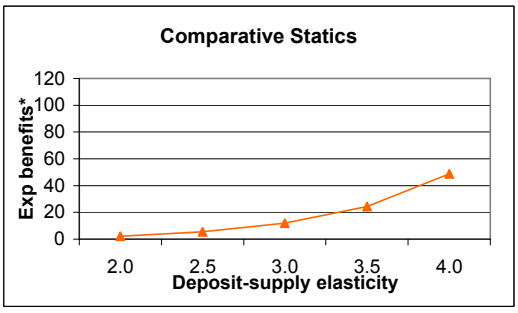


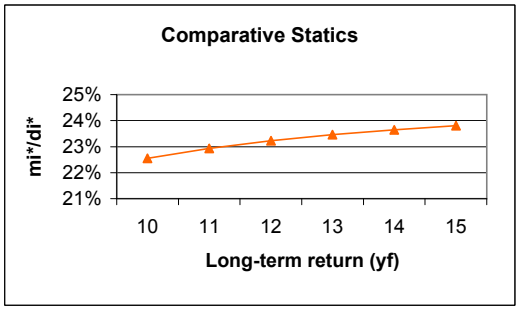












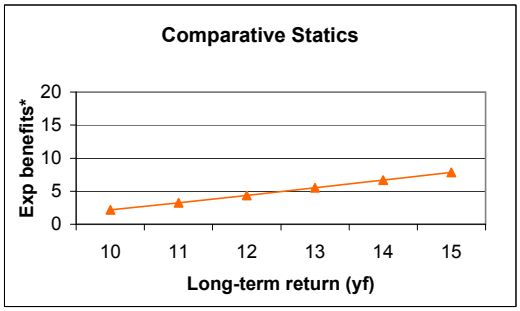
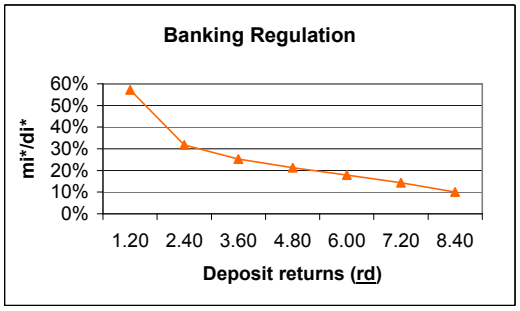
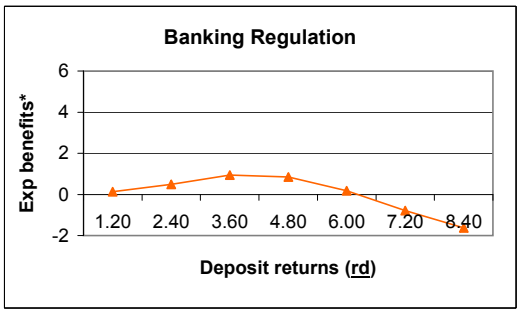
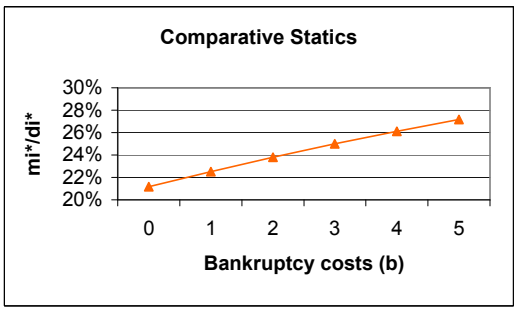


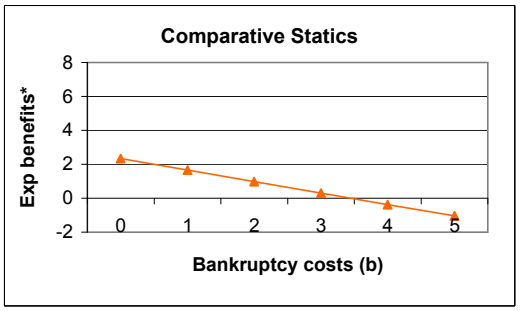
Fig. 5.3.c. Deposit Return Regulations and Individual Banking Decisions

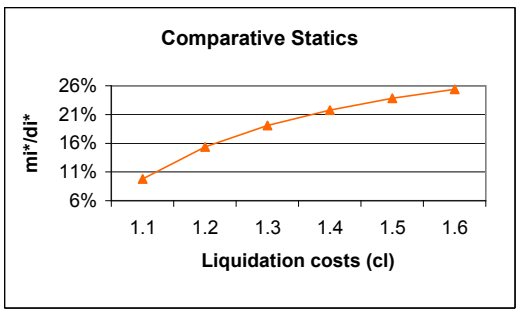
Monopolistically Competitive Intermediaries (n=3) and Deposit-Return Controls

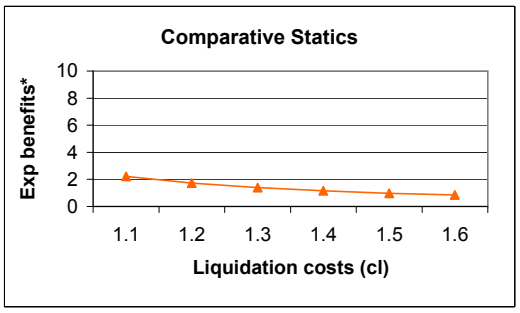


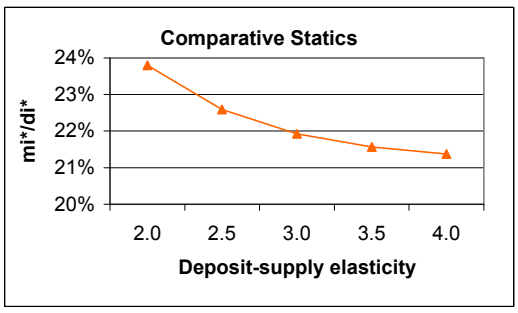


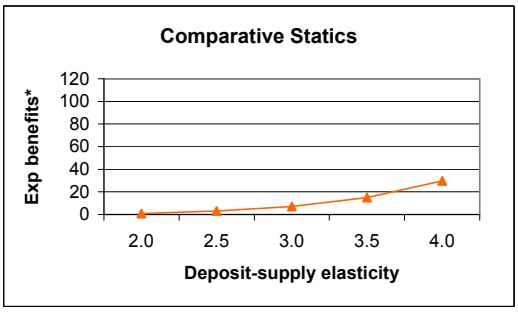


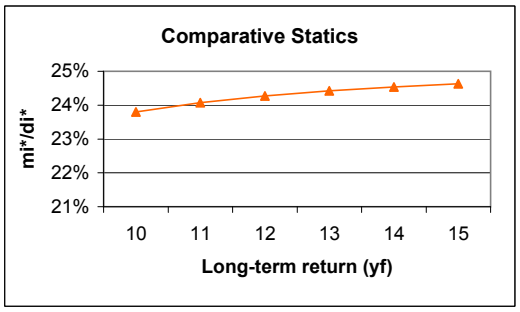












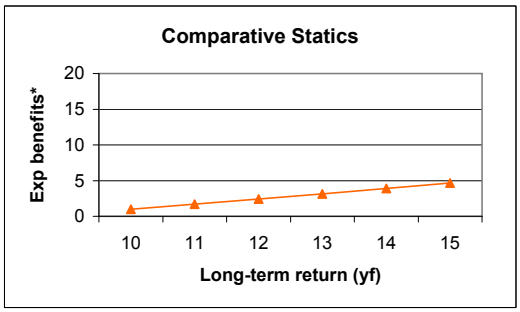
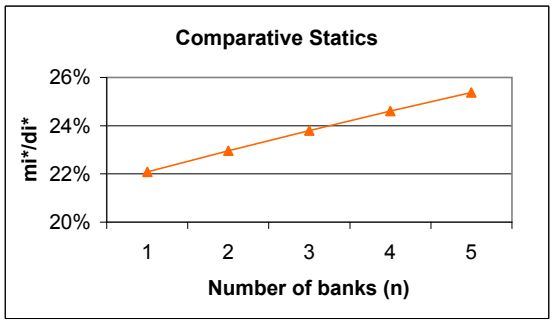


Fig. 5.4. Deposit Return Regulations and Individual Banking Decisions

Monopolistically Competitive Intermediaries and Deposit-Return Controls
Institutional Setting Comparison



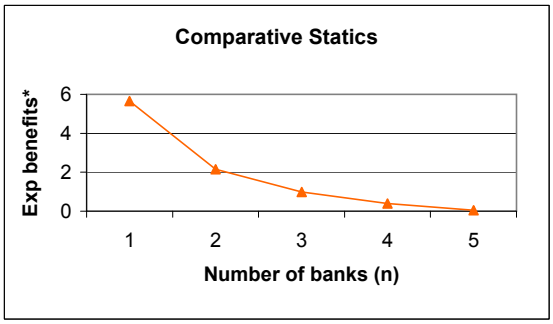
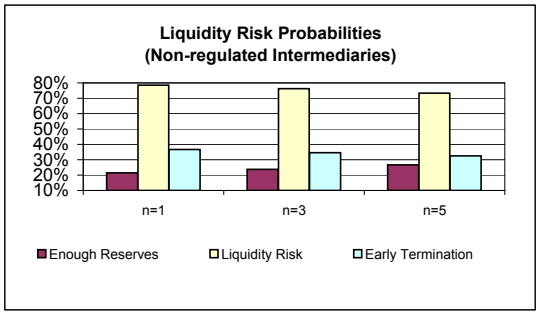
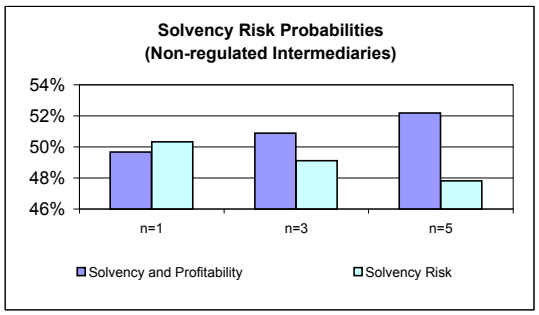


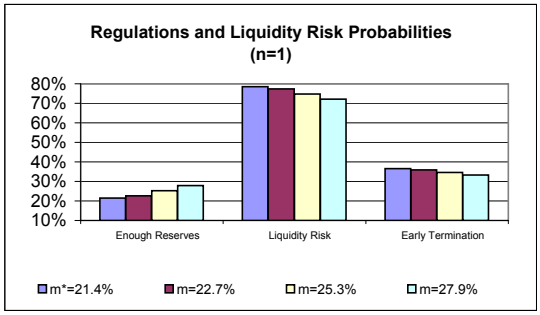
Fig. 5.5. BANKING REGULATIONS AND PROBABILISTIC RISK EFFECTS

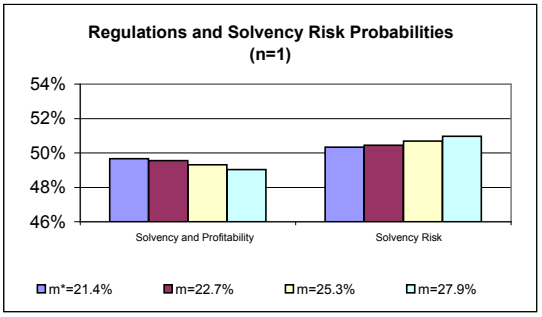
Monopolistically Competitive Intermediaries and Minimum Reserve-Ratio Regulations (m)

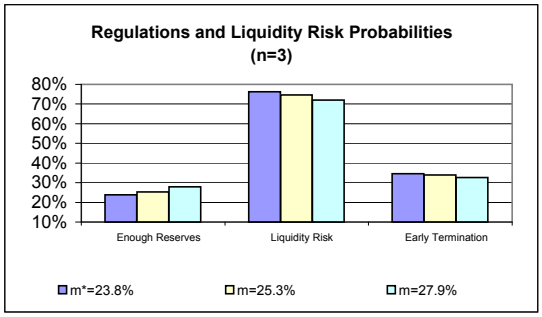
Institutional Setting Comparisons

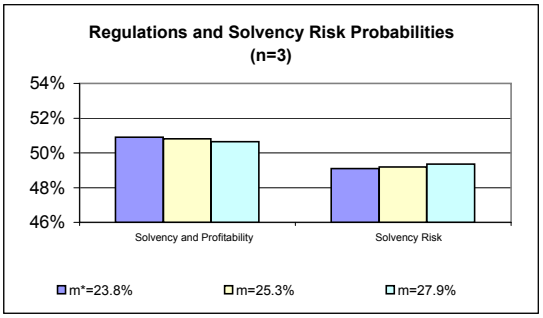


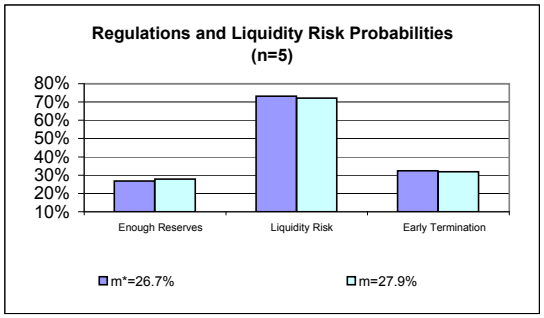


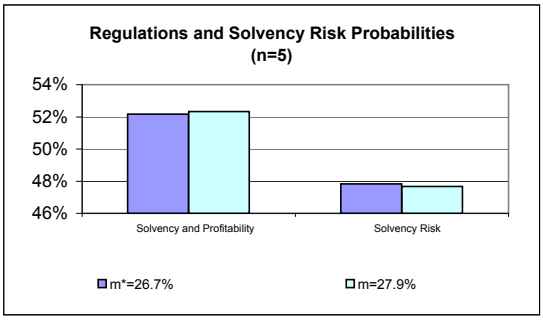










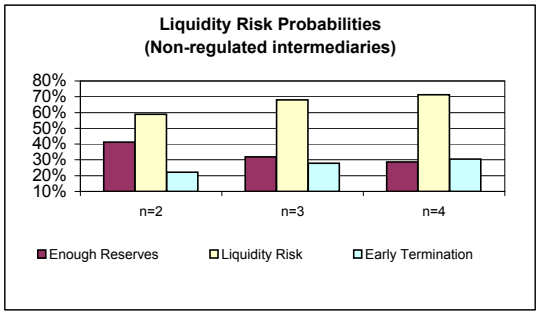


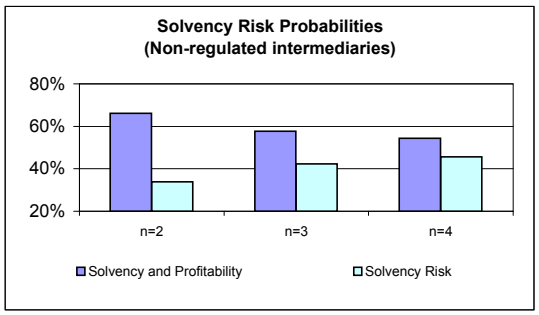
* Optimal values for non-regulated intermediaries under the institutional setting analysed

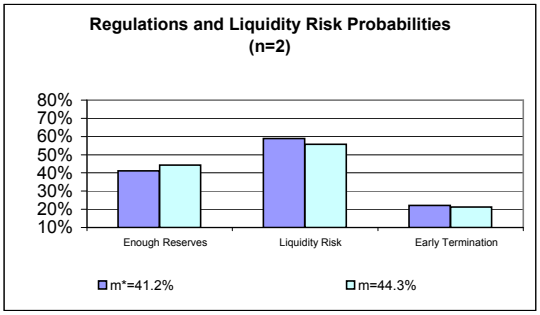
Fig. 5.6. BANKING REGULATIONS AND PROBABILISTIC RISK EFFECTS

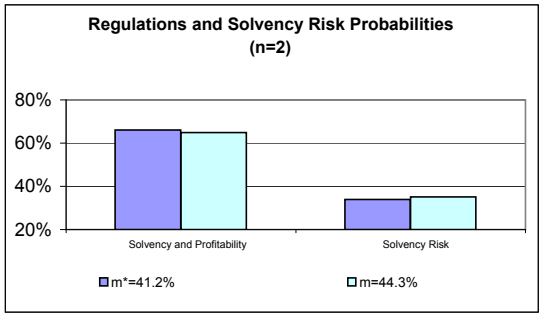
Perfectly Competitive Intermediaries and Minimum Reserve-Ratio Regulations (m)

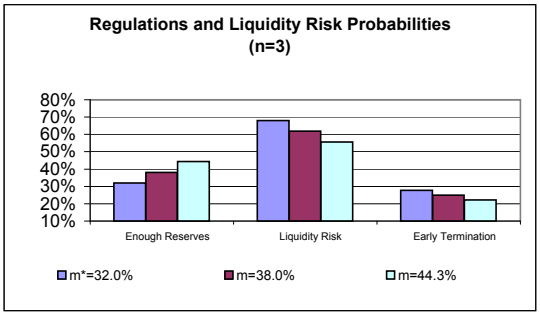
Institutional Setting Comparisons

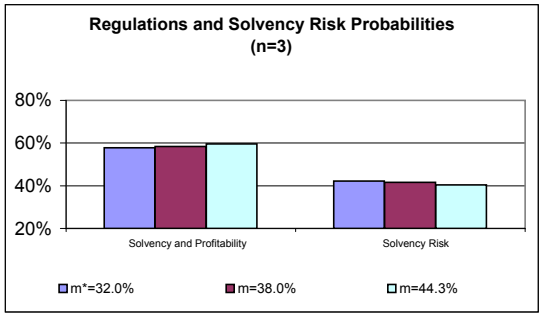


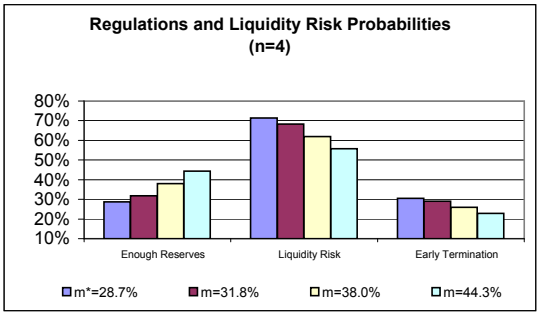


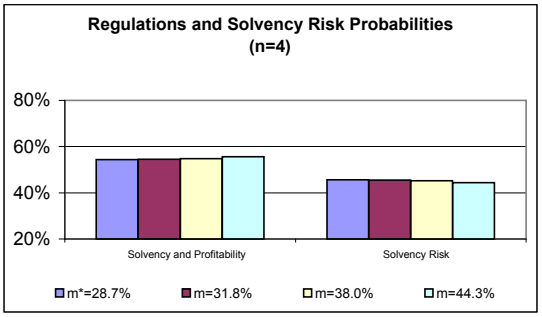










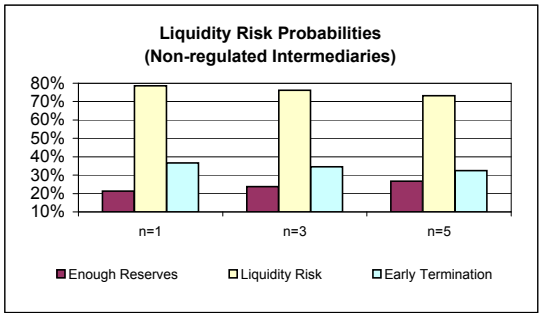


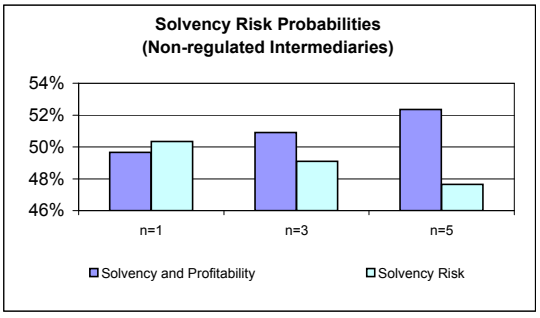
* Optimal values for non-regulated intermediaries under the institutional setting analysed

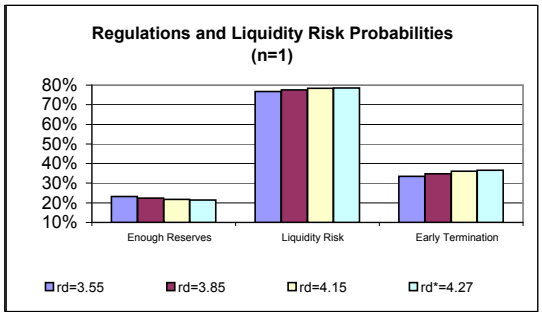
Fig. 5.7. BANKING REGULATIONS AND PROBABILISTIC RISK EFFECTS

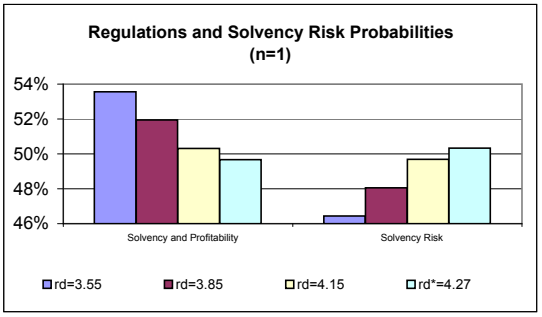
Monopolistically Competitive Intermediaries and Deposit-Return Ceiling Regulations (rd)

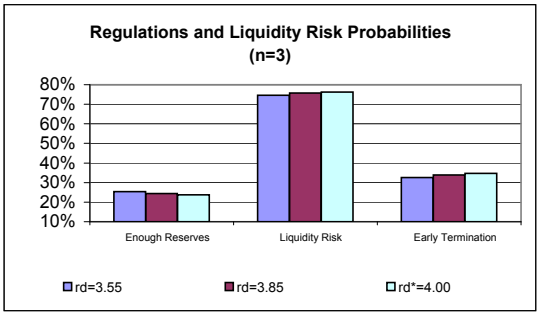
Institutional Setting Comparisons

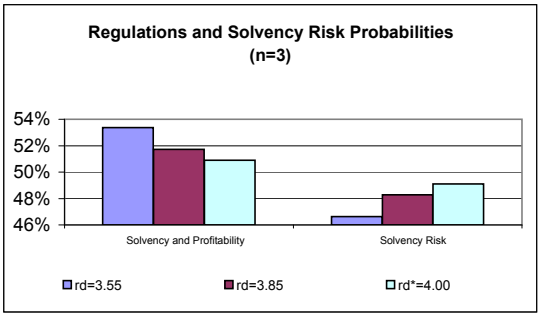


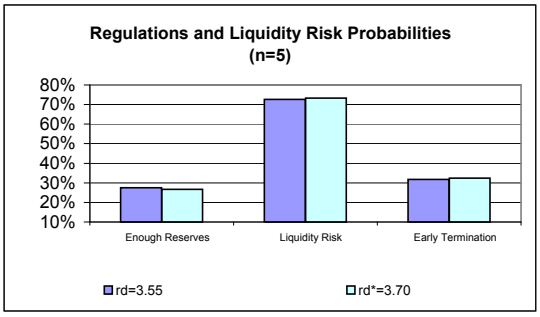


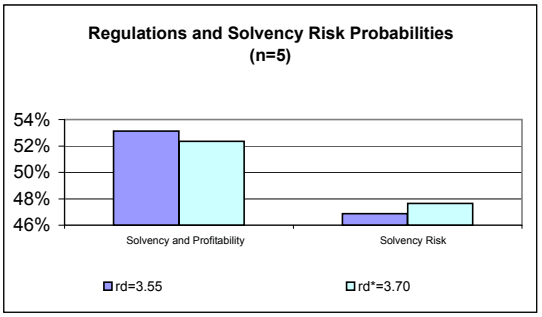










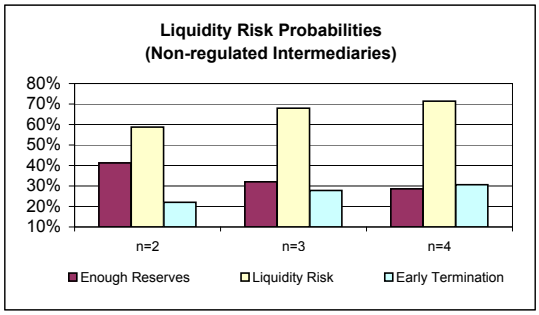


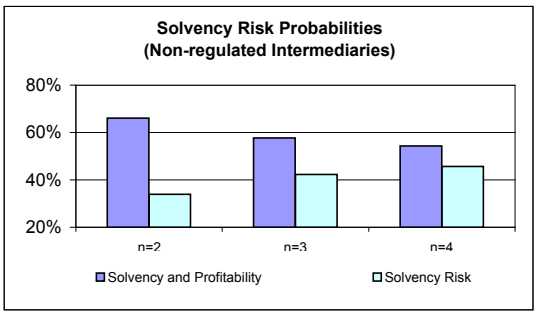
* Optimal values for non-regulated intermediaries under the institutional setting analysed

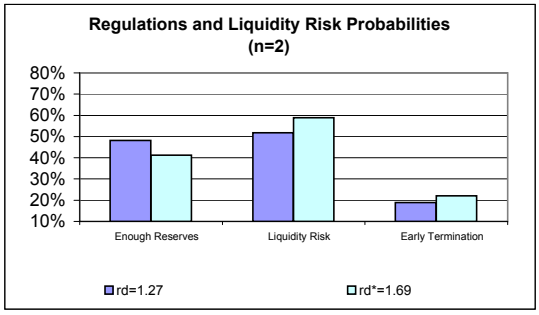
Fig. 5.8. BANKING REGULATIONS AND PROBABILISTIC RISK EFFECTS

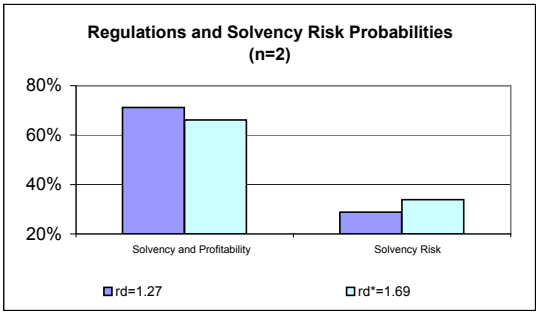
Perfectly Competitive Intermediaries and Deposit-Return Ceiling Regulations (rd)

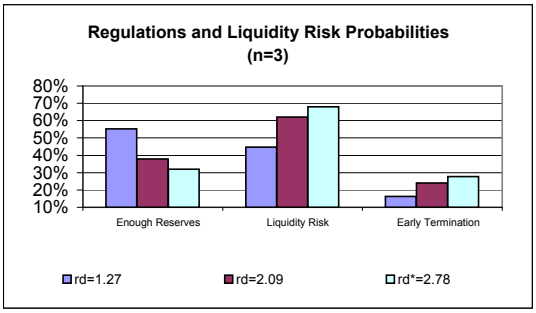
Institutional Setting Comparisons

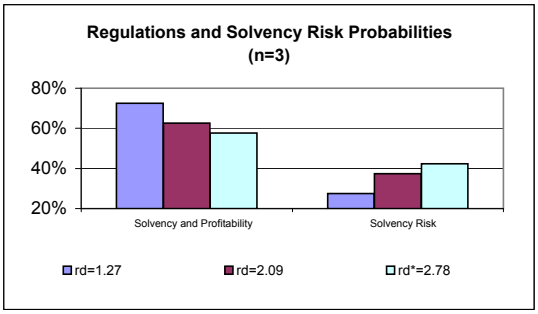


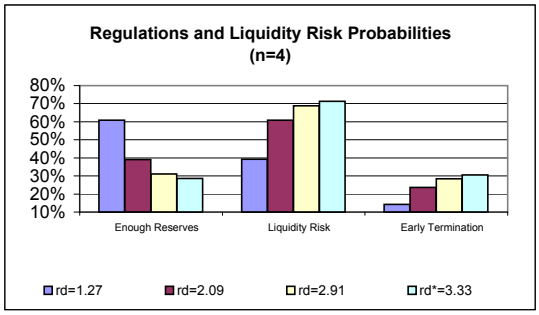


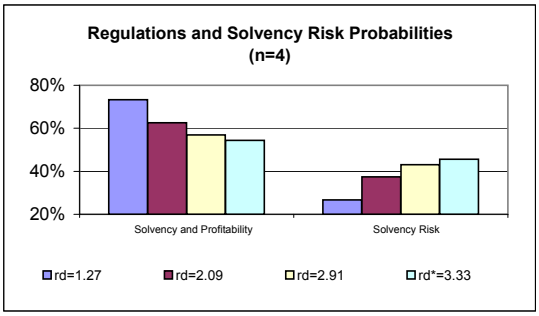












* Optimal values for non-regulated intermediaries under the institutional setting analysed

CHAPTER 6
EVIDENCE FROM QUALITATIVE, FINANCIAL STRUCTURE AND DEVELOPMENT INDICATORS

6.1. Introduction

In this chapter, we investigate the empirical relationships among risk management, banking fragility and banking market structure based on the theory of comparative financial systems [Allen and Gale (1997), (2000a) and (2001) and Levine (2002)]. Concretely, we describe some stylised facts regarding the associations among financial structure and development, banking market structure and banking fragility; and we assess competing theories and policy views regarding the relationships between banking stability and management practices, and between fragility and banking market structures. Banking and financial data for a sample of 47 countries are used for the empirical assessments.

We base our investigation on the studies of Demirguc-Kunt and Detragiache (1998a) and Hardy and Pazarbasioglu (1999), on banking fragility determinants, and Levine (2002), on the nexus between financial systems and economic growth. Methodologically, we use a double-technique approach based on OLS regressions and random effects logit models for panel data. Econometrically, this double-technique approach synthesises and expands the goals of the above studies to analyse the nexus among financial systems, banking competition and banking stability. Furthermore, it allows us to analyse the joint relationships among risk management practices, banking market structure and banking fragility.

The motivation of this investigation relies on academic and policy grounds. In first instance, it is motivated by our own findings regarding the pertinence to analyse banking behaviour in terms of the joint relationships among risk management, fragility and banking market structure. Another motivation relies on specific concerns of regulatory authorities and practitioners regarding adequate risk management practices, the effects of competition on banking stability and the optimal design of

financial sector policies.[1] A third one relates to the assessment of the relative merits of bank-based and market-based financial systems for encouraging specific performance goals.[2] A fourth one relies on academic concerns regarding the importance of cross-sectional and inter-temporal risk.[3] Our final motivation relies on the recognised necessity to analyse the relationships between financial structure and banking fragility and between banking competition and fragility. [4]

The main questions that we explore in this chapter are the following: What are the main empirical relationships among risk management practices, banking fragility and market structure? Does banking stability depend on the degree of financial development and/or on the structure of the financial system? [5] Which financial policy view seems to be the most adequate to encourage banking stability according to evidence? Which may be the better risk management practices to achieve stability? Are these practices focused on inter-temporal smoothing or on cross-sectional risk sharing? How market structure determinants affect the stability of banking intermediaries? Does banking competition enhance banking fragility? What may be the main implications for the design of financial polices?

[1] See Freixas and Santomero (2004) for a recent review on these concerns.

[2] Since the nineteenth century, economists have debated around who should drive the development of the financial system, banking institutions or financial markets (*bank-based* and *market-based views*, respectively). More recently, other economists have rejected such dichotomy arguing that reforms should encourage the creation of an environment in which intermediaries and markets could provide financial services (*service-based view*).

[3] Cross-sectional risks are risks that are diversifiable at a given point of time. Inter-temporal risks are risks that are not diversifiable (macroeconomic shocks). Risk management practices involving cross-sectional risk sharing eliminate risks through exchanges of risks among individuals. Practices involving inter-temporal smoothing eliminate risks by accumulating low risk, liquid assets. Allen and Gale (2001) have pointed out that we do not know how important the types of risk-sharing are for theoretical and policy purposes.

[4] The necessity to develop studies to analyse the relationship between financial structure and banking crises has been pointed out by Demirguc-Kunt and Detragiache (1998a). Specifically, they have indicated that "variables that capture the structure of the banking system and, more generally, the structure of financial markets…, are likely to play an important role in breeding banking crises, but they are neglected here because of lack of data. A study limited to a smaller set of countries that includes more structural variables might yield to more interesting results" [Demirguc-Kunt and Detragiache (1998a: p. 105)].
Regarding the relationship between banking competition and fragility, various surveys show that it is not clear if competition encourages fragility or stability. [See Canoy et. al (2001), Carletti and Hartmann (2002), and Allen and Gale (2003)].

[5] Banking stability is a fundamental concern for regulatory authorities. Caprio and Klingebiel (1996a) and (1996b) show that the costs that the economies pay due to banking insolvency episodes usually are above 15% of their GDP. Moreover, these costs do not include the ones associated to the exchange-rate crises and economic downturns that usually accompany such episodes.

The empirical study relies on a data set on banking fragility, financial structure and development macro-micro indicators for a sample of 47 economies between 1990 and 1997.[6] Fragility indicators include categorical variables for episodes of systemic and borderline banking crises. Financial structure and development ones include measures of activity, size and efficiency of intermediaries. Banking market structure ones include measures of bank penetration, concentration and public ownership. These indicators allow us to analyse the relationships among risk management, banking fragility and banking market structure using the most extensive data available. Moreover, given the inclusion of banking market structure indicators, our study fits into the tradition of failure-determinant macro-micro studies.[7]

Academically our investigation expands the banking literature on several ways. To our knowledge, our study is the first one to analyse the empirical relationships among banking crises, risk management practices and market structure from an international perspective. A second contribution relates to the characterisation of stylised facts regarding the associations among financial structure and development, banking market structure and banking fragility. A third one relates to the study on how financial structure and development relate to banking fragility. A fourth one relates to the construction of several market structure indicators to empirically assess the nexus between banking competition and fragility. Overall, we can summarise by indicating that the contributions of our study relate to the provision of evidence among competing theories and policy views for academic and policy purposes.

The assessment approach to evaluate the theories that relate banking stability and risk management practices and the ones that relate banking fragility with banking market structures is based on random effects logit models for panel data. Specifically, the policy views that relate banking stability and management practices are analysed comparing the qualitative predictions of such views with respect to the econometric outcomes of three regression sets defined by theoretical considerations. Finally, the

[6] Specifically, we build these indicators using panel-data extracted from the cross-country database on financial development and structure [Beck, Demirguc-Kunt and Levine (2000)], and from the one on episodes of systemic and borderline banking crises [Caprio and Klingebiel (2002)].

[7] Macro-micro studies have better comparability and explanatory properties than solely macro or micro ones [Gonzalez-Hermosillo (1999)]. Despite their advantages, these studies are limited due to data availability. Thus, our analysis expands a relatively scarce literature.

relationship between banking fragility and competition is analysed by using another regression set integrated by four models.

Our main findings have implications for academic and policy purposes. OLS regressions show that banking market structure, financial structure and development associations can be differentiated according to banking stability. Aggregate indicators suggest that *financial development is associated to market-based financial systems and to non-competitive banking systems*. However, these associations mostly rely on the stability of the banking system. The exception relies on the associations between market-based and financial development indicators. In such case the consistency of the aggregate and individual associations holds independently of banking stability.

Individual indicators suggest that market structure determinants *have differentiated associations*. Specifically, OLS estimations suggest that *banking concentration and foreign-owned banks always seem to characterise bank-based and underdeveloped financial systems*. Moreover, they also suggest that the associations of public banks may depend on systemic banking stability. Specifically, they suggest that *financial development is significantly associated to public banks only when the banking systems are fragile*; and that *market-based systems are significantly associated to public banks only when the banking systems are stable*.

Random effects logit models for panel data suggest *that banking crises are more likely in bank-based financial systems* and that *financial development enhances banking stability*. Regarding banking market structure, the models provide evidence that *competition enhances banking fragility*. Interestingly, the regression sets provide evidence rejecting the bank-based policy view. This finding suggests that *risk management practices based in the accumulation of liquid assets may not be the most adequate way to enhance banking stability*. According to the theory on comparative financial systems, the use of derivatives and cross-sectional risk sharing techniques might be better [Allen and Gale (2001)].

The chapter is divided in six sections. Section 6.2 describes the methodological issues regarding the empirical analysis of the relationships among risk management, fragility and banking market structure. The econometric specifications for analysing the

predictions associated to the financial and market structure theories are made explicit. Section 6.3 presents and discusses the data used in the econometric analysis. Section 6.4 characterises the stylised facts among financial structure and development, banking structure and fragility. Section 6.5 assesses the financial intermediation theories regarding the relationships between banking stability and management practices, and between fragility and banking market structures. Theoretical and policy implications are discussed. Section 6.6 summarises and discusses the main findings. Finally, the appendix of the chapter focuses on the statistical tests that support the panel-data analysis.

6.2. Intermediation theories and econometric methodology

In this section we describe the theories and policy-views that relate risk management practices, banking fragility and banking market structures from an econometric perspective. Specifically, we focus on the theoretical foundations underlying the binary response regression frameworks that conduct the analysis. Particularly, on the qualitative predictions associated to the different hypotheses assessed. We do this to define the basis, structure and scope of the econometric analysis in methodological terms.

6.2.1. Financial structure, risk management and banking fragility

Theoretically, the nexus between financial structures and risk management practices has been explained in terms of the opportunities to engage on inter-temporal risk smoothing activities [Allen and Gale (2001)]. According to the theory on comparative financial systems, risk management practices should change depending on the prevailing financial structure [Allen and Gale (1997)]. Specifically, in market-based ones, adequate practices should be oriented to the use of derivatives and other similar techniques.[8] While for bank-based ones, they should be oriented to the accumulation of low risk, liquid assets. [9]

[8] This conclusion is reached under the basis that in market-based financial systems, risk sharing is mainly achieved through exchanges of risk among individuals at a given point of time. Risks are traded to allow more risk-averse people to bear less risk than people that are less risk averse. The underlying assumption beneath these exchanges is that risks are diversifiable because "market-based systems can actually create risks through changes in asset values" [Allen and Gale (2001: pp. 11-12)].

[9] In bank-based financial systems, risk sharing is achieved through practices that inter-temporally smooth asset returns. These practices aim to hedge non-diversifiable risks, like macroeconomic shocks, by allowing intergenerational risk sharing or asset accumulation. The justification of such practices

The theory on comparative systems supports the hypothesis that financial structure matters for the design of normative policies. Paradoxically, there is no normative consensus about the relative merits of different financial structures with respect to aggregate economic and financial performance goals. Moreover, the debate around the pertinence and implications of different financial structures remains as one of the oldest ones in economic theory.[10] Specifically, some economists have argued in favour of bank-based financial systems by pointing out that banks are "better at mobilising savings, identifying good investments and exerting sound corporate control" [Levine (2002: p. 398)]. While others have counter-argued by emphasising "the advantages of markets in allocating capital, providing risk management tools and mitigating problems associated with excessively powerful banks" [Levine (2002: p. 398)].

Evidently, this situation imposes problems for the design of adequate financial sector reform strategies. Competing views for normative policy purposes indicate that financial development should encourage the transformation of financial systems in different directions. However, empirical evidence to support the pertinence among competing theories and policy views is scarce.[11] To our knowledge, Levine (2002) has developed the only cross-country examination designed to assess which view of financial structure is more consistent with the data. His study has focused on the relationship between financial structure and economic growth. Interestingly, the results of that study indicate that there is no support either for the bank-based or the market-based views. Thus, currently there is no consensus around the relative contributions of banks and financial markets in promoting specific performance goals.

We believe that banking stability goals can be used to assess the normative policy views. According to the theory on comparative financial systems, the specific views for normative policy are the bank-oriented, the market-oriented and the service-

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relies on the hypothesis that "such [non-diversifiable] risks can be averaged over time in a way that reduces their impact on individual welfare" [Allen and Gale (2001: p. 13)].

[10] Such debate can be traced to the nineteen century, when some economists argued that Germany have overcome the United Kingdom as an industrial power due to the relative superiority of the German bank-based financial system with respect to the market-based British one [Goldsmith (1969)].

[11] Usually, studies on the comparative merits of bank-based and market-based financial systems have focused on Germany and Japan characterising them as economies with bank-based financial systems and on the United States and the United Kingdom characterising them as economies with market based ones [Goldsmith (1969), Levine (1997)].

oriented ones [Levine (2002)]. In the context analysed here, each view refers to the type of policy reforms that may encourage the banking system to operate effectively and with stability. Moreover, each view also refers to the specific risk management practices that banks should develop to achieve such goals. Notice that banking stability mainly depends on risk management practices that may be adequate according to the prevailing financial system structure.

The theoretical hypotheses regarding the relationship among financial structure, risk management and banking stability are the following:

Bank-based view: Bank-based financial systems enhance stability when adequate inter-temporal risk smoothing practices exist among banking institutions. Reforms should privilege the elimination of risk by inducing banks to accumulate low risk, liquid assets. Financial development is associated with better banking systems.

Market-based view: Market-based financial systems enhance banking stability when securities markets efficiently share cross-section risk and introduce market discipline in the behaviour of banks. Reforms should encourage the use of derivatives and similar techniques to manage diversifiable risks in first instance. Financial development is associated to more complete financial markets.

Services-based view: Financial services, whether provided by banks or markets, enhance stability. Unless overall financial development happens to be positively related to either bank-based or market-based systems, specific risk management practices should not be privileged to enhance the stability of banking sector. Reforms should encourage the improvement of financial arrangements and services.

6.2.2. Banking market structure and fragility

Banks are firms that search for profit offering liquidity, credit and payment services, transforming assets and processing information. More precisely, they are firms that manage risks to achieve profit maximisation objectives. Thus, their behaviour and performance in the financial system must be affected by market conditions. This suggests that market structure influence the management decisions of the intermediaries. Considering that among management goals, in addition, to

maximisation of profits, we also have the minimisation of financial distress, banking crisis studies must consider how competition affects the behaviour of the intermediary firms. Paradoxically, theories and empirical studies on the relationship among banking behaviour, market structure and financial fragility are scarce and offer mixed conclusions [See Chapter 2]. Thus there is no consensus about the effects of competition on banking fragility.

Comparative financial system theory provides us with an alternative and complementary justification for the joint study of risk management practices and market structure with banking fragility. According to this literature "inter-temporal smoothing by banks is not viable in the presence of direct competition from markets" [Allen and Gale (2001: p. 14)]. Individual decisions of banking intermediaries are determined by competition among banks and markets, and by competition between banks themselves.

Theoretically, it seems that adequate institutional risk management practices should depend on the relationship between financial system structure and banking stability, while at the same time, the behaviour of individual banks must change according to market structure prevailing in the banking systems. Paradoxically, empirical studies on financial and banking market structures or on the relationship among risk management practices, fragility and the degree of banking competition are scarce or non existent. Even though, it has been pointed out that studies between financial structure and fragility may improve our understanding about the likelihood of crises [Demirguc-Kunt and Detragiache (1998a)], little research has been done. Regarding the relationship between banking fragility and competition, most studies analyse the nexus between banking crises with some market structure determinants, often with contradictory results [See Friedman and Schwartz (1971), Claessens and Klingebiel (2001) and Beck, Demirguc-Kunt and Levine (2003)].

6.2.3. Econometric specification of alternative theoretical hypotheses

The assessment approach to evaluate the hypotheses that relate financial structure, risk management and banking fragility and the ones that relate banking fragility with banking market structure, is based on random effects logit models for panel data. We develop the analysis comparing the qualitative predictions of the alternative

hypotheses with respect to the econometric outcomes of three regression sets defined by theoretical considerations. The idea is to analyse which predictions are better correlated with empirical evidence for a sample of economies using qualitative, financial structure and development indicators.

Econometrically, we assess the hypotheses estimating the probabilities of banking crises. More specifically, given cross-country annual data for n economies, in each period t, the i-country is either experiencing a banking crisis, or it is not. The categorical dependent variable y takes the value of one if there is a crisis and zero otherwise. The probability that a crisis is likely to occur is hypothesised to be a function of a matrix of independent K vector-variables $\mathbf{x}_{it} = \mathbf{x}_{it1}, \mathbf{x}_{it2}, ..., \mathbf{x}_{itK}$.[12]

Models for binary outcomes with panel data rely on certain assumptions. The main assumption for the unobserved effects binary response model is:

$$\Pr(y_{it} = 1 | \mathbf{x}_i, c_i) = \Pr(y_{it} = 1 | \mathbf{x}_{it}, c_i) = G(\mathbf{x}_{it}\boldsymbol{\beta} + c_i) \quad t = 1,2,...T \tag{6.1}$$

Where:

y_{it} Banking crisis binary variable

$\mathbf{x}_i$ Matrix that contains $\mathbf{x}_{it}$ for all t

$\boldsymbol{\beta}$ Vector of $K \times 1$ coefficients

c_i Unobserved effect (individual heterogeinity)

$G(\mathbf{x}_{it}\boldsymbol{\beta} + c_i)$ Distribution function taking values on the open unit interval

Logit models for panel data require two further assumptions in addition to the main one.[13] Specifically, the first assumption is that the outcomes are independent conditional on $(\mathbf{x}_i, c_i)$. The second one is that $G(\cdot)$ is defined in terms of a logistic probability function (cdf). The first assumption implies that the idiosyncratic errors

[12] $\mathbf{x}_{it}$ is a matrix which dimension is $(T \times n) \times K$. The first $(T \times n) \times 1$ vector of $\mathbf{x}_{it}$ is the unitary one.

[13] Notice that the main assumption defines equalities and relationships. Specifically, the former equality "rules out lagged dependent variables in $\mathbf{x}_{it}$, as well as certain kinds of explanatory variables whose future movements depend on current and past outcomes of y_i." [Wooldridge (2002: p. 483)]. While the latter, introduces c_i in the index inside $G(\cdot)$ and defines the nature of the binary response model.

have a constant variance across t and that they are not serially correlated. The second one defines the model as a logit one. [14]

The standard banking fragility literature includes indicator sets to capture the main features of the economic environment [Demirguc-Kunt and Detragiache (1998a), (2000)]. Such analyses represent the financial and economic environment by an econometric equation model. In our case, the indicators capture the environment and provide the assessment testing ground to evaluate the alternative hypotheses through the estimation of sets of equations. Such indicators can be classified into financial structure, banking market structure and financial development ones.

The alternative hypotheses regarding financial and market structures with fragility are represented as rival predictions on different econometric specifications of the coefficient vector estimation $\boldsymbol{\beta} = [\beta_M, \beta_S, \beta_F]$.[15] The hypotheses are assessed by comparing the qualitative predictions of the diverse theories and policy views involved with respect to the econometric outcomes of the estimation specifications. The specifications of the independent-variable matrix, $\mathbf{x}_{it} = [M_{it}, S_{it}, F_{it}]$, are:

$$\mathbf{x}_{it}^1 = [M_{it}, S_{it}, 0] \Rightarrow \boldsymbol{\beta}^1 = [\beta_M, \beta_S, 0] \quad (6.2a)$$

$$\mathbf{x}_{it}^2 = [M_{it}, 0, F_{it}] \Rightarrow \boldsymbol{\beta}^2 = [\beta_M, 0, \beta_F] \quad (6.2b)$$

$$\mathbf{x}_{it}^3 = [M_{it}, S_{it}, F_{it}] \Rightarrow \boldsymbol{\beta}^3 = [\beta_M, \beta_S, \beta_F] \quad (6.2c)$$

Where

M_{it} Vector of banking market structure indicators

S_{it} Vector of financial structure indicators

F_{it} Vector of financial development indicators

[14] Defining the cumulative probability function as normal defines a probit model. In spite of being popular, probit models require additional assumptions for estimation purposes. Specifically, probit model estimations assume that c_i and $\mathbf{x}_{it}$ variables are independent and that c_i has a normal distribution. These assumptions are required to achieve consistency of the estimators. Unobserved effects logit models do not require these assumptions.

[15] Methodologically, we follow and expand the procedure designed by Levine (2002) to build the set of specification vectors that define the characteristics of the financial and banking systems according to the theory on comparative financial systems.

Each estimation specification involves a relationship between the independent-variable matrix with respect to the banking crisis indicator. We refer to them as the financial structure, the financial development and the financial structure and development specifications. [16] Their estimation constitutes the basis for the assessment of the alternative theoretical hypotheses. Particularly, for the relationships among financial structure, risk management and banking fragility, the assessment involves the joint estimation of the three specifications. While for the relationship between fragility and banking market structure, it only involves the estimation of the third one focusing on the market structure determinants. We rename it as the banking market structure specification.

The indicator subsets include individual and aggregate macro-micro indicators. Specifically, banking market structure indicators include individual indicators of non-foreign bank penetration, concentration and public ownership. Financial structure and development indicators include individual measures of activity, size and efficiency of intermediaries. Three aggregate indicators summarise the information contained on the banking market and financial structure and financial development individual indicators. [17] Such aggregate indicators are built using principal components to remove potential problems of multicollinearity among the individual indicators. [18] Thus, the econometric analysis relies on a set of twelve independent-variable indicators.

The assessment approach to evaluate the theories relies on sets of logit models with random effects for panel data. We justify this decision on econometric bases. Specifically, we assume logistic functions because unobserved-effects logit models have statistical advantages with respect to probit ones in terms of estimator

[16] The relationships are associated to the specification vectors (6.2a), (6.2b) and (6.2c).
[17] The absence of accepted empirical definitions for financial structure, financial development and banking market structure makes necessary to use assortments of indicators in the analysis.
[18] Generalising, the principal-components analysis (PCA) aims to "replace p metrical correlated variables by a much smaller number of uncorrelated variables which contain most of the information in the original set. … PCA transforms the set of correlated variables $(x_1,..., x_p)$ to a set of uncorrelated variables $(y_1,..., y_p)$ called principal components in such a way that y_1 explains the maximum possible of the total variance, y_2 the maximum possible of the remaining variance, and so on." [Bartholomew et. al (2002: p. 115)].

consistency.[19] Furthermore, regarding the nature of the unobserved effects, we focus on random effects because of their advantages over fixed ones. [20] Such advantages are defined in terms of omitted variable bias and sample size.[21] Overall, we believe that these arguments justify the pertinence of the assessment approach chosen. [22]

The assessment of the policy views that relate banking stability and management practices is done comparing the qualitative predictions of such views with respect to the econometric outcomes of three specification regression sets. Four regression models that independently assess an econometric relationship among financial development and structure and banking fragility integrate each set. The sets use aggregate, activity, size, and efficiency indicator-based models to clarify and validate the nature and consistency of the relationships analysed.

The coefficient signs associated to the normative views that relate financial structure, risk management and banking fragility are described in the following table:

[19] Econometrically, for logit models "it is possible to obtain a $\sqrt{N}$ − consistent estimator of $\boldsymbol{\beta}$ without *any* [emphasis in the original] assumptions about how c_i is related to $\mathbf{x}_i$." [Wooldridge (2002: p. 490)].

[20] A "random effect" exists when it is assumed zero correlation between the observed explanatory variables and the unobserved effect. While a "fixed effect" means that certain arbitrary correlation is allowed.

[21] According to Wooldridge (2002: p. 252), "This approach [with random effects] is certainly appropriate from an omitted variables or neglected heterogeneity perspective". Moreover, if the number of cross-sectional units (countries, in our case), is relatively large "a fixed effects model would also lead to a substantial loss of degrees of freedom" [Altunbas, Evans and Molyneux (2001: p. 935)].

[22] Interestingly, estimations for models with fixed effects show similar qualitative results. However, given arguments cited above, the text only includes the results for the models with random effects. Wherever relevant, we will comment on the results of the models with fixed effects.

Table 6.1 Financial Structure, Risk Management and Banking Fragility (Qualitative Predictions of Policy Views)

	Bank-Based View	Market-Based View	Service-Based View
Financial Structure Specification: $\boldsymbol{\beta}^1 = [\beta_M, \beta_S, 0]$			
β_S	Positive	Negative	Non significant
Financial Development Specification: $\boldsymbol{\beta}^2 = [\beta_M, 0, \beta_F]$			
β_F	Negative	Negative	Negative
Financial Structure and Development Specification: $\boldsymbol{\beta}^3 = [\beta_M, \beta_S, \beta_F]$			
β_S	Positive	Negative	Non significant
β_F	Negative	Negative	Negative
Notes: The financial structure, financial development and the financial structure and development specifications correspond to the three specifications of the independent-variable matrix [equations 6.2a, 6.2b and 6.2c, respectively]. Positive signs for the banking market structure coefficients are predicted by the hypothesis that competition enhances banking stability. Otherwise, negative signs are predicted.			

The relationship between banking market structure and fragility is analysed using a regression set integrated by four binary response models for panel data. Like in the previous case, each indicator-based model clarifies and validates the nature and consistency of the relationship through individual assessments. The banking market structure indicators include aggregate, concentration, non-foreign bank penetration and public ownership ones. The assumptions underlying the analysis are that banking concentration, the absence of foreign banks and public ownership of banks undermine the competitiveness of the banking systems. Econometrically, the hypothesis that competition enhances banking stability will predict that the qualitative coefficients of the regression sets will be positive. While the one that associates competition to fragility will predict negative ones.

6.3. Financial and banking indicators

In this section we show and discuss the financial and banking indicators used in the econometric analysis. First, we focus on their definition and construction to facilitate their interpretation in econometric terms. Latter, we include a methodological discussion to complement the previous description. We believe that this is necessary because of the absence of empirical definitions for financial structure and development, and for banking market structure and fragility.

6.3.1. Definition and construction

Macro-micro indicators are built by extracting financial and banking data from two databases. Panel-data extracted from the cross-country database on financial development and structure [Beck, Demirguc-Kunt and Levine (2000)], and from episodes of banking crises [Caprio and Klingebiel (2002)], are used to obtain financial structure and development data, and qualitative information on banking crises, respectively. [23] The set of financial and banking data used and their main features are summarised in the following table: [24]

[23]The databases and details on their construction are available at the website of the World Bank. The address is the following: http://econ.worldbank.org [Titles: "A new database on financial development and structure" and "Episodes of systemic and borderline financial crises"].

[24] The financial development and structure database comprises of 38 variables. It includes statistics on the size, activity and efficiency of various intermediaries (commercial banks, insurance companies, pension funds and non-deposit money banks) and markets (primary equity and primary and secondary bond markets). Regarding the database on banking crises, it comprises of the two variables included here.

Table 6.2 Financial and Banking Database

Definition	Variable	Time span	Countries	Observations
Banking fragility variables				
Dummy variable on systemic episodes of banking fragility (crisis=1, non crisis=0)	y_S	1975-1999	93	113
Dummy variable on borderline episodes of banking fragility (crisis=1, non crisis=0)	y_B	1975-1999	44	50
Financial structure and development variables				
Concentration (Ratio of the 3 largest banks to total banking assets)	BCON	1990-1997	137	822
Foreign bank share (assets)	FBSA	1990-1997	111	673
Overhead costs of the banking system relative to banking system assets	BOHC	1990-1997	129	719
Public share (Share of publicly owned commercial bank assets in total commercial bank assets)	PBSA	1980-1997	41	213
Private credit by deposit money banks to GDP (Bank credit ratio)	DBPCY	1960-1997	160	3901
Private credit by deposit money banks and other financial institutions to GDP (Private credit ratio)	TIPCY	1960-1997	161	3923
Stock market capitalisation to GDP (Market capitalisation ratio)	SMCY	1976-1997	93	1171
Stock market total value traded to GDP (Total value traded ratio)	SMVY	1975-1997	93	1264

Methodologically, we define the individual indicators according to the data available. Specifically, we follow Demirguc-Kunt and Levine (1999) and Levine (2002) to build indicators of financial structure and development based on measures of relative size, activity and efficiency of banks and markets.[25] The banking crisis indicator is a qualitative variable that includes annual periods of borderline and systemic national banking crises. Its construction follows the standard convention of the fragility literature [Demirguc-Kunt and Detragiache (1998a), Hardy and Pazarbasioglu (1999)]. Finally, the banking market structure indicators are built using relative measures of

[25] The individual indicators to analyse financial structure are: Structure-Activity= Ln(total value traded ratio/bank credit ratio). Structure-Size=Ln(market capitalisation ratio/bank credit ratio).Structure-Efficiency=Ln(Total value traded ratio*Overhead costs).
The individual indicators to analyse financial development are: Finance-Activity=Ln(total value traded ratio*private credit ratio). Finance-Size=Ln(market capitalization ratio*private credit ratio). Finance-Efficiency =Ln(total value traded ratio/overhead costs).

foreign bank penetration, concentration and public versus private ownership of commercial banks. [26]

The aggregate indicators summarise the information content of the individual indicators according to their type. They are defined as the first principal components of the assortments of individual indicators. More specifically, each aggregate indicator is defined as the first linear combination of the three individual indicators that integrate each assortment type. The way in which the aggregate indicators summarise the relevant information of the assortments is based on the proportion of the total variance that is accounted by the principal-components sets. Each first principal component is built in a way that explains the maximum possible of the total variance of the indicators of each assortment. [27]

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[26] The individual indicators to analyse banking market structure are: Banking-Concentration= Ln(Ratio of the 3 largest banks to total banking assets). Banking-Domestic=Ln(1-Ratio of foreign banks to total banking assets). Banking-Public=Ln(Ratio of publicly owned commercial banks to total commercial bank assets).

[27] Mathematically, the principal component analysis (PCA) problem is to determine the coefficients a_{ij} for the following linear system:

$$y_1 = a_{11}x_1 + a_{21}x_2 + ... + a_{p1}x_p$$

$$y_2 = a_{12}x_1 + a_{22}x_2 + ... + a_{p2}x_p$$

...

$$y_p = a_{1p}x_1 + a_{2p}x_2 + ... + a_{pp}x_p$$

where

$(x_1,..., x_p)$ Former set of correlated variables

$(y_1,..., y_p)$ Set of principal component variables.

PCA requires that the coefficients must leave the relative positions or the configuration of the points unchanged. This is achieved by introducing an orthogonality condition for the coefficients. Algebraically, such condition can be written as:

$$\sum_{i=1}^{p} a_{ij}^2 = 1 \quad (j = 1,2,..., p)$$

$$\sum_{i=1}^{p} a_{ij}a_{ik} = 0 \quad (j \neq k; j = 1,2,..., p; k = 1,..., p)$$

Finding the eigenvalues $(\lambda_1, \lambda_2,..., \lambda_p)$ and eigenvectors of the correlation matrix solves the above problem. The variance of each principal component can be obtained by listing the eigenvalues from the largest to the smallest. The variance of first principal-component will be the eigenvalue λ_1. The proportion of total variance explained by the first principal-component will be then:

$$\frac{\lambda_1}{\lambda_1 + \lambda_2 + ... + \lambda_p}$$

Duncan (1997) and Bartholomew et. al. (2002), provide detailed explanations on the principal-components methodology.

We use the principal-components methodology to simplify the task to understand the explanatory multivariate data in terms of a smaller number of uncorrelated variables. Intuitively, given that the first principal component is positively correlated to the each of the individual indicators, it can be interpreted as a measure of what is common to all the variables. Specifically, we can interpret the aggregate indicators for financial development and banking market structure as indexes of scale for the degree of financial development and for the absence of banking competition. While the aggregate financial structure indicator can be interpreted as an indicator of relative prominence of the markets in the financial system.

The set of financial and banking indicators are summarised in the following table:

Table 6.3 Financial and Banking Macro-Micro Indicators

Name	Definition	Measurement
Banking Fragility Indicators		
Crisis	Binary variable for fragility: Banking crisis=1 Non banking crisis=0	Episodes of systemic and borderline banking crises
Financial Structure Indicators		
Structure Activity	$STCACT = \ln\left(\frac{SMVY}{DBPCY}\right)$	Activity of stock markets relative to that of banks
Structure Size	$STCSIZ = \ln\left(\frac{SMCY}{DBPCY}\right)$	Size of stock markets relative to that of banks
Structure Efficiency	$STCEFF = \ln(SMVY * BOHC)$	Efficiency of stock markets relative to that of banks
Structure Aggregate	First principal component of the set of individual financial structure indicators.	Scale index of financial structure
Financial Development Indicators		
Finance Activity	$FINACT = \ln(SMVY * TIPCY)$	Activity of stock markets and intermediaries
Finance Size	$FINSIZ = \ln(SMCY * TIPCY)$	Size of stock markets and intermediaries
Finance Efficiency	$FINEFF = \ln\left(\frac{SMVY}{BOHC}\right)$	Financial sector efficiency
Finance Aggregate	First principal component of the set of individual financial development indicators.	Scale index of financial development
Banking Market Structure Indicators		
Banking Concentration	$BNKSTC = \ln(BCON)$	Banking system concentration
Banking Domestic	$BNKFGN = \ln(1 - FBSA)$	Domestic-owned banking share
Banking Public	$BNKPUB = \ln(PBSA)$	Public-owned banking share
Banking Aggregate	First principal component of the set of individual banking market structure indicators.	Scale index of banking market structure
Notes: The characterisation of the financial and banking systems depends on the indicators' relative value (with respect to the sample medians). Large values of the financial structure indicators are associated to market-based financial systems; small ones are related to bank-based ones. Large values of the financial development variables are associated to high levels of financial development. Large values in the banking market structure indicators are associated to non-competitive banking systems.		

6.3.2. Methodological issues on indicators

Methodologically, the indicators use the most extensive publicly available data to deal with banking market structure, financial structure and development issues. Their main advantage is that they treat consistently the financial and banking system data across economies and across time. This feature allows us to make international comparisons. Moreover, given their macro-micro nature, the indicators allow to improve more conventional analyses because the econometric estimations have the explanatory power associated to micro studies. Thus, the indicators combine the comparability and explanatory advantages of the studies based solely on macro or micro variables.

However, the indicators have some limitations. First, it is important to recall that the information that they can provide is limited because it is relative to the country sample and because of the relatively ad-hoc criteria used to build the indicators. For example, financial structure indicators can indicate that certain economies may have bank-based financial systems because their stock markets are very underdeveloped by international standards. Conversely, financial systems of economies with small and underdeveloped banking systems may be assumed as market-based ones [Demirguc-Kunt and Levine (1999)]. A second limitation is that any classification for an economy can change according to the sample analysed. Finally, a third limitation is related to the interpretation of the aggregate indicators. Specifically, given that the first principal component is just a mathematical transformation, it has been argued that "almost by definition any such interpretation can only be *subjective* [emphasis in the original]." [Duncan (1997): Lecture 5, p. 1].

Furthermore, the characterisation of banking crises also is not as direct as it seems [Caprio and Klingebiel (2002)]. Usually banking problems are underestimated and the size of the crisis losses is not readily available. Moreover, the time span of banking crises is not easy to determine. Financial distress periods, where the banking system has negative worth, can occur over a period of time, before and after being detected. Also it is not always clear when a crisis is over. Thus, even at a mere qualitative level, the characterisation of banking crisis requires certain judgement.

Econometrically, the main limitation of the data relies on the scope of the sample for which information is available. Although the financial structure and development

database contains data over the period 1960-1997 for 175 countries, complete sets of data required were available only for the nineties. This limitation on financial structure and development indicators also constrains the available financial crisis dependent variable sample.[28] The final macro-micro indicator sample comprises data for a sample of 47 economies and 115 banking crises over the period 1990-97.[29]

6.4. Stylised facts on financial development and financial and banking market structures

In this section we characterise the financial and banking stylised facts associated to stable and unstable banking systems. We do this by estimating sets of OLS regressions that analyse specific financial and banking relationships. The relationships analysed are the ones between banking market structure and financial development, between banking market structure and financial structure, and between financial development and financial structure. We do this for the aggregate and individual indicators.

Econometrically, we analyse the relationships between the indicators using four regression sets (One for the aggregate ones and three for the individual ones). Each set includes subsets of three single-variable OLS regressions to describe the associations between a specific pair of indicators. While the first regression estimates such associations using all the sampled data; the second and the third ones re-estimates them for the data involving unstable and stable banking systems.[30] In all regressions, we include a constant term to eliminate constant effects.[31] We do this aiming to find and establish some stylised facts around the relationships between financial and banking systems with banking fragility.

We organise the four regression sets according to the degree of aggregation of the data and according to the relationship studied. More specifically, the first set of regressions

[28] The complete database on crisis episodes contains data for 163 episodes during the period 1975-1999.
[29] The sample includes data for Argentina, Australia, Bolivia, Brazil, Barbados, Canada, Switzerland, Chile, Colombia, Costa Rica, Cyprus, Germany, Ecuador, Egypt, Spain, Ghana, Greece, Guatemala, Honduras, Ireland, Jamaica, Jordan, Japan, Kenya, Korea, Morocco, Mexico, Malaysia, Namibia, Nigeria, Netherlands, Norway, New Zealand, Peru, Philippines, Paraguay, El Salvador, Sweden, Thailand, Trinidad and Tobago, Tunisia, Turkey, Taiwan, United States, Venezuela, South Africa and Zimbabwe.
[30] Notice that the qualitative crisis indicator allows us to distinguish between banking systems.

focuses on the relationships between the aggregate indicators, while the other three regressions focus on the individual ones. Thus, while the aggregate set analyses the overall relationships between the financial and banking data, the latter sets analyse particular ones. Specifically, the second regression set focuses on the relationships between banking market structure and financial development. The next focuses on the ones between banking market structure and financial structure. Finally, the fourth set focuses on the relationships between financial development and financial structure.

6.4.1. Empirical regularities on aggregate indicators

Here we report the OLS regression results for the aggregate macro-micro indicators.[32] As indicated above, the aggregate indicators for financial development, financial structure and banking market structure summarise the information content of their individual components. Thus, we can consider that this regression set shows an overview of the stylised facts between the structures prevailing in the financial systems, financial development and the degree of banking competition.

We summarise the results of the first regression set in the following table:

[31] The coefficients and t-statistics associated to these constant values are not reported in the regression results indicated below. We do this for simplicity purposes and to focus on the relationships between the indicators.

[32] The econometric estimations contained in this chapter were done using Stata software version 6.

Table 6.4 Relationships Between Financial and Banking Aggregate Indicators (Regression Analysis)

	β (t)	R^2	β (t)	R^2	β (t)	R^2
Regressor Indicator	***All Observations (1)***		***Stable Banking Systems (2)***		***Fragile Banking Systems (3)***	
Regressed Indicator: Banking-Aggregate						
Finance Aggregate	0.83*** (3.644)	0.30	0.06 (0.111)	0.00	0.79*** (4.163)	0.55
Regressed Indicator: Banking-Aggregate						
Structure Aggregate	1.23*** (4.485)	0.40	-0.09 (-0.235)	0.00	1.32*** (3.817)	0.51
Regressed Indicator: Finance-Aggregate						
Structure Aggregate	0.69*** (18.345)	0.56	0.59*** (13.523)	0.51	0.81*** (11.259)	0.60
Notes: The regressions use OLS to estimate equations of the form: $y=\alpha+\beta x$, where y and x are the regressed and regressor indicators, respectively. The regressions use different observations for comparison purposes. Specifically, the first column refers to regressions that include all the observations. The second column refers to regressions that include observations for which the banking fragility variable is equal to zero. The third column refers to the ones for which the banking fragility variable is equal to one. Each column contains the estimate of β, the t-statistic of this estimate (in parentheses) and the R^2 value of the regression. One, two and three asterisks indicate significance levels of 10, 5 and 1 percent respectively. The estimated coefficients for constants are not reported.						

Table 6.4 shows that the associations among banking competition, financial structure and the degree of financial development seem to be consistent considering all observations. The estimations suggest that *financial development is associated to market-based systems and to non-competitive banking systems*. However, such associations are mostly consistent when the banking systems are stable. Otherwise, the estimated associations are not significant. These findings suggest that banking competition reforms *will not* encourage fragility under financially developed or market-based financial systems. Otherwise, the result will be banking crises. Interestingly, in all cases, regressions show that the development of financial systems *is significantly associated* to market-based systems.

6.4.2. Banking market structure and financial development

Here we report the OLS regression results for the banking market structure and financial development indicators. Financial development indicators involving measures of relative activity, size and efficiency of the intermediaries and markets are

related to measures of banking concentration, domestic bank-penetration and public ownership of commercial banks. Thus, we can consider that this regression set shows the relationships between the determinants of the degree of financial development with respect to the ones of the absence of banking competition.

We summarise the results of the second regression set in the following table:

Table 6.5. Banking Market Structure and Financial Development (Regression Analysis)

	β (t)	R^2	β (t)	R^2	β (t)	R^2
Regressor Indicator	***All Observations (1)***		***Stable Banking Systems (2)***		***Fragile Banking Systems (3)***	
Regressed Indicator: Banking-Concentration						
Finance Activity	-1.68*** (-4.024)	0.05	-1.56*** (-3.188)	0.05	-2.09*** (-2.899)	0.08
Regressed Indicator: Banking-Domestic						
Finance Activity	4.31*** (4.591)	0.08	5.75*** (6.116)	0.20	3.16* (1.690)	0.03
Regressed Indicator: Banking-Public						
Finance Activity	0.22 (0.732)	0.01	-0.28 (-0.953)	0.05	1.33*** (4.449)	0.52
Regressed Indicator: Banking-Concentration						
Finance Size	-0.86*** (-3.019)	0.03	-0.66* (-1.843)	0.01	-1.26*** (-2.670)	0.07
Regressed Indicator: Banking-Domestic						
Finance Size	3.28*** (5.206)	0.10	4.10*** (5.759)	0.18	2.24* (1.861)	0.04
Regressed Indicator: Banking-Public						
Finance Size	0.00 (0.006)	0.00	-0.23 (-0.948)	0.04	0.54*** (3.567)	0.45
Regressed Indicator: Banking-Concentration						
Finance Efficiency	-1.31*** (-3.570)	0.04	-1.19*** (-2.761)	0.03	-1.71*** (-2.742)	0.07
Regressed Indicator: Banking-Domestic						
Finance Efficiency	3.59*** (4.308)	0.07	4.93*** (5.702)	0.17	2.51 (1.540)	0.02
Regressed Indicator: Banking-Public						
Finance Efficiency	0.27 (1.092)	0.03	-0.32 (-1.481)	0.10	1.49*** (6.481)	0.70

Notes: The regressions use OLS to estimate equations of the form: $y=\alpha+\beta x$, where y and x are the regressed and regressor indicators, respectively. The regressions use different observations for comparison purposes. Specifically, the first column refers to regressions that include all the observations. The second column refers to regressions that include observations for which the banking fragility variable is equal to zero. The third column refers to the ones for which the banking fragility variable is equal to one. Each column contains the estimate of β, the t-statistic of this estimate (in parentheses) and the R^2 value of the regression. One, two and three asterisks indicate significance levels of 10, 5 and 1 percent respectively. The estimated coefficients for constants are not reported.

Table 6.5 shows that the associations between the banking market indicators and the degree of financial development seem to be differentiated. The estimations suggest that *financial development is associated to non-concentrated banking systems and to domestic-owned banks*. This finding is relatively surprising because it is assumed that the less banking concentration or the more foreign penetration imply more banking competition. Interestingly*, financial development is significantly associated to public banks only when the banking systems are fragile*. Otherwise, it is no significant. We believe that the latter finding may reflect public intervention efforts to deal with banking crises.

6.4.3. Banking market structure and financial structure

Here we report the OLS regression results for the banking market structure and financial structure individual indicators. From an academic point of view, we can view this regression set as capturing the relationships between the determinants of the prominence of financial markets with respect to the ones of the absence of banking competition.

We summarise the results of the third regression set in the following table:

Table 6.6 Banking Market Structure and Financial Structure (Regression Analysis)

	β (t)	R^2	β (t)	R^2	β (t)	R^2
Regressor Indicator	***All Observations (1)***		***Stable Banking Systems (2)***		***Fragile Banking Systems (3)***	
Regressed Indicator: Banking-Concentration						
Structure Activity	-0.76*** (-2.916)	0.03	-0.98*** (-3.583)	0.06	-0.59 (-1.206)	0.01
Regressed Indicator: Banking-Domestic						
Structure Activity	2.25*** (3.574)	0.05	3.21*** (5.381)	0.16	1.59 (1.279)	0.01
Regressed Indicator: Banking-Public						
Structure Activity	0.34 (1.519)	0.05	-0.20* (-1.752)	0.15	1.48*** (5.831)	0.65
Regressed Indicator: Banking-Concentration						
Structure Size	0.08 (0.625)	0.00	-0.06 (-0.423)	0.00	0.28 (1.151)	0.01
Regressed Indicator: Banking-Domestic						
Structure Size	0.81** (2.589)	0.02	1.06*** (3.078)	0.06	0.47 (0.781)	0.00
Regressed Indicator: Banking-Public						
Structure Size	0.11 (1.223)	0.04	-0.15*** (-3.680)	0.42	0.69*** (5.652)	0.68
Regressed Indicator: Banking-Concentration						
Structure Efficiency	-1.15*** (-3.982)	0.05	-1.42*** (-4.433)	0.09	-0.89* (-1.693)	0.03
Regressed Indicator: Banking-Domestic						
Structure Efficiency	2.61*** (3.909)	0.06	3.60*** (5.438)	0.16	1.94 (1.437)	0.02
Regressed Indicator: Banking-Public						
Structure Efficiency	0.23 (0.876)	0.01	-0.28 (-1.243)	0.07	1.30*** (3.928)	0.46

Notes: The regressions use OLS to estimate equations of the form: $y=\alpha+\beta x$, where y and x are the regressed and regressor indicators, respectively. The regressions use different observations for comparison purposes. Specifically, the first column refers to regressions that include all the observations. The second column refers to regressions that include observations for which the banking fragility variable is equal to zero. The third column refers to the ones for which the banking fragility variable is equal to one. Each column contains the estimate of β, the t-statistic of this estimate (in parentheses) and the R^2 value of the regression. One, two and three asterisks indicate significance levels of 10, 5 and 1 percent respectively. The estimated coefficients for constants are not reported.

Table 6.6 shows that associations between the banking market structure indicators and the financial structure prevailing in the financial system seem to be differentiated. The estimations suggest that *market-based systems are associated to non-concentrated banking systems and to domestic-owned banks*. This finding means that banking concentration and foreign-owned banks seem to *characterise* bank-based financial systems.[33] We believe that these findings reveal that in bank-based systems, it is easier for banks to collude and to be acquired by foreigners when the banking systems seem to be stable. Interestingly, *market-based systems are significantly associated to public banks only when the banking systems are stable*. Otherwise, they are not significant.

6.4.4. Financial development and financial structure

Here we report the OLS regression results for the financial development and financial structure individual indicators. This regression set shows the relationships between the determinants of the prominence of financial markets with respect to the ones that induce financial development.

We summarise the results of the fourth regression set in the following table:

[33] However, it can be argued that the regressions that involve the size of markets relative to that of banks are not statistically significant. Moreover, it can also be argued that, in spite of being consistent, the regression estimations are not significant under banking distress.

Table 6.7. Financial Development and Financial Structure

(Regression Analysis)

	β (t)	R^2	β (t)	R^2	β (t)	R^2
Regressor Indicator	***All Observations (1)***		***Stable Banking Systems (2)***		***Fragile Banking Systems (3)***	
Regressed Indicator: Finance-Activity						
Structure Activity	0.51*** (27.126)	0.69	0.47*** (19.961)	0.64	0.54*** (16.266)	0.72
Regressed Indicator: Finance-Size						
Structure Activity	0.55*** (12.853)	0.35	0.44*** (8.899)	0.27	0.64*** (8.548)	0.43
Regressed Indicator: Finance-Efficiency						
Structure Activity	0.59*** (27.235)	0.73	0.52*** (19.433)	0.67	0.65*** (17.074)	0.77
Regressed Indicator: Finance-Activity						
Structure Size	0.10*** (6.591)	0.12	0.07*** (3.741)	0.06	0.14*** (5.068)	0.21
Regressed Indicator: Finance-Size						
Structure Size	0.18*** (7.628)	0.16	0.15*** (5.355)	0.12	0.21*** (5.042)	0.20
Regressed Indicator: Finance-Efficiency						
Structure Size	0.14*** (7.165)	0.16	0.11*** (4.642)	0.10	0.18*** (5.134)	0.24
Regressed Indicator: Finance-Activity						
Structure Efficiency	0.61*** (31.024)	0.77	0.57*** (22.514)	0.73	0.64*** (19.471)	0.81
Regressed Indicator: Finance-Size						
Structure Efficiency	0.70*** (15.639)	0.48	0.60*** (11.861)	0.44	0.82*** (10.294)	0.55
Regressed Indicator: Finance-Efficiency						
Structure Efficiency	0.67*** (27.087)	0.72	0.61*** (18.415)	0.64	0.74*** (19.210)	0.80

Notes: The regressions use OLS to estimate equations of the form: $y=\alpha+\beta x$, where y and x are the regressed and regressor indicators, respectively. The regressions use different observations for comparison purposes. Specifically, the first column refers to regressions that include all the observations. The second column refers to regressions that include observations for which the banking fragility variable is equal to zero. The third column refers to the ones for which the banking fragility variable is equal to one. Each column contains the estimate of β, the t-statistic of this estimate (in parentheses) and the R^2 value of the regression. One, two and three asterisks indicate significance levels of 10, 5 and 1 percent respectively. The estimated coefficients for constants are not reported.

Table 6.7 shows statistically *significant associations between market-based financial systems and financially developed financial systems*.[34] The consistency and robustness of these associations hold independently of banking stability considerations. Interestingly, our findings indicate that the associations are magnified during crisis periods for all the measures considered. We believe that these findings suggest *that banking crises may encourage financial development*, but also that *they may encourage the transformation of financial systems into market-based ones*.

Finally, we summarise the stylised facts regarding the relationships among financial development, financial structure and banking market structure with banking fragility based on the OLS regressions: Aggregate indicators suggest that *financial development is associated to market-based financial systems and to non-competitive banking systems.* However, these associations mostly rely on the stability of the banking system. The exception relies on the associations between market-based and financial development indicators. In such case the consistency of the aggregate and individual associations holds independently of banking stability considerations.

Individual indicators suggest that market structure determinants *have differentiated associations*. Specifically, OLS estimations suggest that *banking concentration and foreign-owned banks always seem to characterise bank-based and underdeveloped financial systems.* Moreover, they also suggest that the associations of public banks may depend on systemic banking stability. Specifically, they suggest that *financial development is significantly associated with the presence of public banks only when the banking systems are fragile*; and that *market-based systems are significantly associated with the presence of public banks only when the banking systems are stable*.

6.5. Econometric assessments of intermediation theories

Here we assess the alternative theoretical hypotheses indicated in Section 6.2. Specifically, we report the econometric outcomes that allow the comparisons between the theoretical predictions and the international evidence. These econometric assessments are detailed in the following subsections. First, we assess the policy views

[34] The regressions show that all the associations are direct and statistically significant.

that relate banking stability and management practices based on the analysis of financial structure and development indicators. Finally, we assess the relationship between fragility and banking competition based on the analysis of the market structure indicators.[35]

6.5.1. Policy views on banking stability and management practices

The hypotheses on the nexus among financial structure, risk management and banking fragility suggest specific policies to encourage banking stability. Here we show the outcomes of the three regression sets to assess the competing policy views. As indicated before, each set comprises four regression models that independently assess each econometric specification by using assortments of indicators. The absence of empirical definitions and need to clarify and validate the nature and consistency of the relationships defined by the equations (6.2), make us believe on the adequacy of this approach for the empirical assessments.

The regression sets for the assessment of the policy views are integrated by aggregate, activity, size, and efficiency indicator-based models. In all cases, the dependent variable is the qualitative crisis variable and the estimations include random effects. Each set is designed to assess a particular econometric specification included in the equation set (6.2). Thus, the three regression sets are the financial structure, the financial development and the financial structure and development.

The financial structure regression set estimates the specification defined by equation (6.2a). We summarise the results for the financial structure set in the following table:

[35] The econometric assessments are supported by statistical analyses. Such analyses include tests for heterogeneity, robustness and functional form specification for all the regression models. Such test results are included in the appendix of the chapter.

Table 6.8 Evidence on the Financial Structure Specification
(Random Effects Logit Models for Panel Data)

/Model	Aggregate	Activity	Size	Efficiency
Regression Indicators				
Banking Aggregate	-3.57* (-1.935)	-1.37 (-1.581)	-2.02 (-1.139)	-1.13 (.)
Structure Aggregate	-2.03** (-2.142)	-	-	-
Structure Activity	-	-1.10*** (-2.650)	-	-
Structure Size	-	-	-2.94 (-1.170)	-
Structure Efficiency	-	-	-	-0.80 (.)
Constant	-2.11* (-1.791)	-2.51** (-2.122)	-2.01 (-1.113)	-5.45 (.)
Observations	32	36	34	37
LR-CHI2	11.41***	11.10***	6.96**	9.67
Prob > chi2	0.0033	0.0039	0.0308	-
Log Likelihood	-14.22	-16.02	-17.41	-16.92
σ_u	6.10	2.25	3.15	2.27
ρ	0.97	0.83	0.90	0.83
CHI2 (Ho: ρ=0)	5.20**	3.44*	4.14**	4.12**
Prob > chi2	0.0226	0.0635	0.0419	0.0424
Notes: The dependent variable is the banking crisis dummy. The z statistics are given in parenthesis and are based on IRLS variance estimators. One, two and three asterisks indicate significance levels of 10, 5 and 1 percent respectively.				

Table 6.8 shows that the associations between the financial structure indicators and banking crises are consistently negative. The estimations suggest that *banking stability is associated to market-based financial systems.* Theoretically, it provides mixed evidence supporting the market-based and service-based views (negative significant coefficients and non-significant ones, respectively).[36] Econometrically, the Wald criterion suggests that the most significant model is the aggregate one, which supports the market-based view.[37] Thus, our findings suggest that *bank-driven financial systems are more likely to face banking crises than market-driven ones, rejecting then*

[36] It can be argued that in the efficiency-based regression, the results does not necessarily imply that the efficiency coefficient is insignificant due to the fact that the software could not report the standard errors. We are aware of this limitation. However, this limitation does not modify the financial structure analysis. Notice that all the qualitative results are consistent.

[37] ρ is significantly close to one in all regressions. This fact suggests that individual heterogeneity exists and that a random effect specification is an adequate one for econometric modelling.

the bank-based policy view. Finally, it is worthy to point out that the regressions provide some support to the hypothesis that banking competition enhances fragility.

The financial development regression set estimates the specification defined by equation (6.2b). We summarise the results on that set in the following table:

Table 6.9 Evidence on the Financial Development Specification
(Random Effects Logit Models for Panel Data)

/Model	Aggregate	Activity	Size	Efficiency
Regression Indicators				
Banking Aggregate	-1.12 (-0.927)	-0.79 (-1.071)	-0.97 (-0.856)	-1.41** (-2.181)
Finance Aggregate	-1.07 (-1.321)	-	-	-
Finance Activity	-	-0.72** (-2.420)	-	-
Finance Size	-	-	-0.83 (-1.408)	-
Finance Efficiency	-	-	-	-0.76 (-1.570)
Constant	-1.18 (-0.870)	-3.48** (-1.997)	-2.58 (-1.253)	-0.28 (-0.395)
Observations	32	36	34	37
LR-CHI2	8.09**	10.51***	7.17**	9.78***
Prob > chi2	0.0175	0.0052	0.0277	0.0075
Log Likelihood	-15.88	-16.31	-17.30	-16.86
σ_u	1.76	1.46	1.52	4.14
ρ	0.75	0.68	0.69	0.94
CHI2 (Ho: ρ=0)	1.12	1.09	0.79	4.36**
Prob > chi2	0.2904	0.2975	0.3734	0.0368
Notes: The dependent variable is the banking crisis dummy. The z statistics are given in parenthesis and are based on IRLS variance estimators. One, two and three asterisks indicate significance levels of 10, 5 and 1 percent respectively.				

Table 6.9 shows that the associations between the financial development indicators and banking crises are consistently negative. The estimations suggest that *banking stability is associated to financial development.* Econometrically, the Wald and Gauss-Hermite tests suggest that all the evaluated models are stable (See Appendix for chapter 6, Section 2.B). Particularly, the efficiency model seems to be the most

adequate one because individual heterogeneity exists.[38] Theoretically, our findings suggest that *underdeveloped financial systems are likely to face banking crises.* Furthermore it is interesting to point out, once again, the regressions provide support to the hypothesis that banking competition enhances fragility.

Finally, the financial structure and development regression set estimates the specification defined by equation (6.2c). We summarise the results on the financial structure and development set in the following table:

[38] It is worthy to point out that estimations that include fixed-effects show that the qualitative results do not change. The statistical analyses for models with fixed effects consistently reject the null hypothesis of no incorrect omission. Given that miss-specification problems can be associated to random ones, we believe that this consideration also justifies the modelling with random effects. The statistical tests for the models with random effects are included in the appendix of the chapter.

Table 6.10 Evidence on the Financial Structure and Development Specification (Random Effects Logit Models for Panel Data)

/Model	Aggregate	Activity	Size	Efficiency
Regression Indicators				
Banking Aggregate	-1.02 (-1.288)	-1.38 (-1.428)	-0.72 (-0.583)	-4.03** (-2.147)
Structure Aggregate	-0.64 (-0.936)	-	-	-
Structure Activity	-	-0.67 (-0.754)	-	-
Structure Size	-	-	-0.91 (-0.826)	-
Structure Efficiency	-	-	-	-1.52** (-2.209)
Finance Aggregate	-0.30 (-0.349)	-	-	-
Finance Activity	-	-0.39 (-0.544)	-	-
Finance Size	-	-	-0.58 (-1.196)	-
Finance Efficiency	-	-	-	-0.31 (-0.515)
Constant	-0.82 (-0.829)	-3.43* (-1.652)	-2.48 (-1.410)	-11.77** (-2.307)
Observations	32	36	34	37
LR-CHI2	8.99**	11.43***	8.02**	13.67***
Prob > chi2	0.0295	0.0096	0.0456	0.0034
Log Likelihood	-15.44	-15.85	-16.88	-14.92
σ_u	1.56	2.26	1.21	7.29
ρ	0.70	0.83	0.59	0.98
CHI2 (Ho: ρ=0)	1.57	1.79	0.60	7.51***
Prob > chi2	0.2101	0.1809	0.4398	0.0061
Notes: The dependent variable is the banking crisis dummy. The z statistics are given in parenthesis and are based on IRLS variance estimators. One, two and three asterisks indicate significance levels of 10, 5 and 1 percent respectively.				

Table 6.10 shows that the associations among the financial structure and development indicators and banking crises are consistently negative. It also shows that most variables are not significant. Theoretically, the bank-view postulates significant and negative coefficients for the development indicators, while it postulates significant and positive coefficients for the financial structure ones. The market-based view postulates negative coefficient for all coefficients. The service-based view postulates significant and negative coefficients for the development indicators, while it postulates the no significance of the structure ones. These considerations make us conclude that *the evidence rejects the bank-based view*.

Econometrically, using the Wald criterion and the Gauss-Hermite sensitivity indicators, all models are significant and consistently stable. Interestingly, according to the Wald criterion, the efficiency model is the most statistically valid. Its associated ρ statistic supports the random-effects specification modelled.[39] But also, it finds a significant negative relationship between the market structure indicator and fragility.

Finally, we summarise our findings by indicating that the evidence suggests *that banking crises are more likely in bank-based financial systems* and that *financial development enhances banking stability*. Moreover, the *assessments provide evidence rejecting the bank-based policy view*. Theoretically, the latter finding suggests that *risk management practices based in the accumulation of liquid assets may not be the most adequate way to enhance banking stability*. According to the theory of comparative financial systems, the use of derivatives and cross-sectional risk sharing techniques might be better [Allen and Gale (2001)].

6.5.2. Banking competition and banking crises

The hypotheses on the nexus between banking competition and fragility are evaluated using the market structure regression set. The set comprises four regression models that independently assess the econometric specification by using assortments of indicators. The banking market structure indicators include aggregate, concentration, non-foreign bank penetration and public ownership ones. Again, the dependent variable is the crisis variable and the estimations include random effects.

The banking market structure regression set estimates the specification defined by equation (6.2c). We summarise the results for that set in the following table:

[39] The coefficient signs estimated for the models with fixed effects show are consistent with the ones displayed. However, they also show statistically low Wald values. Interestingly, it is worthy to indicate

Table 6.11 Evidence on the Banking Market Structure and Fragility Hypotheses (Random Effects Logit Models for Panel Data)

/Model	Aggregate	Concentration	Domestic	Public
Regression Indicators				
Structure Aggregate	-0.64 (-0.936)	-0.49* (-1.899)	-0.25 (-0.868)	-0.42 (-1.129)
Finance Aggregate	-0.30 (-0.349)	-0.32 (-1.334)	-0.51* (-1.755)	-0.38 (-0.764)
Banking Aggregate	-1.02 (-1.288)	-	-	-
Banking Concentration	-	-2.37*** (-3.098)	-	-
Banking Domestic	-	-	2.44 (1.447)	-
Banking Public	-	-	-	0.27 (0.711)
Constant	-0.82 (-0.829)	-2.65*** (-4.130)	-0.90* (-1.857)	-0.54 (-0.823)
Observations	32	261	220	35
LR-CHI2	8.99**	13.64***	14.24***	8.95**
Prob > chi2	0.0295	0.0034	0.0026	0.0299
Log Likelihood	-15.44	-125.05	-105.12	-17.13
σ_u	1.56	3.58	3.19	0.00
ρ	0.70	0.92	0.91	0.00
CHI2 (Ho: ρ=0)	1.57	59.19***	52.74***	0.00
Prob > chi2	0.2101	0.0000	0.0000	0.9999

Notes: The dependent variable is the banking crisis dummy. The z statistics are given in parenthesis and are based on IRLS variance estimators. One, two and three asterisks indicate significance levels of 10, 5 and 1 percent respectively.

Table 6.11 shows that the associations among the financial structure and development indicators and banking crises are consistently negative. It provides evidence to support the hypothesis that *banking competition enhances fragility.* Econometrically, only the aggregate and concentration models support the hypothesis that competition enhances fragility. However, among all the regression sets, the concentration model is the only one with significant determinants. Moreover, according to the Wald criterion, the concentration model is clearly significant. Furthermore, its ρ value is significantly close to one.

Evidently, the econometric results suggest that *market structure determinants may have differentiated effects regarding the likelihood of crises*. Specifically, the results

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that, among the models with fixed effects, the efficiency one was the only significant according to the Wald criterion.

show that the degree of banking concentration is significantly and negatively correlated to banking crises. Regarding banking ownership, they offer evidence, but not significant, that the domestic and public shares of banking assets may be positively correlated to such crises. Thus, what the regressions suggest is that *the stability of the banking system and banking performance may be affected by the property regime of banks*. [40]

Finally, our findings confirm that financial development and more market-based financial systems enhance banking stability. Although, the coefficients for such variables are significant only in the concentration and domestic models, they show consistent patterns regarding the relationships among financial structure, financial development and banking market structure with banking fragility. [41]

6.6. Conclusions and discussion

Both academics and policy makers are concerned with banking issues. Normally, they are involved on debates and controversies about how to encourage banking stability and about how to improve the risk management practices of the intermediaries. Apparently, the consensus is that these goals will be achieved understanding and modifying the environment in which the intermediaries develop their activities. However, the existence of different theories and policy views shows that we still are far about how to achieve such goals.

Here we have contributed to such debate by providing evidence based on qualitative, financial structure and development indicators. Specifically, we have characterised the stylised financial and banking facts associated to stable and unstable banking systems and we have assessed competing theories and policy views regarding the aggregate relationships between banking stability and management practices, and between fragility and banking market structures.

[40] This conclusion has support on banking efficiency studies. In a study for the German banking system Altunbas, Evans and Molyneux (2001) show that public and mutual banks have differentiated levels of efficiency (and probably some slight cost and profit advantages), over their private sector competitors.

[41] The consistency of these results does not only apply to the financial development and structure relationships with banking stability. In the previous regression sets, consistency also appears in what concerns to the relationship between competition and banking fragility. Moreover, in the corresponding regressions with fixed effects, the estimated negative coefficients for the banking-aggregate variable are

The stylised facts suggest that *financial development is associated to market-based financial systems and to non-competitive banking systems.* However, these associations mostly rely on the stability of the banking system. We believe that these findings suggest *that banking crises may encourage financial development*, but also that *they may encourage the transformation of financial systems into market-based ones*. Individual indicators suggest that market structure determinants *have differentiated associations*. Specifically, while *banking concentration and foreign-owned banks always seem to characterise bank-based and underdeveloped financial systems.* They also suggest that the associations of public banks may depend on systemic banking stability.

The econometric assessments have concrete implications regarding the competing theories and policies. The regression sets suggest *that banking crises are more likely in bank-based financial systems* and that *financial development enhances banking stability*. In what concern to the policies that may encourage banking stability, the *evidence rejects the bank-based view*. Thus, banking problems seem to be more associated to failures on cross-sectional risk sharing activities than to failures on inter-temporal risk-sharing ones. The main implication of the assessments is that derivatives and other techniques that eliminate risk through risk exchanges in specific moments of time might be adequate risk management practices to encourage banking stability.

The empirical analysis between market structure determinants and banking fragility also lead to some interesting implications. According to the regression results, *banking competition seems to encourage banking fragility, but the particular effects of the individual market structure indicators may be differentiated*. This empirical finding *is consistent* with our own theoretical ones [See Chapter 5]. Apparently, the main implication is that what really matters is the degree of banking competition, not the banking market determinants per se.

Further implications suggest that banking ownership and financial structure matter for policy design. Regarding these implications, the first implication traditionally has

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mostly significant. Interestingly, in the regressions with fixed effects, such variable is the only significant in most cases.

found support among academics and policy makers.[42] The second one directly contradicts other studies.[43] Thus, our findings seem to complement other studies on the relationships between property regime and economic performance and about the pertinence of distinguishing between financial systems for policy purposes.

Methodologically, our conclusions support the view that the banking organisation approach to banking and the theory of comparative financial systems are important as guidelines to understand the behaviour of the intermediaries. According to our findings, the microeconomic and aggregate analyses are complementary, rather than substitute tools to analyse the behaviour of the intermediaries. The joint study of the relationships among risk management, fragility and banking market structure seems to provide the nexus between both analytical guidelines.

Finally, we conclude by indicating that we have offered a methodological departure point to study the behaviour of the banking intermediaries considering the aggregate relationships among risk management, fragility and banking market structure.[44] Thus, our empirical results and conclusions should be considered as a first and preliminary attempt to deal with specific theory and policy controversies using the data currently available.

[42] The literature on the nexus between industrial ownership and performance is extensive. See Altunbas, Evans and Molyneux (2001) for a review focused on financial firms.

[43] Interestingly, Levine (2002) concludes that there is no support for either the bank-based or the market-based view. "Distinguishing countries by financial structure does not help in explaining cross-country differences in long-run economic performance." [Levine (2002: p. 423)]. We believe that our results differ from the ones of the former investigation because of the nature of the explained variables, the econometric techniques used and because we have included banking market structure indicators. Notice that, according to our theoretical findings, banking behaviour should be analysed considering the joint relationships among risk management, fragility and banking market structure.

[44] We still need to address other issues regarding financial systems and banking behaviour. Issues like the ones that concern the empirical effects of banking regulations on the stability of banking systems. We believe that the study of Demirguc-Kunt, Laven and Levine (2004) on the impact of bank regulations, market structure and institutions may be a methodological departure for further analyses.

CHAPTER 7
CONCLUSIONS AND FURTHER RESEARCH AGENDA

7.1. Introduction

In this chapter we summarise our research findings and suggest some ideas for developing further research. We do this by organising our findings and proposals accordingly to the order followed in this investigation. We begin by indicating the findings associated to the theoretical microeconomic relationships between banking behaviour and risk management goals and between banking behaviour and financial regulation. Latter, we continue with the ones associated to the empirical aggregate relationships among financial and market structures, development and banking crises. Finally, based on both types of findings, we indicate some proposals for developing further research.

Theoretically, we use the industrial organisation approach to analyse the relationships between banking behaviour and risk management goals and between banking behaviour and regulation effects. We develop and calibrate models to study the monopolistic competition effects on banking stability and to study the effects of asset and liability uncertainty on banking decisions. We extend such analyses to study the effects caused by portfolio restrictions and deposit interest-rate regulations.

Empirically, we characterise the financial and banking stylised facts associated to stable and unstable banking systems. Furthermore, we assess among competing theories and policy views regarding the relationships between banking stability and management practices, and between fragility and banking market structure. The empirical study relies on OLS regressions and random effects logit models for panel data. The dataset includes data for a sample of 47 countries during the period 1990-97.

Our research findings confirm that the joint relationships among risk management practices, the likelihood of banking fragility and the features that define the banking market structures can explain the behaviour of the intermediaries. We believe that the relevance of such findings relies on the recognised necessity to understand the behaviour of banking intermediaries. The understanding of intermediaries' behaviour

is not only necessary to guaranteeing the allocation of resources. It is essential for the design and implementation of adequate financial and banking policies. Given that the traditional analysis of banking firms has not been centred on the relevance of the joint behavioural relationships, this is the main contribution of our research as a whole.

The chapter is divided in six sections. Section 7.2 summarises our research findings on the relationships among risk management, fragility and the banking market structure. Specifically, it focuses on the theoretical ones between banking firm behaviour and risk management goals. Section 7.3 includes our research findings on banking behaviour and regulation. Section 7.4 describes our empirical findings on the relationships between financial system and banking intermediaries. Section 7.5 indicates some areas in which we believe that further research can be developed. The last section concludes.

7.2. Risk management, fragility and banking market structure

Our research shows that a microeconomic framework to analyse the joint relationships among institutional risk management, fragility and market structure can be built by extending the Monti-Klein banking firm model. Structurally, we show that it can be built by combining the model of the monopolistically competitive banking firm with some elements associated to the institutional risk management and financial crisis ones. Furthermore, we also show that the framework is flexible enough to analyse the behaviour of the intermediaries under diverse environmental and policy assumptions.

The framework assumes the intermediaries as firms that maximise profits and minimise bankruptcy costs by managing their short-term and long-term assets. It also assumes that their decisions are taken considering the existence of imperfect competition in the deposit market, uncertainty on depositors' behaviour and on investment returns, trade-offs between liquidity insurance and profitability and the availability of liquidity-risk strategies. Analytically, the framework clarifies the inter-temporal relationships between liquidity and solvency risks and between the viability of the asset transformation process and banking profitability.

Theoretically, the basic framework model can be seen as the asset management banking firm counterpart of the traditional liquidity insurance and financial fragility models in which depositors play the main role. Its main contribution relates to the justification of the necessity to analyse the joint relationships among risk management, fragility and the banking market structure. The main analytical finding shows that the optimal reserves/deposits ratio *depends* on the modified Lerner-banking index. Thus, the allocation that maximises profits and that minimises short-term fragility depends on the banking market structure.

The comparative-static calibrations show some interesting results. Concretely, they show that *increases in the number of symmetric banks,* bankruptcy or liquidation costs *will increase the optimal reserve/deposit ratios,* and that the associated banking benefits will be reduced. Moreover, they also show that increases in the deposit-supply elasticity or in the quality of long-term investment portfolios will have the opposite effects.

The previous banking behavioural analysis of the basic model is complemented by the analysis of two simplified monopolistic versions of it. These simplified versions assume that only one type of uncertainty exists and the behavioural analysis is done under this basis. The analyses of the monopolistic models clarify how the viability of the asset transformation process and the inter-temporal relationships among risks are related. However, we believe that their main contribution relates to the clarification that the maximisation of long-term profits and the minimisation of financial distress are *complementary and compatible* management objectives.

Finally, other research findings relate to the effects of banking uncertainty. Traditionally, these effects have been analysed in the context of the separability property, the irrelevance of asset-liability management (ALM) practices and associated regulation policies. Our models corroborate the academic claim that the separability property *does not hold* when uncertainty is introduced. Furthermore, they also show that market structure always influences the optimal banking decisions. Therefore, our models *not only justify ALM practices*, but also suggest that market

regulations *will have direct effects* on competition and management practices and *indirect effects* on banking stability.

7.3. Banking regulations, stability and the degree of banking competition

Based on the previous conclusions, we investigate the relationships among banking regulations, its effects on stability and the degree of market competition. Specifically, our research analyses the effects of reserve-ratio and deposit-return regulations on the behaviour of the intermediaries and the likelihood of liquidity and solvency risks. Interestingly, our findings show that the effects and the design of regulation practices depend on the degree of banking competition. Thus, what our findings suggest is that the impact of regulations on banks and design of regulation practices depends on the specific competitive environment of the banking industry.

Our findings are obtained from two variation models of the basic framework. Theoretically, each variation can be seen as a specific banking firm counterpart of traditional regulation models in which the government plays the main role. Each variation shows how banking regulations and the degree of banking competition affect the viability, solvency and profitability of the intermediation process. More specifically, each variation clarifies the specific behavioural-risk, control-risk and regulatory-risk effects associated to a certain type of regulation.

The analyses of the effects on the likelihood of liquidity and solvency risks associated to changes in the banking decisions and regulatory instruments (*behavioural-risk* and *control-risk effects*) show *differentiated effects*. Interestingly, our findings show that these differences *depend on the size of the deposit markets*. Moreover, they suggest that the qualitative effects caused by the decisions taken by bankers and regulators may be identical when the size of the deposit market is relatively small. Thus, our findings suggest that the achievement of banking and regulatory goals may depend on the degree of banking competition in the banking markets.

Our research suggests that deposit-return ceiling regulations may be better than minimum reserve requirement ones due to the existence of differentiated effects.

Reserve requirement regulations seem to reduce the likelihood of banking solvency risk only when the intermediaries are perfectly competitive. The inter-temporal regulatory-risk effects depend on the nature of the regulations imposed and the competitive environment. Interestingly, while *these effects seems not to be differentiated in the short run*, when idiosyncratic shocks appear; *they are clearly evident in the long run*, when solvency, profitability or failure may occur.

Finally, our research findings show that banking fragility is enhanced when the number of perfectly competitive intermediaries increases in the banking system and the system is not regulated. They also show that regulations can enhance short-term stability, at least, for monopolistically competitive intermediaries. Therefore, our models *justify regulatory practices*. Furthermore, they also suggest the use of interest-rate instruments as regulatory devices instead of asset portfolio restrictions for regulation purposes. The reason is because the former may eliminate the possibility of differentiated, and undesirable, risk effects regarding the viability, solvency and profitability of intermediaries.

7.4. Financial systems and the design of stability-enhancing policies

Our research concludes with an econometric analysis of the aggregate relationships between banking stability and risk management practices, and between banking fragility and banking market structures. Specifically, the investigation characterises the financial and banking stylised facts associated to stable and unstable banking systems and assesses among competing theories and policy views. Econometrically, the study uses OLS regressions and random effects logit models for panel data for the empirical assessments. Academically, it can be included into the tradition of failure-determinant macro-micro studies.

Methodologically, the main contributions of the empirical research are related to the inclusion of banking market structure and banking fragility qualitative indicators for the assessments of financial system theories and policy views. Further contributions relate to the analysis of the relationship between financial structure and banking fragility. We emphasise these features because, to our knowledge, our research uses

by first time qualitative panel data techniques for assessing banking fragility from an international perspective.

Our main findings have implications for academic and policy purposes. Regressions show that banking market structure, financial structure and development associations can be differentiated according to banking stability. Aggregate indicators suggest that *financial development is associated to market-based financial systems and to non-competitive banking systems*. However, these associations mostly rely on the stability of the banking system. The exception relies on the associations between market-based and financial development indicators.

Individual indicators suggest that market structure determinants *have differentiated associations*. Specifically, OLS estimations suggest that *banking concentration and foreign-owned banks always seem to characterise bank-based and underdeveloped financial systems*. They also suggest that the associations of public banks may depend on systemic banking stability. Specifically, they suggest that *financial development is significantly associated with public banks only when the banking systems are fragile*; and that *market-based systems are significantly associated with public banks only when the banking systems are stable*.

Random effects logit models for panel data suggest *that banking crises are more likely in bank-based financial systems* and that *financial development enhances banking stability*. Regarding banking market structure, the models provide evidence that *competition enhances banking fragility*. Interestingly, the regression sets provide evidence rejecting the bank-based policy view. This finding suggests that *risk management practices based in the accumulation of liquid assets may not be the most adequate way to enhance banking stability*. Thus, the use of derivatives and cross-sectional risk sharing techniques might be better.

7.5. Agenda for further research

We have summarised our research findings to show how the relationships among risk management practices, the likelihood of banking fragility and the features of the banking market structures can explain the behaviour of banking firms. The relevance

of such findings relies on the recognised necessity to understand the behaviour of banking intermediaries. Here we include some issues that may improve our understanding on banking intermediaries' behaviour. Following the order of our research, we classify such issues into microeconomic and aggregates ones.

Academically, we believe that further microeconomic studies on intermediaries' behaviour can be developed along the lines of the theories of oligopoly pricing and market microstructure.[1] Specifically, we believe that the industrial organisation tools that may give us revealing insights on banking behaviour relate to product differentiation, competition with asymmetric information and analyses of repeated interaction and dynamics. Informational tools relate to information-based modelling, strategic trading, market viability and stability, and the analysis of liquidity and the relationships between banking markets. Evidently, the relevance of these tools relies on the facilities that they provide to analyse more policy-oriented concerns.[2]

The understanding the behaviour of the intermediaries is necessary for the design of financial regulations. We believe that further microeconomic studies on banking regulation should focus on the risk-effects of regulatory instruments like entry, branching, network and merger restrictions, deposit insurance and capital requirements. Further variations of our basic microeconomic framework can be developed to investigate the effects of such regulations on the intermediaries. Evidently, the relevance of such analyses will be associated to the assessment and comparison of different regulation policies. [3]

[1] See Vives (1999) for an introduction to oligopoly pricing theory, and O'Hara (1995) and Spulber (1999) for an introduction to market microstructure models.

[2] Specific concerns that we believe that can be analysed relate to the role that information and deposit contracts may play in bank runs and banking panics and the modelling of private sector alternatives (modifications of the deposit contract), to government deposit insurance. Furthermore, we also believe that our framework can be useful to analyse issues associated to the optimal design of banking systems (issues involving its industrial organisation, scope and regulation). Notice that it has been pointed out that "the extension of financial distress based models of risk management to an equilibrium setting is, as noted earlier, an important area for further research" [Hunter and Smith (2002: p. 219)].

[3] We believe that further regulatory issues can be analysed with variations of our framework. Issues regarding the effects of government initiatives in stanching bank runs, deposit insurance pricing and the comparison between deposit insurance with respect to the suspension of convertibility as mechanisms for bank run deterring. In spite that some analyses exist regarding these issues [See Bhattacharya and Thakor (1993), Freixas and Santomero (2004)], none of them focuses on how the joint relationships among risk management, fragility and market structure may alter their conclusions.

Empirically, microeconomic studies on banking regulations seem a promising area for further research. Evidently, the availability of data remains as the main constraint to develop these studies. However, recent efforts suggest that these problems will be overcome in the short-run. Micro studies, like the ones of Demirguc-Kunt, Laeven and Levine (2004), suggest that the development of further empirical research may be feasible. Empirical studies on the joint relationships among institutional regulations, banking fragility and market structure seem promising fields to understand intermediaries´ behaviour.

The research agenda on the behaviour of the banking intermediaries must include aggregate issues. Given that our findings suggest that banking behaviour depend on the financial systems and these systems evolve over time, the development of a dynamic theory on how financial systems change may be necessary to understand their behaviour. Theoretically, questions regarding the evolution drivers of the financial system (legal and regulatory systems, political factors, financial innovation and financial crises) still need to be answered. But also, questions regarding how these drivers may change the behaviour and management practices of the intermediaries.[4]

We believe that the empirical analysis of the legal system and banking fragility can be a useful departure point to analyse how these drivers may modify the behaviour of the intermediaries. Indicators of legal codes like the ones used by La Porta, Lopez-de-Silanes and Vishny (1997) and (1998) may be included in our database. Technically, such indicators can be included in our financial structure and development regression sets by using instrumental-variable methods. This is not a really difficult task to do so. Evidently, the real problem concerns to the availability and quality of data.[5]

[4] Allen and Gale (2001) review these drivers of the evolution of the financial systems. Particularly, in what concerns to the legal rights, it has been pointed out that "systematic differences among countries in the structure of laws and their enforcement, …, account for the differences on financial development" [La Porta, Lopez-de-Silanes and Vishny (2002: p. 1147)]. See La Porta, Lopez-de-Silanes and Vishny (1997), (1998) and (2000), for other studies on the relationship between law and finance. Finally, regarding financial innovation, we still need to investigate the role of banking intermediaries in the process.

[5] Econometrically, the proposed analysis seems feasible. Levine (2002) has evaluated the role of the legal rights on studies of economic growth. However, given the nature of the data, the analysis in our case will involve different econometric techniques.

We conclude by indicating that behavioural issues concern researchers and practitioners alike. Specifically, among researchers, there is a consensus around the necessity to "move further in constructing a theory of financial intermediation that can explain the day-to-day operations of financial institutions and markets and their role within the real economy" [Scholtens and Van Wensveen (2000: p. 1249)]. In what concerns to practitioners, there is the necessity to reconcile the observed behaviour of financial intermediaries with intermediation theory for management and regulation purposes. Thus, further studies on the joint relationships among risk management, fragility and market structure seem to be necessary for theoretical and policy purposes.

7.6. Concluding remarks

Here we have analysed the behaviour of banking institutions focusing on the joint relationships among institutional risk management, fragility and banking market structure. The guideline assumption underlying such approach has been that these relationships are the most important ones that define and delimit the activities and decisions available to banking firms. Under this assumption, our research has been organised in two aggregation levels: One based on the industrial organisation theory, and the other based on the theory of comparative financial systems. In both cases, an institutional perspective has permeated the analyses.

Academically, our research constitutes an effort to study of the behaviour of banking institutions making explicit that the intermediaries are firms that maximise profits by managing risks. The recognised necessity to understand the behaviour of banking intermediaries and the theoretical and practical implications associated to this understanding make us believe in the importance of this research. Hopefully, further results based on our investigations will have some relevance for the design and implementation of banking policies and practices.

However, we must admit that such hope may not become reality soon. Theoretically, we need further studies to explain how and why intermediaries perform their activities considering uncertainty and risk. Moreover, practical issues concerning inter-bank and global markets, acquisition and processing of information, contagion effects, financial innovation and the management of banking risks when traditional banking activities

are declining are topics that need be addressed by researchers. The reconciliation between theory and observed behaviour of the intermediaries requires further knowledge on intermediaries' behaviour.

Risk managers and regulators need this knowledge to encourage better banking practices. However, we are still far from such goal. Academics, managers and regulators reflect a diversity of approaches to deal with this banking concern. Current management practices and regulation frameworks mainly are based on national considerations. We are far from a consensus regarding the desirable standard practices and institutional features that could define adequate management and regulation practices for banking firms. However recent discussions, regarding the new Basel Accord, show that efforts exist to improve and systematise risk management banking practices for regulation purposes.

This situation makes evident the necessity to develop further analyses on behavioural issues in the banking industry. Here we have assumed that such analyses can be done by making explicit that such behaviour can be understood in terms of the compatibility of the risk management goals of the intermediaries with the economic and financial environments within which they operate. However, we also believe that the analyses on the effects of banking decisions and of imposed rules should are steps to deal with a more complex problem: The problem of designing mechanisms for the minimisation of intermediaries´ risk exposure without constraining their intermediary functions. This behavioural problem is particularly relevant in the context of banking institutions that can operate not only in a domestic, but on a global scale.[6]

We expect to have contributed toward the reconciliation between intermediation theory and intermediaries´ behaviour. We sincerely hope to encourage further research.

[6] Recent concerns regarding the interactions among, banking behaviour, risk management practices and financial regulation have highlighted the international dimension of banking activities. Concerns about the impact of the Basel Accord proposal on the global banking system are a representative example.

APPENDICES

1. Appendix for Chapter 2

In this appendix we offer an introduction to banking risks and institutional risk management theory. Specifically, we describe the nature of the risks that banks normally deal to develop their activities and we offer an overview about how risk management has been integrated into financial models to explain intermediaries' activities. We concentrate on why risks and risk management are important to explain the behaviour of intermediaries, instead of concentrating in the traditional concern about how risk management techniques deal with risk. [1]

We show how intermediation theory has explained intermediaries' behaviour in terms of the nature of their risk management activities. Theoretically, this approach makes us to explicitly assume an institutional perspective to analyse banking intermediaries. Moreover, it also offers the possibility to explain the observed behaviour of financial institutions in modern financial markets.

The appendix is divided in two sections. The first section describes the relationship between banking risks and intermediation activities from the perspective of researchers and practitioners. The second one reviews the development of the institutional risk management models.

1.A. Banking risks and intermediation activities

Banking management concerns are related to liquidity, asset, liability and capital management considerations. Risks and risk management play a central role for financial decisions taking. Specifically, banking institutions have to control and select

[1] Traditionally, the focus is on the how these individual factors explain the performance of intermediaries [See Bhattacharya and Thakor (1993) and Freixas and Rochet (1997)]. Interestingly, the risk management literature usually focuses on specific tools and models to deal with risk, but not in the institutional aspects of risk management. See Bessis (2002) and Hunter and Smith (2002).

the risks inherent to the management of deposits, loans, portfolios of securities, and off-balance sheet contracts.[2]

The scope of risk management practices is as diverse as the risks that banks face. These risks include micro-risks, like the ones concerning credit to individual borrowers; and macro-risks, such as market risks, interest rate and exchange rate risks, which may be well beyond the control of a single market participant. Roles associated to them, such as the provision of liquidity insurance and the search for profitable asset transformation activities, explain their exposition to this variety of risks. Thus, we believe that in order to study the risk management process we should start by classifying the types of banking risks. Given the scope and nature of the risks that these intermediaries face, several classifications have been proposed.

Academically, risks can be divided according to their aggregation level, their balance sheet effects, or according to the banking-activity to which they are associated [Freixas and Rochet (1997)]. An aggregation-type economic classification differentiates between idiosyncratic and systemic risks[3]. An accounting-financial one differentiates between liquidity and solvency ones. Finally, an activity-association one distinguishes among credit-default, deposit-liquidity and market risks.[4]

Practitioners and regulatory authorities usually classify market risks according to the techniques and management tools required for measuring, monitoring and controlling risks based on expectations of banking performance. Thus, they divide market risks in credit, liquidity (maturity), interest rate, foreign exchange, settlement, operational, legal, reputational, political and systemic risks [Sheng (1999)].[5] Based on this classification, *we distinguish between intermediary and non-intermediary risks*.

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[2] Theoretically, it has been accepted that "the management of risks, in the full acceptation of the term, can be seen as the major activity of banks, as well as other financial intermediaries" [Freixas and Rochet (1997: p. 221)].

[3] Idiosyncratic risks are microeconomic risks that can be diversified away by the law of large numbers, while systematic are macroeconomic ones that cannot. Notice that banks generally deal with both types of risks. Other intermediaries do not necessarily deal with both types. For example, insurance companies main concern is with idiosyncratic risks.

[4] Credit-default risk happens when borrowers are unable to repay a debt and the banking credit activity is affected. Deposit-liquidity risks occur when banks must pay unexpected deposit withdrawals. Market risks affect the portfolios of marketable assets and liabilities held by the banks.

[5] Heffernan (1996) develops a similar classification and a simplified one is described by Bessis (2002).

Intermediary risks are the banking risks associated directly to their main functions. Thus, these risks depend on creditors, liquidity provisions, interest and exchange rates, settlements and the operation of the bank itself. *Non-intermediary risks are the ones that depend on external or intangible factors*. These depend on the legal system, reputation, political environment and the perception of the financial markets (contagion effects).

The relevance of the latter classification is related to current research frontiers. Theory still needs to address the analysis of intermediary risk areas like the ones concerning settlement and operational risks; while it needs to extend the analysis undertaken on non intermediary ones, like the one related to systemic risk.

Concerning intermediary risks, Pyle (1997) has indicated that risks that result from costs carried out in carrying out settlement failures, failures to meet regulatory requirements or failures to properly monitor employees, usually are highly important for firms. About non-intermediary risks, Allen and Gale (2000b) have indicated that an important topic for further research is related to the kinds of arrangements that banks set up given uncertainty, the individual benefits of access to liquidity and the social costs of contagion.[6]

1.B. Institutional risk management models

Banking functions and intermediary activities depend on adequate risk management practices. Specifically, from the point of view of banking entrepreneurs, risk management activities provide the means to maximise profits and to minimise financial distress in the banking markets; while for regulators, they provide the means to allocate resources and to avoid fragility in the financial system. The relevance associated to these issues explains why financial research has long focused on risk management.

Historically, the theory of financial risk management practices and financial intermediation can be dated back to Modigliani and Miller (1958). There it is shown

[6] See Bougheas (1999) for a theoretical analysis of contagious bank runs. See Allen and Gale (2001) for a review on the bank contagion literature.

that, allowing arbitrage, the value of the firm is independent of how it manages its' financial risk in an economy with perfect markets, zero bankruptcy costs and without taxes. The relevance of this paper is related to the justification of management rationales. Risk management matters when these conditions are not satisfied. Thus, since then management models include at least one of these conditions to rationalise the behaviour of financial intermediaries.

One of the most important contributions to the development of institutional management theory refers to the analysis of intermediaries as firms. Among these contributions, the seminal works of Monti (1972) and Klein (1971) are relevant because they provide the foundations to the industrial organisation approach to intermediation theory. Specifically, their works analyse how monopolistic banks should determine their optimal lending and deposit decisions to maximise profits. Their contribution relates to the one of Leland (1972) and Sandmo (1971), who study the problem of how firms choose their investment and financing decisions given uncertainty and a maximisation utility function. The relevance of the latter papers relates to the development of the theory of the firm under uncertainty.

More recent contributions are Ederington (1979) and Rolfo (1980). These papers examine the problem of hedging (off-balance sheet risk management) in the context of a firm that takes positions in off-balance sheet instruments to maximise a mean/variance objective function or expected utility. The main contribution of these analyses relies on the integration of the theory of the firm with the mean-variance analysis pioneered by Markowitz (1958) and Tobin (1958).

Financial fragility theory has provided incentives for the development of institutional risk management theory. Following Bryant (1980), Diamond and Dybvig (1983) explain bank runs in terms of the financial structure of the intermediaries, deposit insurance and liquidity needs of depositors. Concretely, they show that bank runs are equilibrium outcomes when there is incomplete information about the timing of depositors' liquidity requirements. This is important because this result is related to one of the main concerns of the risk management literature: The one regarding why

firms might want to manage risk in equilibrium or, in other words, the one about how risk management practices can be rationalised.

Inter-temporal considerations can differentiate between solvency and liquidity risks, but also provide with the most accepted economic rationale for risk management: the prevention of financial distress [Allen and Santomero (1997), Scholtens and Wensdeen (2000)]. This is important because it answers why intermediaries may engage in risk management activities in terms of the fear of bankruptcy and the financial fragility phenomenon. However, this has not been the unique offered solution. Alternative proposed rationales for risk management in the context of financial intermediaries are managerial self-interest, non-linear taxes and capital market imperfections.[7]

Hedging models provide further insight about risk management decisions. These models show how the firm's management decisions are complicated by multiple sources of risks [Anderson and Danthine (1981)] and/or imperfect competitive markets [Morgan and Smith (1987)]. Along the lines of such models, Hunter and Smith (2002) analyse the hedging of future investment opportunities when the banking utility function is concave and the costs are convex. The relevance of these papers is that they suggest that bankruptcy costs, market structure, and multiple uncertainty may affect risk management practices.

Recent risk management models focus on the simultaneous decisions regarding hedging and leverage. Leland (1998) studies the joint investment, hedging and leverage decisions in a dynamic value maximisation framework. Mello and Parsons (2000) argue that the optimal hedging for a firm facing constraints is one that minimises the variability in the marginal value of cash balances. These papers determine the optimal demand of hedging given specific financial distress costs and the existence of risk neutral traders that provide free insurance. Thus, their conclusions are limited in terms of applicability. However, the relevance of these papers is that they provide a departure point to study the dynamics of the risk management process.

2. Appendix for Chapter 4

In this appendix we obtain the first order conditions, (4.4a) and (4.4b), necessary to obtain the optimal reserves to deposits ratio. Our goal will be to derive such conditions from the maximisation program (4.3) and the assumptions regarding market structure in order to show that risk management, liquidity and solvency depend on the characteristics of the deposit markets. We divide this appendix in two sections. In the first, the partial derivatives and FOC are obtained while in the second, we focus on the FOC for deposits and rewrite it in terms of market structure features.

2.A. Partial derivatives and first order conditions

We start by setting the partial derivatives of the program. Such partial derivatives are obtained deriving the expected benefit function using the Leibnitz's rule for iterated integrals for the exterior one and the Leibnitz's rule for differentiation of integrals for the ones inside the brackets.[8]

The obtained partial derivative for reserves is:

$$\frac{\partial}{\partial \mathrm{M_i}}\overline{\pi}_i(M_i,D_i)=-\frac{1}{y_F D_i}\left[\left[\int_{x_h}^{x_M}\int_{y_{Hi}^*}^{y_F}(y-1)dydx\right]D_i-\left[\int_{r_D(D)}^{y_F}(y-r_D(D))dy\right][D_i-M_i]\right]$$

$$+\frac{1}{y_F D_i}\left[-\left[\int_{x_M}^{x_l}\int_{y_{Li}^*}^{y_F}ydydx\right](1-c_l)D_i-\left[\int_{r_D(D)}^{y_F}(y-r_D(D))dy\right][D_i-M_i]\right]$$

$$-\frac{BD_i}{y_F(D_i-M_i)^2}\left[-\int_{x_h}^{x_M}(1-r_D(D))(1-x)dx\right]$$

$$-\frac{BD_i}{y_F(D_i-M_i)^2}\left[\int_{x_M}^{x_l}\frac{1-x}{[D_i-M_i-c_l(xD_i-M_i)]^2}dx\right]r_D(D)(D_i-M_i)^2(1-c_l)$$

(2A.1)

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[7] See Allen and Santomero (1997), for a review of the literature on these alternative rationales.

[8] Leibnitz's rules for differentiation of integrals are:

$$\frac{d}{d\alpha}\int_a^b H_1(x,\alpha)dx=\int_a^b\left(\frac{d}{d\alpha}H_1(x,\alpha)\right)dx$$

$$\frac{d}{d\alpha}\int_{\theta_1(\alpha)}^{\theta_2(\alpha)}H_2(y,\alpha)dy=\int_{\theta_1(\alpha)}^{\theta_2(\alpha)}\left(\frac{d}{d\alpha}H_2(y,\alpha)\right)dy+H_2(\theta_2,\alpha)\frac{d\theta_2}{d\alpha}-H_2(\theta_1,\alpha)\frac{d\theta_1}{d\alpha}$$

Simplifying this partial derivative and equating them to zero we obtain:

$$\frac{\partial}{\partial \mathrm{M_i}}\overline{\pi}_i\left(M_i^*, D_i^*\right)=0$$

$$\int_{x_h}^{x_M}\int_{y_{Hi}^*}^{y_F}(y-1)dydx+\int_{x_M}^{x_l}\int_{y_{Li}^*}^{y_F}y(1-c_l)dydx$$

$$=\frac{BD_i^*}{\left(D_i^*-M_i^*\right)^2}\left[\int_{x_h}^{x_M}\left(1-r_D\left(D^*\right)\right)(1-x)dx-\left[\int_{x_M}^{x_l}\frac{(1-x)(1-c_l)r_D\left(D^*\right)}{\left[D_i^*-M_i^*-c_l\left(xD_i^*-M_i^*\right)\right]^2}dx\right]\left(D_i^*-M_i^*\right)^2\right]$$

(2A.2)

This is equation (4.4a) in the text.

Analogously, the following derivative for deposits is obtained.

$$\frac{\partial}{\partial D_{\mathrm{i}}}\overline{\pi}_i(M_i,D_i)=\frac{1}{y_F D_i^2}\left[\left[\int_{x_h}^{x_M}\int_{y_{Hi}^*}^{y_F}\left[y-x-(1-x)\left[r_D(D)+D_{\mathrm{i}}\frac{\partial}{\partial D_{\mathrm{i}}}r_D(D)\right]\right]dydx\right]D_i^2\right]$$

$$-\frac{1}{y_F D_i^2}\left[\int_{r_D(D)}^{y_F}\left(y-r_D(D)\right)dy\right](D_i-M_i)M_i$$

$$-\frac{1}{y_F D_i^2}\left[\left[\int_{x_M}^{x_l}\int_{y_{Li}^*}^{y_F}\left[-(1-c_l x)y+(1-x)\left[r_D(D)+D_{\mathrm{i}}\frac{\partial}{\partial D_{\mathrm{i}}}r_D(D)\right]\right]dydx\right]D_i^2-\left[\int_{r_D(D)}^{y_F}\left(y-r_D(D)\right)dy\right](D_i-M_i)M_i\right]$$

$$-\frac{B}{y_F\left(D_i-M_i\right)^2}\left[-\left[\int_{x_h}^{x_M}(1-x)dx\right]\left[-(1-r_D(D))M_i-(D_i-M_i)D_{\mathrm{i}}\frac{\partial}{\partial D_{\mathrm{i}}}r_D(D)\right]\right]$$

$$-\frac{B}{y_F\left(D_i-M_i\right)^2}\left[-\int_{x_M}^{x_l}\frac{(1-x)\left[(1-c_l)M_i r_D(D)-\left[D_i-M_i-c_l\left(xD_i-M_i\right)\right]D_i\frac{\partial}{\partial D_{\mathrm{i}}}r_D(D)\right]}{\left[D_i-M_i-c_l\left(xD_i-M_i\right)\right]^2}dx\right]\left(D_i-M_i\right)^2$$

(2A.3)

Simplifying, we obtain the first order condition for deposits:

$$\frac{\partial}{\partial D_{\mathrm{i}}}\overline{\pi}_i\left(M_i^*, D_i^*\right)=0$$

$$\int_{x_h}^{x_M}\int_{y_{Hi}^*}^{y_F}\left[y-x-(1-x)\left[r_D\left(D^*\right)+D_i^*\frac{\partial}{\partial D_{\mathrm{i}}}r_D\left(D^*\right)\right]\right]dydx$$

$$+\int_{x_M}^{x_l}\int_{y_{Li}^*}^{y_F}\left[y(1-c_l x)-(1-x)\left[r_D\left(D^*\right)+D_i^*\frac{\partial}{\partial D_{\mathrm{i}}}r_D\left(D^*\right)\right]\right]dydx$$

$$=$$

$$\frac{B}{\left(D_i^*-M_i^*\right)^2}\left[\int_{x_h}^{x_M}(1-x)dx\right]\left[\left(1-r_D\left(D^*\right)\right)M_i^*+\left(D_i^*-M_i^*\right)D_i^*\frac{\partial}{\partial D_{\mathrm{i}}}r_D\left(D^*\right)\right]$$

$$-\frac{B}{\left(D_i^*-M_i^*\right)^2}\left[\int_{x_M}^{x_l}\frac{(1-x)\left[(1-c_l)M_i^*r_D\left(D^*\right)-\left[D_i^*-M_i^*-c_l\left(xD_i^*-M_i^*\right)\right]D_i^*\frac{\partial}{\partial D_{\mathrm{i}}}r_D\left(D^*\right)\right]}{\left[D_i^*-M_i^*-c_l\left(xD_i^*-M_i^*\right)\right]^2}dx\right]\left(D_i^*-M_i^*\right)^2 \tag{2A.4}$$

The last derivative can be rewritten as

$$\frac{\partial}{\partial D_{\mathrm{i}}}\overline{\pi}_i\left(M_i^*, D_i^*\right)=0$$

$$\int_{x_h}^{x_M}\int_{y_{Hi}^*}^{y_F}\left[y-x-(1-x)\left[r_D\left(D^*\right)+D_i^*\frac{\partial}{\partial D_{\mathrm{i}}}r_D\left(D^*\right)\right]\right]dydx$$

$$+\int_{x_M}^{x_l}\int_{y_{Li}^*}^{y_F}\left[y(1-c_l x)-(1-x)\left[r_D\left(D^*\right)+D_i^*\frac{\partial}{\partial D_{\mathrm{i}}}r_D\left(D^*\right)\right]\right]dydx$$

$$-\frac{BD_i^*}{\left(D_i^*-M_i^*\right)^2}\left[\left[\int_{x_h}^{x_M}(1-x)dx\right]\left(D_i^*-M_i^*\right)\frac{\partial}{\partial D_{\mathrm{i}}}r_D\left(D^*\right)\right]$$

$$-\frac{BD_i^*}{\left(D_i^*-M_i^*\right)^2}\left[\int_{x_M}^{x_l}\frac{(1-x)\left[D_i^*-M_i^*-c_l\left(xD_i^*-M_i^*\right)\right]\frac{\partial}{\partial D_{\mathrm{i}}}r_D\left(D^*\right)}{\left[D_i^*-M_i^*-c_l\left(xD_i^*-M_i^*\right)\right]^2}dx\right]\left(D_i^*-M_i^*\right)^2$$

$$=$$

$$\frac{BM_i^*}{\left(D_i^*-M_i^*\right)^2}\left[\int_{x_h}^{x_M}\left(1-r_D\left(D^*\right)\right)(1-x)dx-\left[\int_{x_M}^{x_l}\frac{(1-x)(1-c_l)r_D\left(D^*\right)}{\left[D_i^*-M_i^*-c_l\left(xD_i^*-M_i^*\right)\right]^2}dx\right]\left(D_i^*-M_i^*\right)^2\right] \tag{2A.5}$$

2.B. Market structure and first order conditions

Assuming identical banking firms and a deposit-supply function with constant deposit-supply elasticity, we can define the identity below:

$$r_D(D)+\frac{\partial r_D(D)}{\partial D_i}D_i = r_D(D)\left(1+\frac{1}{N\varepsilon_D}\right) \qquad (2A.6)$$

The RHS expression allows us to study the relationship between market structure, and banking deposit decisions. That is because the deposit derivatives can be rewritten in terms of the inverse elasticities with two limiting cases: N=1 (monopsony) and N=+∞ (perfect competition).

Given the deposit-supply elasticity definition and symmetric banks, (2A.5) can be rewritten as:

$$\frac{\partial}{\partial D_{\mathrm{i}}}\overline{\pi}_i\left(M_i^*, D_i^*\right)=0$$

$$\int_{x_h}^{x_M}\int_{y_{Hi}^*}^{y_F}\left[y-x-(1-x)r_D\left(D^*\right)\left[1+\frac{1}{N\varepsilon_D}\right]\right]dydx+\int_{x_M}^{x_l}\int_{y_{Li}^*}^{y_F}\left[y(1-c_l x)-(1-x)r_D\left(D^*\right)\left[1+\frac{1}{N\varepsilon_D}\right]\right]dydx$$

$$-\frac{Br_D\left(D^*\right)}{N\varepsilon_D}\left[\int_{x_h}^{x_M}\frac{(1-x)}{\left(D_i^*-M_i^*\right)}dx+\int_{x_M}^{x_l}\frac{(1-x)}{\left[D_i^*-M_i^*-c_l\left(xD_i^*-M_i^*\right)\right]}dx\right]$$

$$=$$

$$\frac{BM_i^*}{\left(D_i^*-M_i^*\right)^2}\left[\int_{x_h}^{x_M}\left(1-r_D\left(D^*\right)\right)(1-x)dx-\left[\int_{x_M}^{x_l}\frac{(1-x)(1-c_l)r_D\left(D^*\right)}{\left[D_i^*-M_i^*-c_l\left(xD_i^*-M_i^*\right)\right]^2}dx\right]\left(D_i^*-M_i^*\right)^2\right]$$

(2A.7)

Rearranging terms

$$\frac{\partial}{\partial D_{\mathrm{i}}}\overline{\pi}_i\left(M_i^*, D_i^*\right)= 0$$

$$\int_{x_h}^{x_M}\int_{y_{Hi}^*}^{y_F}\left[y - x - (1-x)r_D\left(D^*\right)\right]dydx + \int_{x_M}^{x_l}\int_{y_{Li}^*}^{y_F}\left[y(1-c_l x) - (1-x)r_D\left(D^*\right)\right]dydx$$

$$-\frac{r_D\left(D^*\right)}{N\varepsilon_D}\left[\int_{x_h}^{x_M}\int_{y_{Hi}^*}^{y_F}(1-x)dydx + \int_{x_M}^{x_l}\int_{y_{Li}^*}^{y_F}(1-x)dydx\right]$$

$$-\frac{Br_D\left(D^*\right)}{N\varepsilon_D}\left[\int_{x_h}^{x_M}\frac{(1-x)}{\left(D_i^* - M_i^*\right)}dx + \int_{x_M}^{x_l}\frac{(1-x)}{\left[D_i^* - M_i^* - c_l\left(xD_i^* - M_i^*\right)\right]}dx\right]$$

=

$$\frac{BM_i^*}{\left(D_i^* - M_i^*\right)^2}\left[\int_{x_h}^{x_M}\left(1 - r_D\left(D^*\right)\right)(1-x)dx - \left[\int_{x_M}^{x_l}\frac{(1-x)(1-c_l)r_D\left(D^*\right)}{\left[D_i^* - M_i^* - c_l\left(xD_i^* - M_i^*\right)\right]^2}dx\right]\left(D_i^* - M_i^*\right)^2\right]$$

(2A.8)

This is equation (4.4b) in the text.

3. Appendix for Chapter 5

In this appendix we evaluate and analyse the behavioural and control-risk derivatives in both control models. Specifically, we determine the qualitative changes in the probabilistic ranges that define the likelihood of liquidity and solvency for intermediaries when the behavioural and control variables change. This evaluation is possible because the probabilistic ranges are defined by the liquidity cut-offs and the banking solvency function thresholds. Moreover, because of the inter-temporal framework used to design the models, the analysis can differentiate between the short-term effects, associated to the viability of the asset transformation process, and the long-term ones, associated to the solvency and profitability of intermediaries.

The appendix is divided in two sections. In the first section, the behavioural-risk and control-risk derivatives on the liquidity regulation model are obtained and analysed, while in the second one, does the same for the deposit-return regulation one.

3.A. Behavioural and control-risk effects on the reserve-ratio control model

In this section we analyse the behavioural-risk effects associated to changes in individual deposits and the control-risk effects associated to changes in liquidity ratios. Then we sign them to evaluate the risk effects on the reserve-ratio control model. Particularly, we write these derivatives in terms of the deposit-supply elasticity to analyse how market structure influences banking management goals.

Behavioural-risk effects with reserve-ratio controls

Here we analyse how deposits affect the probabilities associated to the inter-temporal risks through variations in the probabilistic ranges that define the viability, solvency and profitability of the asset transformation process.

The short-term behavioural-risk derivatives are the following:

$$\frac{d}{dD_i}\left[x_h(D_i)-0\right]=\frac{d}{dD_i}x_h(D_i)=\frac{r_D(D)}{N\varepsilon_D}\frac{(y_F-1)(1-m)}{D_i\left[r_D(D)-1\right]^2}>0 \qquad (3A.1a)$$

$$\frac{d}{dD_i}\left[x_M(D_i)-x_h(D_i)\right]=-\frac{r_D(D)}{N\varepsilon_D}\frac{(y_F-1)(1-m)}{D_i\left[r_D(D)-1\right]^2}<0 \qquad (3A.1b)$$

$$\frac{d}{dD_i}\left[x_l(D_i)-x_M(D_i)\right]=-\frac{r_D(D)}{N\varepsilon_D}\frac{y_F(c_l-1)(1-m)}{D_i\left[y_F c_l-r_D(D)\right]^2}<0 \qquad \text{(3A.1c)}$$

$$\frac{d}{dD_i}\left[1-x_l(D_i)\right]=\frac{r_D(D)}{N\varepsilon_D}\frac{y_F(c_l-1)(1-m)}{D_i\left[y_F c_l-r_D(D)\right]^2}>0 \qquad \text{(3A.1d)}$$

The derivatives show that increases in deposits will reduce the probabilities of managing liquidity surpluses and shortages. This finding suggests that *the viability of the asset transformation process will be reduced when individual deposits increase*. However, this effect seems to depend on market size. Notice that the probabilities of financial failure will not change by increases in individual deposits when the banking system is not concentrated or when the depositors are sensitive.

The long-term behavioural-risk derivatives are the following:

$$\frac{d}{dD_i}\left[y_F-y^*_{Li}(x,D_i)\right]=-\frac{r_D(D)}{N\varepsilon_D}\frac{1-x}{D_i\left[1-m-c(x-m)\right]}<0 \qquad \text{(3A.2a)}$$

$$\frac{d}{dD_i}\left[y_F-y^*_{Hi}(x,D_i)\right]=-\frac{r_D(D)}{N\varepsilon_D}\frac{1-x}{D_i(1-m)}<0 \qquad \text{(3A.2b)}$$

The derivatives show that increases in deposits will increase the probabilities of financial failure. This finding suggests that *the solvency and profitability likelihood will be reduced when deposits increase*. However, like in the short-term cases, these effects seem to depend on market size. Again, the derivatives show that the probabilities of failure will not change by increases in individual deposits when the banking system is not concentrated or when the depositors are sensitive.

We conclude indicating that the viability, solvency and profitability likelihood of regulated intermediaries seems to decrease when individual deposits increase. However, the magnitude of these behavioural-risk effects seems to be inversely related to the intermediaries' number and the deposit-supply elasticity. Therefore, it seems *that market size and the likelihood of the asset transformation process for regulated intermediaries are directly related when reserve-ratio controls apply*.

Control-risk effects with reserve-ratio controls

Here we analyse how reserve-ratio controls affect the probabilities associated to the inter-temporal risks through variations in the probabilistic ranges that define the viability, solvency and profitability of the asset transformation process.

The short-term control-risk derivatives are the following:

$$\frac{d}{dm}\left[x_h(D_i)-0\right]=\frac{d}{dm}x_h(D_i)=\frac{y_F-1}{r_D(D)-1}>0 \tag{3A.3a}$$

$$\frac{d}{dm}\left[x_M(D_i)-x_h(D_i)\right]=-\frac{y_F-r_D(D)}{r_D(D)-1}<0 \tag{3A.3b}$$

$$\frac{d}{dm}\left[x_l(D_i)-x_M(D_i)\right]=-\frac{y_F-r_D(D)}{y_F c_l-r_D(D)}<0 \tag{3A.3c}$$

$$\frac{d}{dm}\left[1-x_l(D_i)\right]=-\frac{y_F(c_l-1)}{y_F c_l-r_D(D)}<0 \tag{3A.3d}$$

The derivatives show that restrictive reserve-ratio controls will reduce the probabilities of managing liquidity surpluses and shortages. This finding suggests that *the viability of the asset transformation process will be reduced when compulsory reserve-ratios are restrictive*. Interestingly, the likelihood of early termination due to liquidity shortages seems to be reduced. These findings imply that regulators should consider the existence of trade-offs between the avoidance of shortage problems and the overall viability of the asset transformation process.

The long-term control-risk derivatives are the following:

$$\frac{d}{dm}\left[y_F-y^*_{Li}(x,D_i)\right]=\frac{r_D(D)(1-x)(c_l-1)}{(1-m-c_l(x-m))^2}>0 \tag{3A.4a}$$

$$\frac{d}{dm}\left[y_F-y^*_{Hi}(x,D_i)\right]=-\frac{(r_D(D)-1)(1-x)}{(1-m)^2}<0 \tag{3A.4b}$$

Interestingly, the derivatives show that increases in controlled reserve-ratios will have mixed effects. Only for the case of liquidity shortages, such increases will reduce the probabilities of financial failure.

The above finding confirms the existence of an inter-temporal trade-off from the regulators' perspective. Restrictive reserve-ratio controls can reduce at a cost the

likelihood of financial fragility due to liquidity shortages. This cost will be the reduction of the likelihood of the overall viability of the asset transformation process and the reduction of the solvency and profitability likelihood in case of liquidity surpluses.

3.B. Behavioural and control effects on the deposit-return control model

In this section we analyse the behavioural-risk effects associated to changes in individual reserves and the control-risk effects associated to changes in deposit-returns. Then we sign them, whenever possible, to evaluate the risk effects on the deposit-return control model. Particularly, we write these derivatives in terms of the deposit-supply elasticity to analyse how market structure influences banking management goals.

Behavioural-risk effects with deposit-return controls

Here we analyse how reserves affect the probabilities associated to the inter-temporal risks through variations in the probabilistic ranges that define the viability, solvency and profitability of the asset transformation process.

The short-term behavioural-risk derivatives are the following:

$$\frac{d}{dM_i}\left[x_h(M_i)-0\right]=\frac{d}{dM_i}x_h(M_i)=-\frac{y_F-1}{D_i(\bar{r}_D)\left[1-\bar{r}_D\right]}>0 \qquad \text{(3A.5a)}$$

$$\frac{d}{dM_i}\left[x_M(M_i)-x_h(M_i)\right]=\frac{y_F-\bar{r}_D}{D_i(\bar{r}_D)\left[1-\bar{r}_D\right]}<0 \qquad \text{(3A.5b)}$$

$$\frac{d}{dM_i}\left[x_l(M_i)-x_M(M_i)\right]=-\frac{y_F-\bar{r}_D}{D_i(\bar{r}_D)\left[y_F c_l-\bar{r}_D\right]}<0 \qquad \text{(3A.5c)}$$

$$\frac{d}{dM_i}\left[1-x_l(M_i)\right]=-\frac{d}{dM_i}x_l(M_i)=\frac{y_F(1-c_l)}{D_i(\bar{r}_D)\left[y_F c_l-\bar{r}_D\right]}<0 \qquad \text{(3A.5d)}$$

The derivatives show that increases in reserves will reduce the probabilities of managing liquidity surpluses and shortages. This finding suggests that *the viability of the asset transformation process will be reduced when reserves increase*. However, the likelihood of early termination due to liquidity shortages seems to be reduced. Interestingly, it seems that banking firms face a dilemma similar to the one faced by regulators in the control model developed before: They should face a trade-off

between the avoidance of financial distress due to liquidity shortages and the overall viability of the asset transformation process.

The long-term behavioural-risk derivatives are the following:

$$\frac{d}{dM_i}\left[y_F - y^*_{Li}(x, M_i)\right] = -\frac{(1-c_l)(1-x)D_i(\bar{r}_D)\bar{r}_D}{\left[D_i(\bar{r}_D) - M_i - c_l\left[\tilde{x}D_i(\bar{r}_D) - M_i\right]\right]^2} > 0 \qquad \text{(3A.6a)}$$

$$\frac{d}{dM_i}\left[y_F - y^*_{Hi}(x, M_i)\right] = -\frac{(1-x)\left[\bar{r}_D - 1\right]}{\left[D_i(\bar{r}_D) - M_i\right]^2} D_i < 0 \qquad \text{(3A.6b)}$$

Again, the derivatives show that increases in reserves will have mixed effects. Only for the case of liquidity shortages, such increases will reduce the probabilities of financial failure. This behavioural-risk effect is similar to the one associated to regulators' decision in the reserve-ratio control model.

Control-risk effects with deposit-return controls

Here we analyse how deposit-return controls affect the probabilities associated to the inter-temporal risks through variations in the probabilistic ranges that define the viability, solvency and profitability of the asset transformation process.

The short-term control-risk effect derivatives are the following:

$$\frac{d}{d\bar{r}_D}\left[x_h(M_i) - 0\right] = -\frac{y_F - 1}{D_i(\bar{r}_D)} \frac{(\bar{r}_D - 1)N\varepsilon_D M_i - \bar{r}_D\left(D_i(\bar{r}_D) - M_i\right)}{\bar{r}_D(\bar{r}_D - 1)^2} \qquad \text{(3A.7a)}$$

$$\frac{d}{d\bar{r}_D}\left[x_M(M_i) - x_h(M_i)\right] = \frac{1}{D_i(\bar{r}_D)} \frac{(y_F - \bar{r}_D)(\bar{r}_D - 1)N\varepsilon_D M_i - \bar{r}_D(y_F - 1)\left(D_i(\bar{r}_D) - M_i\right)}{\bar{r}_D(\bar{r}_D - 1)^2} \qquad \text{(3A.7b)}$$

$$\frac{d}{d\bar{r}_D}\left[x_l(M_i) - x_M(M_i)\right] = \frac{1}{D_i(\bar{r}_D)} \frac{(y_F - \bar{r}_D)(y_F c_l - \bar{r}_D)N\varepsilon_D M_i - \bar{r}_D y_F(c_l - 1)\left(D_i(\bar{r}_D) - M_i\right)}{r_D(y_F c_l - \bar{r}_D)^2} \qquad \text{(3A.7c)}$$

$$\frac{d}{d\bar{r}_D}\left[1 - x_l(M_i)\right] = \frac{y_F(c_l - 1)}{D_i(\bar{r}_D)} \frac{(y_F c_l - \bar{r}_D)N\varepsilon_D M_i + \bar{r}_D\left(D_i(\bar{r}_D) - M_i\right)}{\bar{r}_D(y_F c_l - \bar{r}_D)^2} > 0 \qquad \text{(3A.7d)}$$

The derivatives show that increases in the deposit-return controls will increase the probabilities of financial failure due to liquidity shortages. This finding suggests that *the likelihood of short-term fragility due to shortages will be reduced when deposit*

ceilings are less restrictive.[9] Regarding the other derivatives, it is clear that the viability of the asset transformation process directly relates to the intermediaries' number and the deposit-supply elasticity. Therefore, it seems *that increases in the deposit-return controls may increase the viability of the asset transformation process when the size of the deposit market is relatively big.* [10]

The long-term control-risk derivatives are the following:

$$\frac{d}{d\bar{r}_D}\left[y_F - y^*_{Li}(x, M_i)\right] = -(1-x)D_i(\bar{r}_D)\frac{(c_l - 1)N\varepsilon_D M_i + D_i(\bar{r}_D) - M_i - c_l\left(xD_i(\bar{r}_D) - M_i\right)}{\left[D_i(\bar{r}_D) - M_i - c_l\left(xD_i(\bar{r}_D) - M_i\right)\right]^2} < 0 \qquad \text{(3A.8a)}$$

$$\frac{d}{d\bar{r}_D}\left[y_F - y^*_{Hi}(x, M_i)\right] = (1-x)D_i(\bar{r}_D)\frac{(\bar{r}_D - 1)N\varepsilon_D M_i - \left(D_i(\bar{r}_D) - M_i\right)}{\bar{r}_D\left[D_i(\bar{r}_D) - M_i\right]^2} \qquad \text{(3A.8b)}$$

Once more, the derivatives show that control-risk effects will depend on market structure. Only for the case of liquidity shortages, increases in deposit-return controls will clearly reduce the probabilities of financial failure. Increases in deposit-return controls may reduce the probabilities of failure in case of surpluses only if the size of the deposit market is small enough. [11]

We conclude by indicating that the behavioural and control-risk qualitative effects, for both models, are summarised in Table 5.3 in the text.

[9] Deposit-return ceilings apply when they the regulated ceiling is below the non-regulated one. They are less restrictive the higher they are. Notice that intermediaries do not have incentives to pay high deposit-returns.

[10] Analytically, this implies that the sign of the control-risk derivative 3A.7a is negative and that the ones of 3A.7b and 3A.7c are positive. Assuming that the size of the market is relatively small, these signs may change. In the latter case, the analysis will be identical to the one done for the behavioural-risk derivatives 3A.1a-3A.1d.

[11] Assuming that the size of the market is small enough, 3A.8b will be negative. This will confirm our previous indication regarding the qualitative similarities between the control-risk derivatives in this model and the behavioural-risk ones in the model with deposit-return controls.

4. Appendix for Chapter 6

In this appendix we provide details regarding the statistical tests associated to the econometric study. Specifically, we include statistical tests to assess the robustness and functional form specification for all the regression models. The inclusion of these tests is necessary due to the absence of an econometric selection criterion to model the regression sets.[12]

The specific robustness tests are based on the Gauss-Hermite sensitivity indicators[13] and the functional form diagnostic one is based on the Ramsey's RESET test.[14] Thus, the tests are regression-based ones.

The appendix is divided in four sections. The former three sections include the regression-based tests associated to the financial structure, financial development, financial structure and development specifications, respectively. The fourth section

[12] As indicated in the main text, our assessment approach assumes linear modelling specifications. Evidently our study can be criticised under these grounds. However, it is interesting to mention that discussions around the econometric modelling procedure are rarely, if ever, included in academic papers. Interestingly, none of the applied papers indicated in this chapter concerns with regression stability or functional form specification diagnostics.

[13] The Gauss-Hermite sensitivity indicators are used to check the quadrature approximation used in random-effects estimators. Basically, the G-H indicators are re-estimations of the analysed regression model (and, particularly, the maximum likelihood estimator). The important feature of such re-estimations is that they use, as starting point, the converged solution. Such re-estimations are evaluated for different numbers of quadrature points for comparative purposes. As a rule of thumb, if the re-estimations show appreciable changes – greater than a relative difference of 0.01 with respect the reference estimation- the realibalility of the reference estimation, and the robustness of the results, may questioned. A more restrictive criterion indicates that if the fitted quadrature coefficients do not change by more than a relative difference of 0.0001, the choice of quadrature does not significantly affect the outcome and the econometric results may be robust [See Stata help on commands]. Evidently, the usage of G-H estimators can be criticised on the grounds of the relatively ad hoc comparison criteria. Furthermore, they can be criticised on the grounds that the numerical techniques cannot distinguish between local and global maximum points.
Here we include for each regression two re-estimations. We indicate the absolute and relative differences of each re-estimation with respect to the fitted model. Moreover, we include the sum of squared relative differences.

[14] The Ramsey´s RESET test detects specification errors by analysing regressions that include auxiliary regression variables. Under this test, such variables are the higher order powers of the predicted values from the original regressions. The variables are assumed to be proxy of unknown omitted variables.
Methodologically, the for each regression included in the main text is conducted as follows:

a) First we regress the dependent variable on the independent ones. Then we obtain the fitted values of the dependent variable $\hat{y}$.
b) Latter we re-run the regression, including $\hat{y}^2$ and $\hat{y}^3$ as additional variables.
c) Finally, we test for the joint significance of the coefficients associated to such variables. The null hypothesis of no specification error is rejected if the additional variables have significant explanatory power.

includes the regression-based tests associated to the banking market structure and fragility hypotheses.

4.A. Tests for the financial structure specification models

Here we include the tests for the regressions in the financial structure set [Table 6.8 in main text]. These tests are developed to support the conclusions regarding the relationship between financial structure and banking fragility.

The robustness outcome assessments are summarised in the following table:

Table 4A.1 Robustness Tests on the Financial Structure Specification (Gauss-Hermite Sensitivity Indicators for Main Models)

/Model	Aggregate	Activity	Size	Efficiency
Fitted Quadrature (12 points)				
Log Likelihood	-14.22	-16.02	-17.41	-16.92
Comparison Quadrature (8 points)				
Log Likelihood	-13.97	-14.58	-17.42	-16.97
Difference	0.2506	1.4357	-0.0138	-0.0536
Relative Diff.	-0.0176	-0.0896	0.0007	0.0031
Comparison Quadrature (16 points)				
Log Likelihood	-14.52	-16.14	-17.51	-16.88
Difference	-0.2963	-0.1288	-0.1030	0.0355
Relative Diff.	0.0208	0.0080	0.0059	-0.0021
Sum of Squared Relative Diff.	0.0007	0.0080	0.0000	0.0000
Notes: The likelihood is computed using the Gauss-Hermite quadrature. The default number of points to use in the G-H quadrature for the models included in the main text is 12.				

The functional form assessment outcomes are summarised in the following table:

Table 4A.2 Specification Tests on the Financial Structure Specification (Ramsey's RESET Tests for Main Models)

/Model	Aggregate	Activity	Size	Efficiency
Regression Indicators				
Banking Aggregate	0.98 (.)	1.73 (.)	309.94 (0.000)	0.48 (0.342)
Structure Aggregate	0.01 (.)	-	-	-
Structure Activity	-	-0.20 (-0.245)	-	-
Structure Size	-	-	583.72 (.)	-
Structure Efficiency	-	-	-	-0.21 (-0.380)
$\hat{Y}^2$	0.02 (0.376)	-0.30 (.)	-63.57 (0.000)	-0.05 (-0.164)
$\hat{Y}^3$	0.01 (1.464)	0.16 (1.302)	27.51 (0.000)	0.09 (0.839)
Constant	-0.35 (.)	0.39 (0.130)	-22.68 (.)	-1.20 (-0.314)
Observations	32	36	34	37
LR-CHI2	12.91***	14.82***	26.77***	11.51**
Prob > chi2	0.0016	0.0006	0.0000	0.0214
Log Likelihood	-13.48	-14.15	-7.50	-16.00
σ_u	2.19	4.63	1096.71	1.86
ρ	0.82	0.95	0.99	0.77
CHI2 (Ho: ρ=0)	4.58**	6.47**	20.57***	3.36*
Prob > chi2	0.0324	0.0110	0.0000	0.0668
Specification Likelihood Ratio Test				
LR-CHI2 (Ho: $\hat{Y}^2$= $\hat{Y}^3$=0)	1.49	3.72	19.80***	1.83

Notes: The dependent variable is the banking crisis dummy. The auxiliary regression variables are the higher order powers of the predicted probability values from each original regression model. The null hypothesis of no specification error is rejected if the extra variables have significant additional explanatory power. The z statistics are given in parenthesis and are based on IRLS variance estimators. One, two and three asterisks indicate significance levels of 10, 5 and 1 percent respectively.

The tests suggest that the aggregate and the efficiency models are the best ones for econometric modelling. According to the robustness results, the less robust model is the activity one [See Table 4A.1]. Moreover, Table 4A.2 offers evidence that the null of no incorrect omission is rejected only for the size model. Interestingly, the proportion of the total variance ρ, is significantly close to one in all the latter cases. This finding supports the adequacy of the random effects. Thus, we can conclude that the tests supports the conclusion, contained in the main text, that the evidence provides mixed evidence supporting the market-based and the service-based views, rejecting the bank-based one.

4.B. Tests for the financial development specification models

Here we include the tests for the regressions in the financial development set [Table 6.9 in main text]. These tests are developed to support the conclusions regarding the relationship between financial development and banking fragility.

The robustness outcome assessments are summarised in the following table:

Table 4A.3 Robustness Tests on the Financial Development Specification (Gauss-Hermite Sensitivity Indicators for Main Models)

/Model	Aggregate	Activity	Size	Efficiency
Fitted Quadrature (12 points)				
Log Likelihood	-15.88	-16.31	-17.30	-16.86
Comparison Quadrature (8 points)				
Log Likelihood	-15.86	-16.30	-17.24	-13.90
Difference	0.0219	0.0062	0.0587	2.9648
Relative Diff.	-0.0013	-0.0003	-0.0033	-0.1757
Comparison Quadrature (16 points)				
Log Likelihood	-15.85	-15.69	-17.30	-16.97
Difference	0.0301	0.6154	-0.0024	-0.1063
Relative Diff.	-0.0018	-0.0377	0.0001	0.0063
Sum of Squared Relative Diff.	0.0000	0.0014	0.0000	0.0309
Notes: The likelihood is computed using the Gauss-Hermite quadrature. The default number of points to use in the G-H quadrature for the models included in the main text is 12.				

The functional form assessment outcomes are summarised in the following table:

Table 4A.4 Specification Tests on the Financial Development Specification (Ramsey's RESET Tests for Main Models)

/Model	Aggregate	Activity	Size	Efficiency
Regression Indicators				
Banking Aggregate	0.74 (0.992)	0.57 (0.713)	-0.60 (-0.255)	0.52 (0.539)
Finance Aggregate	2.16* (1.773)	-	-	-
Finance Activity	-	0.14 (0.257)	-	-
Finance Size	-	-	12.87* (1.858)	-
Finance Efficiency	-	-	-	0.39 (0.745)
$\hat{Y}^2$	-0.70 (-1.465)	0.25 (0.696)	-11.98** (-1.973)	-0.99** (-1.970)
$\hat{Y}^3$	0.25 (1.489)	0.23 (0.878)	4.38* (1.846)	0.20* (1.808)
Constant	3.86* (1.817)	0.49 (0.170)	56.37* (1.881)	2.85* (1.685)
Observations	32	36	34	37
LR-CHI2	16.74***	12.68**	32.71***	18.13***
Prob > chi2	0.0022	0.0129	0.0000	0.0012
Log Likelihood	-11.56	-15.22	-4.53	-12.69
σ_u	0.00	0.00	0.00	1.20
ρ	0.00	0.00	0.00	0.59
CHI2 (Ho: ρ=0)	0.00	0.00	0.00	0.46
Prob > chi2	0.9997	0.9991	0.9996	0.4959
Specification Likelihood Ratio Test				
LR-CHI2 (Ho: $\hat{Y}^2$= $\hat{Y}^3$=0)	8.65**	2.17	25.53***	8.35**
Notes: The dependent variable is the banking crisis dummy. The auxiliary regression variables are the higher order powers of the predicted probability values from each original regression model. The null hypothesis of no specification error is rejected if the extra variables have significant additional explanatory power. The z statistics are given in parenthesis and are based on IRLS variance estimators. One, two and three asterisks indicate significance levels of 10, 5 and 1 percent respectively.				

The tests suggest that the activity model is the best one for econometric modelling. According to the robustness results, the less robust model is the efficiency one [See Table 4A.3]. Moreover, Table 4A.4 offers evidence that the former activity model does not require additional explanatory variables. Thus, we can conclude that the tests support the conclusion that financial development encourages financial stability.

4.C. Tests for the financial structure and development specification models

Here we include the tests for the regressions in the financial structure and development set [Table 6.10 in the main text]. These tests are developed to support the conclusions regarding banking fragility.

The robustness outcome assessments are summarised in the following table:

Table 4A.5 Robustness Tests on the Financial Structure and Development Specification
(Gauss-Hermite Sensitivity Indicators for Main Models)

/Model	Aggregate	Activity	Size	Efficiency
Fitted Quadrature (12 points)				
Log Likelihood	-15.44	-15.85	-16.88	-14.92
Comparison Quadrature (8 points)				
Log Likelihood	-15.33	-14.78	-16.87	-14.70
Difference	0.1045	1.0641	0.0022	0.2198
Relative Diff.	-0.0067	-0.0671	-0.0001	-0.0147
Comparison Quadrature (16 points)				
Log Likelihood	-15.26	-15.98	-16.88	-15.20
Difference	0.1706	-0.1267	-0.0021	-0.2793
Relative Diff.	-0.0110	0.0079	0.0001	0.0187
Sum of Squared Relative Diff.	0.0001	0.0045	0.0000	0.0005
Notes: The likelihood is computed using the Gauss-Hermite quadrature. The default number of points to use in the G-H quadrature for the models included in the main text is 12.				

The functional form assessment outcomes are summarised in the following table:

Table 4A.6 Specification Tests on the Financial Structure and Development Specification
(Ramsey's RESET Tests for Main Models)

/Model	Aggregate	Activity	Size	Efficiency
Regression Indicators				
Banking Aggregate	1.62 (0.971)	0.83 (0.536)	1.02 (1.102)	451.53 (0.000)
Structure Aggregate	1.29 (0.908)	-	-	-
Structure Activity	-	-0.03 (-0.035)	-	-
Structure Size	-	-	0.20 (0.127)	-
Structure Efficiency	-	-	-	269.87 (0.000)
Finance Aggregate	-0.90 (-0.668)	-	-	-
Finance Activity	-	0.05 (0.072)	-	-
Finance Size	-	-	2.94** (1.983)	-
Finance Efficiency	-	-	-	-230.11 (0.000)
$\hat{Y}^2$	0.10 (0.185)	-0.13 (-0.476)	-1.17 (-1.375)	3.56 (0.000)
$\hat{Y}^3$	0.55 (1.607)	0.12 (1.027)	0.89 (1.551)	1.74 (0.000)
Constant	-1.09 (-0.697)	1.02 (0.305)	11.63** (1.959)	1679.50 (.)
Observations	32	36	34	37
LR-CHI2	13.06**	14.08**	17.53***	26.66***
Prob > chi2	0.0228	0.0151	0.0036	0.0001
Log Likelihood	-13.40	-14.52	-12.12	-8.42
σ_u	3.30	2.03	0.00	264.19
ρ	0.91	0.80	0.00	0.99
CHI2 (Ho: ρ=0)	2.75*	2.20	0.00	14.65***
Prob > chi2	0.0973	0.1376	0.9991	0.0001
Specification Likelihood Ratio Test				
LR-CHI2 (Ho: $\hat{Y}^2$= $\hat{Y}^3$=0)	4.07	2.64	9.50***	12.99***
Notes: The dependent variable is the banking crisis dummy. The auxiliary regression variables are the higher order powers of the predicted probability values from each original regression model. The null hypothesis of no specification error is rejected if the extra variables have significant additional explanatory power. The z statistics are given in parenthesis and are based on IRLS variance estimators. One, two and three asterisks indicate significance levels of 10, 5 and 1 percent respectively.				

According to the robustness results, all the models are almost stable. Among them, the less robust model is the activity one [See Table 4A.5]. Table 4A.6 offers evidence that the null of no incorrect omission is rejected for the size and efficiency models. This fact justifies why we indicate that the evidence seems to reject the bank-based view,

instead of indicating that it seems to give slight support the market-based one [See Subsection 6.5.1].

4.D. Tests for the banking market structure and fragility models

Here we include the tests for the regressions that focus on market structure [Table 6.11 in the main text]. These tests are developed to support the conclusions regarding the relationship between market structure and banking fragility.

The robustness outcome assessments are summarised in the following table:

Table 4A.7 Robustness Tests on the Market Structure Models
(Gauss-Hermite Sensitivity Indicators for Main Models)

/Model	Aggregate	Concentration	Domestic	Public
Fitted Quadrature (12 points)				
Log Likelihood	-15.44	-125.05	-105.12	-17.13
Comparison Quadrature (8 points)				
Log Likelihood	-15.33	-124.26	-104.66	-17.13
Difference	0.1045	0.7962	0.4505	0.0000
Relative Diff.	-0.0067	-0.0063	-0.0042	0.0000
Comparison Quadrature (16 points)				
Log Likelihood	-15.26	-125.89	-105.39	-17.13
Difference	0.1706	-0.8387	-0.2791	0.0000
Relative Diff.	-0.0110	0.0067	0.0026	0.0000
Sum of Squared Relative Diff.	0.0001	0.0000	0.0000	0.0000
Notes: The likelihood is computed using the Gauss-Hermite quadrature. The default number of points to use in the G-H quadrature for the models included in the main text is 12.				

The functional form assessment outcomes are summarised in the following table:

Table 4A.8 Specification Tests on the Market Structure Models (Ramsey's RESET Tests for Main Models)

/Model	Aggregate	Concentration	Domestic	Public
Regression Indicators				
Structure Aggregate	1.29 (0.908)	-0.44 (-1.600)	-0.75** (-2.347)	0.11 (0.218)
Finance Aggregate	-0.90 (-0.668)	-0.22 (-0.728)	-1.05** (-2.476)	-0.02 (-0.031)
Banking Aggregate	1.629436 (0.971)	-	-	-
Banking Concentration	-	-1.91* (-1.677)	-	-
Banking Domestic	-	-	8.55** (2.547)	-
Banking Public	-	-	-	1.00 (1.053)
$\hat{y}^2$	0.10 (0.185)	-0.03 (-0.327)	-0.12 (-0.432)	0.87 (1.247)
$\hat{y}^3$	0.55 (1.607)	0.01 (0.353)	-0.15* (-1.690)	0.49 (1.353)
Constant	-1.09 (-0.697)	-2.16* (-1.989)	-0.71 (-1.505)	-0.03 (-0.031)
Observations	32	261	220	35
LR-CHI2	13.06**	13.96**	19.40***	12.73**
Prob > chi2	0.0228	0.0158	0.0016	0.0260
Log Likelihood	-13.40	-124.89	-102.54	-15.24
σ_u	3.30	3.51	3.34	0.00
ρ	0.91	0.92	0.91	0.00
CHI2 (Ho: ρ=0)	2.75*	59.47***	50.08***	0.00
Prob > chi2	0.0973	0.0000	0.0000	0.9987
Specification Likelihood Ratio Test				
LR-CHI2 (Ho: $\hat{Y}^2 = \hat{Y}^3 = 0$)	4.07	0.32	5.15*	3.78

Notes: The dependent variable is the banking crisis dummy. The auxiliary regression variables are the higher order powers of the predicted probability values from each original regression model. The null hypothesis of no specification error is rejected if the extra variables have significant additional explanatory power. The z statistics are given in parenthesis and are based on IRLS variance estimators. One, two and three asterisks indicate significance levels of 10, 5 and 1 percent respectively.

The tests suggest that the concentration model is the best one for econometric modelling. Econometrically, the regressions seem to be stable [See Table 4A.7]. Interestingly, Table 4A.6 shows that the null of no incorrect omission is rejected only for the domestic model. Moreover, the proportion of the total variance ρ is significantly close to one in most cases. Thus, the statistical tests seem to support the adequacy of the concentration model to explain the competition and fragility nexus.

REFERENCES

Almazan, Andres. (2002) "A model of competition in banking: Bank capital vs. expertise" *Journal of Financial Intermediation,* 11(1), 87-121

Allen, Franklin (2001) "Financial structure and financial crisis" *International Review of Finance*, 2(1/2), 1-19

Allen, Franklin and Gale, Douglas (2003) "Competition and financial stability" Philadelphia, University of Pennsylvania-The Wharton Financial Institutions Center, *Working Paper 03-26*

- (2001) "Comparative financial systems: A survey" Philadelphia, University of Pennsylvania-The Wharton Financial Institutions Center, *Working Paper 01-15*

- (2000a) *Comparing Financial Systems*, Cambridge, United States, MIT Press

- (2000b) "Financial contagion" *Journal of Political Economy*, 108 (1), 1-33

- (1997) "Financial markets, intermediaries and intertemporal smoothing" *Journal of Political Economy*, 105(3), 523-546

Allen, Franklin, et al. (1991) "Financial structure: An international perspective" *Brooking Papers on Economic Activity,* 1991(1), 257-310

Allen, Franklin and Santomero, Anthony M. (2001) "What do intermediaries do?" *Journal of Banking and Finance,* 25(2), 271-294

- (1997) "The theory of financial intermediation" *Journal of Banking and Finance,* 21(11-12), 1461-1485

Altunbas, Yener, Evans, Lynne and Molyneux, Philip (2001) "Bank ownership and efficiency" *Journal of Money, Credit and Banking*, 33(4), 926-954

Altunbas, Yener, et al. (2001) "Efficiency in European banking" *European Economic Review*, 45(10), 1931-1955

Amieva Huerta, Juan and Urriza, Bernardo (2000) C*risis Bancarias: Causas, Costos, Duración, Efectos y Opciones de Política*, Santiago, Chile, CEPAL, Serie Politica fiscal 108

Anderson, Ronald W. and Danthine, Jean-Pierre (1981) "Cross hedging" *Journal of Political Economy,* 89(6), 1189-1196

Barnes, Paul (1987) "The analysis and use of financial ratios: A review article" *Journal of Business Finance and Accounting*, 14(4), 449-461

Barro, Robert J. and Sala-i-Martin Xavier (1995), *Economic Growth*, New York, United States, McGraw-Hill

Barth, James R., Caprio, Gerard and Levine, Ross (2001a) "The regulation and supervision of banks around the world: A new database" Washington, World Bank, *Policy Research Paper 2588*

- (2001b) "Bank regulation and supervision: What works best?" Washington, World Bank, *Policy Research Paper 2765*

- (1999) "Financial regulation and performance: Cross-country evidence" Washington, World Bank, *Policy Research Paper 2037*

Barth, James R., Nolle, Daniel E. and Rice, Tara N. (1997) "Commercial banking structure, regulation and performance: An international comparison" Washington, Comptroller of the Currency, *Comptroller of the Currency Economics Working Paper 97-6*

Bartholomew, David J., et al. (2002) *The Analysis and Interpretation of Multivariate Data for Social Scientists*, Boca Raton, United States, Chapman & Hall/CRC

Beck, Thorstein, Demirguc-Kunt, Asli and Levine, Ross (2003) "Bank concentration and crises" Massachusetts, National Bureau of Economic Research, *NBER Working Paper 9921*

- (2000) "A new database on the structure and development of the financial sector" *The World Bank Economic Review*, 14(3), 597-605

Beck, Thorstein and Levine, Ross (2003) "Legal institutions and financial development" Massachusetts, National Bureau of Economic Research, *NBER Working Paper 10126*

Benston, George J. and Kaufman, George G. (1996) "The appropriate role of bank regulation" *Economic Journal,* 106(436), 688-697

Berger, Allen N. et al. (2004), "Bank concentration and competition: An evolution in the making" *Journal of Money, Credit and Banking,* 36(3), 433-451

Bernanke, Ben and Getler, Mark (1990) "Financial fragility and economic performance" *Quarterly Journal of Economics*, 105(1), 87-114

Bessis, Joel (2002), *Risk Management in Banking*, 2nd ed., Chichester, United Kingdom, John Wiley & Sons

Bhattacharya, Sudipto and Thakor, Anjan V. (1993) "Contemporary banking theory" *Journal of Financial Intermediation,* 3(1), 2-50

Bongini, Paola, Laeven, Luc and Majnoni, Giovanni (2001), "How good is the market at assessing bank fragility? A horse race between different indicators", Document prepared for the joint Bank of England, UK Financial Services Authority, US Federal Reserve Board of Governors, New York Federal

Reserve Bank and the US Office for the Comptroller of the Currency Conference on Banks and Systemic Risk, May 23-25, 2001(London)

Bossone, Biagio (2001) "Do banks have a future? A study on banking and finance as we move into the third millennium" *Journal of Banking and Finance,* 25(12), 2239-2276

Bougheas, Spiros (1999) "Contagious bank runs" *International Review of Economics and Finance*, 8(2), 131-146

Breuer, Janice B. (2004), "An exegesis on currency and banking crises" *Journal of Economic Reviews,* 18(3), 293-320

Bryant, John (1980) "A model of reserves, bank runs, and deposit insurance" *Journal of Banking and Finance*, 4(4), 335-344

Calomiris, Charles W. (1989) "Deposit insurance: Lessons for the record" *Federal Reserve Bank of Chicago Economic Perspectives*, 13(3), 10-30

Calomiris, Charles W. and Gorton, Gary (1991) "The origins of banking panics, models, facts and bank regulation" in G. Hubbard, ed., *Financial Markets and Financial Crises*, (University of Chicago Press, Chicago, IL), 109-173

Caminal Ramon and Matutes, Carmen (2002) "Market power and banking failures" *International Journal of Industrial Organisation*, 20(9), 1341-1361

Canoy, Marcel et. al. (2001) "Competition and stability in banking" The Hague-Netherlands, CPB Netherlands Bureau for Economic Policy Analysis, *CPB Document 15*

Caprio, Gerard and Klingebiel, Daniela (2002) "Episodes of systemic and borderline financial crises" *World Bank Research Domestic Finance Data Sets*, [Online], (July 2002)

- (1996a) “Bank insolvencies: Cross-country evidence” Washington, World Bank, *Policy Research Paper 1620*

- (1996b), “Bank insolvency: Bad luck, bad policy or bad banking?”, Document prepared for the Annual Bank Conference on Development Economics, April 25-26, 1996 (World Bank)

Carletti Elena and Hartmann, Philip (2002) “Competition and stability: What’s special about banking” Frankfurt, European Central Bank, *ECB Working Paper 146*

Claessens, Stijn, Demirguc-Kunt, Asli and Huizinga, Harry (2001) “How does foreign entry affect domestic banking markets?” *Journal of Banking and Finance*, 25(5), 891-911

Claessens, Stijn and Klapper, Leora F. (2002) “Bankruptcy around the world: Explanations of its relative use” Washington, World Bank, *Policy Research Paper 2865*

Claessens, Stijn and Klingebiel, Daniela (2001) “Competition and scope of activities in financial services” *The World Bank Research Observer*, 16(1), 19-40

Cordella, Tito and Yeyati, Eduardo L. (2002) “Financial opening, deposit insurance, and risk in a model of banking competition” *European Economic Review*, 46(3), 471-485.

Corsetti, Giancarlo, Pesenti, Paolo and Roubini, Nouriel (1999) “Paper tigers? A model of the Asian crisis” *European Economic Review*, 43 (7), 1211-1236

Chamberlain, Gary (1980) “Analysis of covariance with qualitative data” *Review of Economic Studies,* 47(1), 225-238

Chari**,** V.V. and Jagannathan, Ravi (1988) “Banking panics, information and rational expectations” *Journal of Finance,* 43 (3), 749-760

Chiang, Alpha C.**,** (1984), *Fundamental Methods of Mathematical Economics*, 3rd ed., Singapore, Singapore, McGraw-Hill

Cho, Yoon J. (1986) "Inefficiencies from financial liberalisation in the absence of well-functioning equity markets" *Journal of Money, Credit and Banking,* 48(2), 191-199

Chumacero, Romulo E. and Langoni, Patricia S. (2001) "Riesgo, tamaño y concentración en el sistema bancario chileno" *Economia Chilena,* 4(1), 25-34

De Palma**,** A. and Gary-Bobo, R. (1996) "Coordination failures in the Cournot approach to deregulated bank competition" University of Paris, Cergy-Pontoise, *Mimeo*

Demirguc-Kunt, Asli (1989) "Deposit-institution failures: A review of the empirical literature" *Economic Review-Federal Reserve Bank of Cleveland,* 25(4), 2-18

Demirguc-Kunt, Asli and Detragiache, Enrica (2000) "Monitoring banking sector fragility: A multivariate logit approach" *The World Bank Economic Review*, 14(2), 287-307

- (1999) "Does deposit insurance increase banking sector stability? An empirical investigation" Washington, World Bank, *WP Working Paper 2247*

- (1998a) "The determinants of banking crises in developing and developed countries" *IMF Staff Papers*, 45(1), 81-109

- (1998b) "Financial liberalisation and financial fragility" Document prepared for the Annual World Bank Conference on Development Economics, April 20-21, 1998 (Washington DC)

Demirguc-Kunt, Asli, Detragiache, Enrica and Gupta, Poonam (2000) "Inside the crisis: An empirical analysis of banking systems in distress" Washington, World Bank, *WB Working Paper 2431*

Demirguc-Kunt, Asli and Huizinga, Harry (2000) "Financial structure and bank profitability" Washington, World Bank, *WB Working Paper 2430*

- (1999) "Determinants of commercial bank interest margins and profitability: Some international evidence" *World Bank Economic Review*, 13(2), 379-408

Demirguc-Kunt, Asli, Laeven, Luc and Levine, Ross (2004) "Regulations, market structure, institutions and the cost of financial intermediation" *Journal of Money, Credit and Banking*, 36(3), 593-622

Demirguc-Kunt, Asli and Levine, Ross (1999) "Bank-based and market-based financial systems: Cross country comparisons" Washington, World Bank, *WB Working Paper 2143*

Dermine, Jean (1986) "Deposit rates, credit rate and bank capital: The Klein-Monti model revisited" *Journal of Banking and Finance*, 10(1), 99-114

Diamond, Douglas W. and Dybvig, Philip H. (1983) "Bank runs, deposit insurance, and liquidity" *Journal of Political Economy,* 91(3), 401-419

Di Giorgio, Giorgio (1999) "Financial development and reserve requirements" *Journal of Banking and Finance,* 23(7), 1031-1041

Dornbush, Rudiger**,** Park, Yung Chul and Claessens, Stijn (2000) "Contagion: How it spreads and How it can be stopped", Document prepared for the joint Asian Development Bank, International Monetary Fund, and World Bank Conference on Contagion: How it spreads and how it can be stopped?, on February 3-4, 2000 (Washington DC)

Dowd, Kevin (1996a), *Competition and Finance: A Reinterpretation of Financial and Monetary Economics*, London, United Kingdom, Macmillan

- (1996b) "The case for financial laissez-faire" *Economic Journal* 106(436), 679-687

Draghi, Mario, Giavazzi, Francesco and Merton, Robert C. (2003) "Transparency, risk management and international financial fragility" Massachusetts, National Bureau of Economic Research, *NBER Working Paper 9806*

Duncan, Alan S. (1997) "Lecture Notes on Computing for Economics and Statistics" York, University of York- Department of Economics and Related Studies, Spring Term 1997.

Ederington, Louis H. (1979) "The hedging performance of the new future markets" *Journal of Finance,* 34(1), 157-170

Edwards, Franklin M. and Mishkin, Frederic S. (1995) "The decline of traditional banking: Implications for financial stability and regulatory policy" Massachusetts, National Bureau of Economic Research, *NBER Working Paper 4993*

Eichengreen, Barry, and Rose, Andrew K. (1999) "The empirics of currency and banking crises", *NBER Reporter Online* [Online], 1(4), (winter 1998/99). Available at: URL:http://www.nber.org/reporter/winter99/eichengreen.html [Accessed 2 September 2000]

- (1998) "Staying afloat when the wind shifts: External factors and emerging-market banking crises", London, Centre for Economic Policy and Research, *CEPR Discussion Paper 1828*

Espinosa-Vega, Marco A., and Smith, Bruce D. (2001) "Socially excessive bankruptcy costs and the benefits of interest rate ceilings on loans", Atlanta, Federal Reserve Bank of Atlanta, *Working Paper 2001-27*

Farmer, Roger E. A. (1984) "New theory of aggregate supply" *American Economic Review*, 74(5), 920-930

Feldstein, Martin (2002) "Economic and financial crises in emerging market economies: Overview of prevention and management" Massachusetts, National Bureau of Economic Research, *NBER Working Paper 8837*

Freixas, Xavier and Rochet, Jean-Charles (1997), *Microeconomics of Banking*, Cambridge, United States, The MIT Press

Freixas, Xavier and Santomero, Anthony M. (2004) "An overall perspective on banking regulation" in S. Bhattacharya, A. Boot and A. Thakor, eds., *Credit Intermediation and the Macroeconomy: Models and Perspectives*, (Oxford University Press, Oxford), 424-448

Friedman, Milton and Schwartz, Anna J. (1971), *A Monetary History of United States 1867-1960*, Princeton, United States, Princeton University Press

Fry, Maxwell J. (1995), *Money, Interest and Banking in Economic Development*, 2ed, Baltimore, United States, The Johns Hopkins University Press

Gertler, Mark (1988) "Financial structure and aggregate economic activity: An overview" *Journal of Money, Credit and Banking*, 20(3), 559-588

Gilbert, R. Alton (1984) "Bank market structure and competition: A survey" *Journal of Money, Credit and Banking*, 16(4), 617-645

Gilbert, R. Alton, Meyer, Andrew P. and Vaughan, Mark D. (2000) "The role of a CAMEL downgrade model in bank surveillance" St. Louis, The Federal Reserve Bank of St. Louis, *Working Paper 2000-021A*

Glick, Reuven and Hutchison, Michael (1999) "Banking and currency crises: How common are twins?" San Francisco, Federal Reserve Bank of San Francisco, *Pacific Basin Working Paper Series 99-07*

Goldsmith, Raymond W. (1969), *Financial Structure and Development*, New Haven, United States, Yale University Press

Goldstein, Morris, Kaminsky, Graciela L. and Reinhart, Carmen M. (2000), *Assessing Financial Vulnerability: An Early Warning System for Emerging Markets*, Washington DC, United States, Institute for International Economics

Gonzalez-Hermosillo, Brenda (1999) "Determinants of ex-ante banking system distress: A macro-micro empirical exploration of some recent episodes" Washington, International Monetary Fund, *IMF Working Paper WP/99/33*

Gonzalez-Hermosillo, Brenda, Pazarbasioglu, Ceyla and Billings, Robert (1997) "Determinants of banking system fragility: A case study of Mexico" *IMF Staff Papers*, 44(3), 295-314

Goodhart, Charles and Illing, Gerard (2002) "Introduction" in Charles Goodhart and Gerhard Illing eds., *Financial Crises, Contagion and the Lender of Last Resort. A Reader*, (Oxford University Press, New York-United States), 1-26

Goodhart, Charles et. al (1998), *Financial Regulation. Why, How and Where Now?,* London, United Kingdom, Routledge

Gorton, Gary (1988) "Banking panics and business cycles" *Oxford Economic Papers*, 40(4), 751-781

Hahm, Joon-Ho and Mishkin, Frederic S. (2000) "The Korean financial crisis: An asymmetric information perspective" *Emerging Markets Review* 1(1), 21-52

Hanson, James A. and De Rezende-Rocha, Roberto (1986) "High interest rates, spreads and the cost of intermediation: Two studies" Washington, World Bank-Industry Department, *Industry and Finance series 18*

Hardy, Daniel C. and Pazarbasioglu, Ceyla (1999) "Determinants and leading indicators of banking crises: Further evidence" *IMF Staff Papers*, 46(3), 247-258

Heffernan, Shelagh A. (2000) “Bank failures” London, City University, *Mimeo*

- (1996) *Modern Banking in Theory and Practice*, Chichester, United Kingdom, John Wiley & Sons Ltd

- (1995) “An econometric model of bank failure” *Journal of Economic and Financial Modelling*, 2(2), 49-83

Hellman, Thomas F., Murdock, Kevin C. and Stiglitz, Joseph E. (2000) “Liberalization, moral hazard in banking and prudential regulation: Are capital requirements enough?” *American Economic Review,* 90(2), 147-165

Honohan, Patrick (1997) “Banking system failures in developing and transition countries: Diagnosis and prediction” Basle, Bank for International Settlements, *BIS Working Paper 39*

Huang, Cliff J. and Crooke, Philip S. (1997), *Mathematics and Mathematica for Economists*, Cornwall, United Kingdom, Blackwell Publishers Ltd

Hunter, William C. and Smith, Stephen D. (2002) “Risk management in the global economy: A review essay” *Journal of Banking and Finance,* 26(2-3), 205-221

Jacklin, Charles J. and Bhattacharya, Sudipto (1988) “Distinguishing panics and information-based bank runs: Welfare and policy implications” *Journal of Political Economy*, 96 (3), 568-592

Jaumandreu, Jordi and Lorences, Joaquin (2002) “Modelling price competition across many markets (An application to the Spanish loans market)” *European Economic Review*, 46 (1), 93-115

Kaminsky, Graciela L. and Reinhart, Carmen M. (1999) “The twin crises: The causes of banking and balance-of-payment problems” *American Economic Review*, 89(3), 473-500

Kaminsky, Graciela L., Lizondo, Saul and Reinhart, Carmen M. (1998) "Leading indicators of currency crises" *IMF Staff Papers*, 5 (1), 1-48

Keeley**,** Michael C. (1990) "Deposit insurance, risk, and market power in banking" *American Economic Review*, 80(5), 1183-1200

Kim, Daesik and Santomero, Anthony M. (1988) "Risk in banking and capital regulation" *Journal of Finance*, 43(5), 1219-1233

Kimball, Ralph C. (2000) "Failures in risk management" *New England Economic Review*, 6(1), 3-12

Kiyotaki, Nobuhiro and Moore, John (1997) "Credit cycles" *Journal of Political Economy*, 105(2), 211-248

Klausner, Michael D. and White, Lawrence H. (1993) "Bank regulatory reform and bank structure" in Michael D. Klausner and Lawrence H. White eds., *Structural Change in Banking*, (New York University Press, New York),

Klein, Michael A. (1971) "A theory of the banking firm" *Journal of Money, Credit and Banking*, 3(2), 205-218

Koskela, Erkki and Stenbacka, Rune (2000) "Is there a trade-off between bank competition and financial fragility?" *Journal of Banking and Finance,* 24(12), 1853-1873

Krugman, Paul (1999) "Balance sheets, the transfer problem, and financial crises" in Peter Isard, Assaf Razin and Andrew K. Rose eds., *International Finance and Financial Crises: Essays in Honor of Robert P. Flood*, (Kluwer Academic Publishers- International Monetary Fund, Norwell, Massachusetts), 31-55

-(1998) "What happened to Asia?" *Chulalongkorn Journal of Economics*, 10(1), 69-87

La Porta, Rafael, Lopez-de-Silanes, Florencio and Vishny, Robert W. (2000) "Investor protection and corporate governance" *Journal of Financial Economics,* 58(1), 3-27

- (1998) "Law and finance" *Journal of Political Economy,* 106(6), 1113-1155

- (1997) "Legal determinants of external finance" *Journal of Finance,* 52(3), 1131-1150

Leland, Hayne E. (1998) "Agency costs, risk management, and capital structure" *Journal of Finance*, 53(4), 1213-1243

-. (1972) "Theory of the firm facing uncertain demand" *American Economic Review*, 62(3), 278-291

Levine, Ross (2002) "Bank-based or market-based financial systems: Which is better?" *Journal of Financial Intermediation*, 11(4), 398-428

- (1997) "Financial development and economic growth: Views and agenda" *Journal of Economic Literature*, 35(2), 688-726

Lloyd-Williams, Michael, Molyneux, Philip and Thorton, John (1994) "Market structure and performance in Spanish banking" *Journal of Banking and Finance,* 18(3), 433-443

Marcus, Alan J. (1984) "Deregulation and bank financial policy" *Journal of Banking and Finance,* 8(4), 557-565

Marion, Nancy P. (1999) "Some parallels between currency and banking crises" in Peter Isard, Assaf Razin and Andrew K. Rose eds., *International Finance and Financial Crises: Essays in Honor of Robert P. Flood*, (Kluwer Academic Publishers- International Monetary Fund, Norwell, Massachusetts), 1-18.

Markowitz, Harry M. (1952) "Portfolio selection" *Journal of Finance*, 7(1), 77-91

Martin, Stephen (1993), *Advanced Industrial Economics*, Massachusetts, United States, Blackwell Publishers

Martinez Peria, Maria S. and Schmukler, Sergio L. (2001) "Do depositors punish banks for bad behaviour? Market discipline, deposit insurance and banking crises" *Journal of Finance,* 56(3), 1029-1051

Mas-Collel, Andreu, Whinston, Michael D. and Green, Jerry R. (1995), *Microeconomic Theory*, New York, United States, Oxford University Press

Matutes, Carmen and Vives, Xavier (2000) "Imperfect competition, risk taking, and regulation in banking" *European Economic Review,* 44(1), 1-34

- (1996) "Competition for deposits, fragility and insurance" *Journal of Financial Intermediation,* 5(2), 184-216

Maudos, Joaquin (2001) "Rentabilidad, estructura de mercado y eficiencia en la banca" *Revista de Economia Aplicada*, 9(25), 193-207

- (1998) "Market structure and performance in Spanish banking using a direct measure of efficiency" *Applied Financial Economics*, 8(2), 191-200

McKenzie, David (2002) "An econometric analysis of IBRD creditworthiness" Washington, World Bank, *WP Working Paper 2822*

Mello, Antonio S. and Parsons, John E. (2000) "Hedging and liquidity" *Review of Financial Studies*, 13(1), 127-153

Merton, Robert C. (1995) "Financial innovation and the management and regulation of financial institutions" Massachusetts, National Bureau of Economic Research, *NBER Working Paper 5096*

Merton, Robert C. and Bodie Z. (1995), "A conceptual framework for analysing the financial environment" in D. B Crane et al. Eds., *The Global Financial System: A Functional Perspective*, (Harvard Business School Press, Boston)

Mishkin, Frederic S. (2000), *The Economics of Money, Banking and Financial Markets*, 6th ed., Boston, United States, Addison Wesley

- (1991) "Asymmetric information and financial crises: A historical perspective" in R. Glenn Hubbard, ed., *Financial Markets and Financial Crises*, (University of Chicago Press, Chicago, IL), 69-108

Modigliani, Franco and Miller, Merton H. (1958) "The cost of capital, corporation finance and the theory of investment" *American Economic Review,* 48(3), 261-297

Molyneux, Philip and Forbes, William (1995) "Market structure and performance in European banking" *Applied Economics* 27(2), 155-159

Monti, Mario (1972) "Deposit, credit and interest rate determination under alternative bank objectives" in Giorgio P. Sego and Karl Shell eds., *Mathematical Methods in Investment and Finance*, (North Holland, Amsterdam), 431-454.

Morgan, George E. and Smith, Stephen D. (1987) "Maturity intermediation and intertemporal lending policies of financial intermediaries" *Journal of Finance*, 42(4), 1023-1034

North, Douglas C. (1981), *Structure and Change in Economic History*, New York, United States, Norton

O' Hara, Maureen (1995), *Market Microstructure Theory*, reprint of 1999, Malden, United States, Blackwell Publishers

Peltzman, Samuel (1976) "Toward a more general theory of regulation" *Journal of Law and Economics,* 19(2), 211-240

Peters, Brian (1999) "Approaches to measuring, limiting and managing risks, especially those facing small and medium-sized institutions" in BIS, *Strengthening the Banking System in China: Issues and Experience*, BIS policy papers Vol. 7 (Bank for International Settlements, Basel), 240-250

Poitevin, Michel (1989) "Financial signalling and the 'deep pocket' argument" *Rand Journal of Economics* 20(1), 26-40

Postlewaite, Andrew and Vives, Xavier (1987) "Bank runs as an equilibrium phenomenon" *Journal of Political Economy*, 95(3), 485-491

Prisman, Eliezer Z., Slovin, Myron B. and Sushka, Marie E. (1986) "A general model of the banking firm under conditions of monopoly, uncertainty and recourse" *Journal of Monetary Economics*, 17(2), 293-304

Pyle, David H. (1997) "Bank risk management: Theory" Berkeley, University of California-Berkeley, *Research Program in Finance Working Paper RPF-272*

Repullo, Rafael (2002) "Capital requirements, market power, and risk taking in banking" Madrid, CEMFI*, mimeo*

Rojas-Suarez, Liliana (2001a) "Rating banks in emerging markets: What credit rating agencies should learn from financial indicators" Washington, Institute for International Economics, *IIE Working Paper 01_06*

- (2001b) "Can international capital standards strength banks in emerging markets?" Washington, Institute for International Economics, *IIE Working Paper 01_10*

Rolfo, Jacques (1980) "Optimal hedging under price and quantity uncertainty: The case of a cocoa producer" *Journal of Political Economy,* 88(1), 100-116

Rose, Peter S. (2002), *Commercial Bank Management* 5th ed., New York, United States, McGraw-Hill/Irwin

Saidenberg, Marc and Schuermann, Til (2003) "The new Basel Capital Accord and questions for research" Philadelphia, University of Pennsylvania-The Wharton Financial Institutions Center, *Working Paper 03-14*

Saini, Krishan G. and Bates, Philip S. (1984) "A survey of the quantitative approaches to country risk analysis" *Journal of Banking and Finance*, 8(2), 341-356

Sandmo, Agnar (1971) "On the theory of the competitive firm price uncertainty" *American Economic Review*, 61(1), 65-73

Santomero, Anthony M. (1989) "The changing structure of financial institutions: A review essay" *Journal of Monetary Economics,* 24(2), 321-328

Scholtens, Bert and Van Wensveen, Dick (2000) "A critique on the theory of financial intermediation" *Journal of Banking and Finance,* 24(8), 1243-1251

Schumacher, Liliana (2000) "Bank runs and currency run in a system without a safety net: Argentina and the 'Tequila' shock" *Journal of Monetary Economics*, 46(1), 257-277

Schumpeter, Joseph A. (1912) *The Theory of Economic Development*, Cambridge, United States, Cambridge University Press. 1951 Edition

Sheng, Andrew LT (2000) "The importance of risk management" *Federal Reserve Bank of Boston: Conference Series [Proceedings]*, 44, 237-342

- (1999) "The framework for financial supervision: macro and micro issues" in BIS, *Strengthening the Banking System in China: Issues and Experience*, BIS policy papers Vol. 7 (Bank for International Settlements, Basel), 154-166.

Shepherd, William G. (1990), *The Economics of Industrial Organization*, 3rd. edition, Englewood Cliffs, United States, Prentice-Hall

Shy, Oz and Stenbacka, Rune (2002) "Market structure and risk taking in the banking industry", Haifa, University of Haifa, *Mimeo*

Spulber, Daniel F. (1999), *Market Microstructure Theory: Intermediaries and the Theory of the Firm*, New York, United States, Cambridge University Press

Stigler, George J. (1971) "The theory of economic regulation" *Bell Journal of Economics and Management Science,* 2(1), 3-21

Stiglitz, Joseph E. (1994) "The role of the state in financial markets" in Michael Bruno and Boris Pleskovic eds, *Proceedings of the World Bank Annual Conference on Development Economics 1993* (World Bank, Washington) 19-52.

Stiglitz, Joseph E. and Weiss, Andrew (1981) "Credit rationing in markets with imperfect information" *American Economic Review,* 71(3), 393-410

Strahan, Philip E. (2000) "The changing financial structure: Challenges for supervisors and risk managers" *FRBNY Economic Policy Review*, 6(4), 89-94

Stulz, Rene M.**,** (2003), *Risk Management and Derivatives*, Ohio, United States, Thomson South-Western

Tirole, Jean (1988), *The Theory of Industrial Organization*, Cambridge, United States, The MIT Press

Tobin, James (1958) "Liquidity preference as behaviour towards risk" *Review of Economic Studies*, 25(2), 65-86

Varian, Hal R. (2003) *Intermediate Microeconomics: A Modern Approach*, 6th ed., New York, United States, Norton

Vila, Anne (2000) “Asset price crises and banking crises: Some empirical evidence” in BIS, *International Financial Markets and the Implications for Monetary and Financial Stability*, BIS conference papers Vol. 8 (Bank for International Settlements, Basel), 232-252.

Vives, Xavier (1999), *Oligopoly Pricing: Old Ideas and New Tools*, Cambridge, United States, The MIT Press

Wheelock, David C. and Wilson, Paul W. (1999) “The contribution of on-site examination ratings to an empirical model of bank failures” St. Louis, The Federal Reserve Bank of St. Louis, *Working Paper 99-023A*

Wolfram, Stephen (1999), *The Mathematica Book*, 4th ed., New York, United States, Wolfram Media/Cambridge University Press

Woolridge, Jeffrey M. (2002), *Econometric Analysis of Cross Section and Panel Data*, Cambridge, United States, MIT Press

Zahler, Roberto (1999) “Strengthening the financial experience in less developed countries: The Latin-American experience” in BIS, *Strengthening the Banking System in China: Issues and Experience*, BIS policy papers Vol. 7 (Bank for International Settlements, Basel), 131-140.