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**Book**

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**Banks and the Finnish  
Credit Cycle 1986 - 1995**

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**Vesa Vihriälä**

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**Banks and  
the Finnish Credit Cycle  
1986 - 1995**

SUOMEN PANKKI  
Bank of Finland



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# Abstract

The study focuses on the role of deposit banks in the makings of the Finnish credit cycle of 1986–1995. A preliminary descriptive analysis suggests that banks' credit supply had a positive effect on credit growth in the boom period and a negative effect in the early 1990s. There are furthermore some indications that moral hazard of weak banks played a role in the expansion phase and that insufficient capital constrained lending later on, thus causing a credit crunch.

A theoretical model set up here suggests that one should examine the effects of both bank capital and costs on lending and also look at the issuance of subordinated debt as a means of testing the moral hazard and credit crunch hypotheses.

An empirical analysis of the behaviour of 483 cooperative and savings banks over the second half of the 1980s gives strong support to the moral hazard hypothesis. In particular, the aggregate credit supply of the savings banks would have been substantially less if their capital had been high enough to eliminate moral hazard incentives.

By contrast, almost no evidence of a credit crunch induced by weak bank capital is found in an analysis of 313 cooperative and savings bank in 1991 and 1992. Instead the effects of borrower creditworthiness and credit demand are underlined.

Keywords: credit crunch, moral hazard, capital regulation, banking crisis

# Tiivistelmä

Tutkimus tarkastelee talletuspankkien roolia Suomen luottosyklissä 1986–1995. Alustavan kuvailevan analyysin perusteella pankkien luotto-politiikka näyttäisi myötävaikuttaneen luottokannan nopeaan kasvuun buumivuosina ja sen supistumiseen 1990-luvun alussa. Lisäksi on viitteitä siitä, että heikkojen pankkien toimintaan liittynyt 'moraalikato' (moral hazard) oli osatekijä luoton laajentumisen vaiheessa ja riittämätön pääoma rajoitti luotonannon kasvua myöhemmin aiheuttaen ns. luottolaman.

Rakennetun teoreettisen mallin nojalla moraalikato- ja luottolamahypoteeseja voidaan parhaiten testata tarkastelemalla sekä pankin omien varojen että kustannusten vaikutuksia luotonannon laajuuteen ja tutkimala lisäksi vastuudebentuurien liikkeeseen laskua.

483:n osuus- ja säästöpankin käyttäytymisen empiirinen analyysi 1980-luvun jälkipuoliskon osalta antaa voimakasta tukea moraalikatohypoteesille. Ennen kaikkea säästöpankkien yhteenlaskettu luotonannon kasvuvauhti olisi ollut huomattavasti pienempi, jos niiden oma pääoma olisi ollut riittävän suuri eliminoimaan kannustimet moraalikatoon.

Sitä vastoin 313:n osuus- ja säästöpankin luotontarjonnan analyysi vuosien 1991 ja 1992 osalta ei juuri lainkaan tue käsitystä omien varojen riittämättömyyden aiheuttamasta luottolamasta 1990-luvun alussa. Sen sijaan luotonottajien luottokelpoisuuden ja luoton kysynnän vaikutukset ovat merkittäviä.

Asiasanat: luottolama, moraalikato, vakavaraisuussäntely, pankkikriisi

# Preface

The roots of this study are in my privileged position in the Financial Markets Department of the Bank of Finland where I was able to witness the unfolding of the Finnish banking crisis of 1991–1994. The unprecedented difficulties of the banks and the economy as a whole, the dire choices faced by the authorities under perplexing uncertainty, and the high costs of bank support naturally raised the question of why and how it all happened. Urgent tasks permitting, I pondered these questions almost daily with my closest colleagues in the department, Peter Nyberg and Heikki Solttila. And we were hardly the only ones to do so. This study is an attempt to give some partial answers.

As with most studies of the kind, this is not a result of the efforts of one person alone. Without the encouragement of professor Bengt Holmström, currently at MIT, I would never have been so bold as to return to academic work after an interval of more than a decade. Since about midway into the project, my supervisors and official examiners at the University of Helsinki, professors Seppo Honkapohja and Erkki Koskela, have helped me immensely to focus the research and have guided me through many difficulties in the analysis. Their suggestions were also important in shaping the final text. Likewise, I am grateful for comments from professor Jean Dermine from INSEAD on an early draft of a chapter.

The work was essentially done in the 1½ year period that, by the goodwill of my superiors at the Bank of Finland, I was able to spend in peace in the Research Department. The department provided an excellent working environment. Juha Tarkka was always ready to discuss any analytical or practical problems I had with the project, and his help was invaluable. Pekka Ilmakunnas and Matti Virén gave very useful advice on several, mainly econometric, issues. Heli Tikkinen did a superb job in transforming a vast data set into a form that allowed for econometric analysis. Päivi Lindqvist edited the drafts with her characteristic efficiency. As always, the Bank of Finland Library speedily provided me with all the material I possibly could ask for. During the last months of the project, Antti Suvanto kindly allowed me to use some of my working hours for making late revisions. In the final phase, the Publications Department gave a helping hand. Glenn Harma checked my English, improving it substantially, and Marja Hirvensalo-Niini and Anneli Heikkilä ensured that the study emerged in an orderly and timely manner.

I also owe a great deal to many people in the Financial Markets Department, Financial Supervision, Government Guarantee Fund and

Statistics Finland in helping me to put together the data used in the analysis. Special thanks go to all the banks that allowed me to use their data. Mr Jaakko Eloranta from Okobank and Mr Rauno Niinimäki from the Savings Bank Association, apart from helping with data, provided highly valuable insider interpretations of events in the cooperative and savings bank groups.

Yet, despite all of above, I would never have managed to complete the project without the unfailing support from the home base. Helena, Riikka and Erkki somehow not only managed to stand a very irritating husband and father for over two years, but they also got the priorities right when the project grew out of proportion in my mind. As any child knows, and a clearheaded adult should know, no article and no calculation can match in importance a Jokerit–TPS game or the finding of an appropriate gift for a classmate on her birthday.

Vesa Vihriälä  
Helsinki, December 1996



# Contents

	page
Abstract	5
Tiivistelmä	6
Preface	7
1 The Finnish Credit Cycle, 1986–1995: An Introduction and Overview	13
1.1 Introduction	13
1.2 Why financial factors may matter	16
1.2.1 Financial markets is not frictionless	16
1.2.2 A role for balance sheets and cash flows	17
1.2.3 A role for intermediaries	18
1.2.4 Intermediaries may also be induced to take 'excessive' risks	20
1.3 Empirical evidence	23
1.3.1 Functioning of the financial system as such	24
1.3.2 Credit or capital crunch in the early 1990s	24
1.3.3 Excessive risk taking	25
1.3.4 Financial factors and real variables	27
1.3.5 Overall conclusion on evidence	29
1.4 The Finnish boom-bust cycle in the light of financial intermediation theories	30
1.4.1 Background: the financial system and deregulation	30
1.4.2 The salient features of the cycle	34
1.4.3 The banking crisis	37
1.4.4 Interpreting the cycle	41
1.4.4.1 Borrower balance sheets	41
1.4.4.2 Intermediaries' behaviour at the aggregate level	45
1.4.4.3 Diversity of bank behaviour and risk taking	56
1.4.4.4 Real effects of bank lending?	60
1.4.5 Conclusions	62
2 Bank Capital, Capital Regulation and Lending	64
2.1 Introduction	64
2.2 The model	65
2.3 Maximization of bank value with fair pricing of subordinated debt and money market debt	73

2.3.1	The optimization problem	73
2.3.2	Solution with strong loan demand ( $M > 0$ , $B = 0$ )	76
2.3.3	Solution with weak loan demand ( $M = 0$ )	80
2.4	Pricing of money market debt is exogenous	81
2.5	Capital requirement levied on the asset side	86
2.6	Discussion	88
3	Credit Growth and Moral Hazard	93
3.1	Introduction	93
3.2	A preliminary look at the data	96
3.2.1	The sample	96
3.2.2	Salient features of the cooperative banks and savings banks	97
3.3	Specification of the equations to be estimated	103
3.4	Estimation results	108
3.4.1	Preliminary experiments	109
3.4.2	The modified equations for the entire period	112
3.4.3	Some checks of robustness	115
3.4.4	Stability over time	119
3.4.5	The behaviour of subordinated debt	122
3.4.6	The quantitative significance of moral hazard	126
3.5	Discussion	129
4	Credit Crunch or Collateral Squeeze?	135
4.1	Introduction	135
4.2	The framework for the empirical analysis	137
4.2.1	Basic selection of data	137
4.2.2	Theoretical background of the analysis	140
4.2.3	Specification of the loan equation	144
4.2.4	Some preliminary observations about the data	147
4.3	The empirical results	149
4.3.1	The main results for 1991–1992	150
4.3.2	Stability over time and other checks of robustness	154
4.3.3	Conclusions on the loan equation estimation	159
4.3.4	Subordinated debt	161
4.4	Discussion	164
5	Concluding Remarks	167
	References	173

Appendix 1	Capital regulation in the 1980s and early 1990s	180
Appendix 2	The second order conditions and the comparative statics	182
Appendix 3	Alternative solutions with weak loan demand	188
Appendix 4	The endogeneity of deposits	191
Appendix 5	The endogeneity of deposit rates and deposit volumes in the 1990s	193
Appendix 6	The operationalization of the exogenous variables in the loan equation	195
Appendix 7	The LAD regression and excluded observations	199
Appendix 8	Further regression results	200



# 1 The Finnish Credit Cycle, 1986–1995: An Introduction and Overview

## 1.1 Introduction

In several developed market economies the latter half of the 1980s was characterized by exceptionally rapid expansion of credit and a rise in asset prices and aggregate output, followed by equally exceptional banking problems and stagnation or a decline in credit stocks, asset prices, output and employment. Recovery from the recessions has also been slower than usual. The most prominent examples of this pattern are (parts of) the United States, Japan, Norway, Sweden and Finland. Also in the United Kingdom and France similar developments have been observed, although to a lesser degree. In terms of output and employment losses, Finland has experienced the most severe recession in the recent history of OECD countries. Its banking problems have also been among the most severe and possibly severest.

In public discussion, the malfunctioning of the financial system has often been made the culprit for both the 'overheating' and the exceptional depth and duration of the subsequent recession. 'Excessive' growth of credit, resulting in 'overindebtedness', has been claimed to have caused or at least promoted a burst of unsustainable growth. This was followed by a period of sluggish aggregate demand associated with a voluntary or forced consolidation of balance sheets. Furthermore, the 'credit crunch' that resulted from financial intermediaries' shortage of capital, 'excessive' risk aversion by bank managers or misguided regulatory stringency has been cited as a significant contributing factor to the recession and slow recovery that followed the boom. Thus the financial system has been implicated, if not as a source of the observed credit cycle, at least as a factor that has strongly contributed to the amplitude of the cycle.

This line of reasoning is by no means new or confined to public discussion. It had a prominent role in many early academic analyses of the American Great Depression. Thus Fisher (1933) argued that in all major booms and depressions two factors have been of central importance: 'overindebtedness to start with and deflation following soon after'. According to Keynes (1936) investment was largely determined by

the 'state of confidence', which in turn depended on borrowers views on the yields of investment projects and on 'the state of credit'. He considered all these factors to be highly volatile. Later, particularly Minsky (eg 1977) and Kindleberger (1982) described financial cycles and crises with the help of psychological concepts such as 'optimism', 'euphoria' and 'pessimism', which set in motion changes in investment, debt finance and asset prices, which again feed back to the confidence of economic agents. The functioning of the financial system and the credit relationships that develop therein are central to their explanation of aggregate economic fluctuations.

Yet, these ideas contrast starkly with most of the macroeconomic theory that has been developed since the Second World War. The neoclassical ISLM models that comprised the mainstream of macroeconomics until the 1970s abstract from the financial system, except for the creation of the medium of exchange, money.

Similarly, in their influential account of monetary developments in the United States, Friedman and Schwarz (1963) allow no role for credit. They claim that money supply changes have in a major way affected output and that banking panics have resulted in significant declines in the deposit component of the money stock. But the crucial issue is money supply. Credit extension and the subsequent debt-deflation have no role in the explanation.

This absence of a role for credit is also characteristic of a substantial body of modern theories that seek to explain aggregate economic fluctuations based on explicit optimizing behaviour by individual economic agents and rational expectations (see eg Romer 1996). In particular, most of the so-called real business cycle models either abstract from all financial market considerations, including money, or incorporate a purely passive money, ie a quantity that responds to the demand for transactions services.

However, in the past 10 years or so an increasing number of models aiming at explaining macroeconomic fluctuations have incorporated a financial system much richer than one that just produces money. Most of these models assign to private debt, balance sheet structures and financial intermediaries an important role in magnifying the effects of various shocks so as to lead to potentially substantial aggregate fluctuations. In some analyses, shocks to financial intermediation can even precipitate real consequences. The so-called 'financial factors' have again become respectable, even if disputed, elements of macroeconomic analysis and policy discussion (see eg Gertler 1988, Bernanke 1993 and Gertler and Gilchrist 1993).

Examining the potential role of financial intermediation in the makings of the recent Finnish boom-bust cycle is particularly interesting. Not only is the cycle extraordinary in amplitude, but economic activity and credit display very strong comovements. If financial factors are at all quantitatively important, they should be so in the Finnish case.

This study focuses on the role of the supply of bank credit in the recent Finnish credit cycle. Given banks' predominant role in financial intermediation, an understanding of their credit-supplying behaviour is crucial for establishing why aggregate credit stocks have displayed the observed swings. The specific hypotheses to be studied are: Did banks' lending policies contribute to the rapid credit growth in the boom period? If they did, did distorted incentives play a role? Similarly was there a credit crunch caused by insufficient bank capital in the early 1990s?

The study comprises five chapters. The rest of this introductory chapter gives the main theoretical arguments concerning the role of financial intermediation in the macroeconomy (section 1.2) and then briefly surveys relevant empirical evidence (section 1.3). This is followed by a description of the salient features of the Finnish boom-bust cycle, and a preliminary interpretation of the cycle from the point of view of the discussed financial intermediation theories (section 1.4). The interpretation is based on aggregate level behaviour of credit stocks and interest rates augmented with some observations about the evolution of bank lending by different bank groups.

In chapter 2 a simple model of bank behaviour is set up and analysed to provide a theoretical basis for the subsequent empirical analysis. Chapter 3 is an analysis of Finnish savings banks' and cooperative banks' lending behaviour in the second half of the 1980s. The main issue is whether or not moral hazard stemming from underpriced bank liabilities contributed to the rapid growth of credit in this period. Chapter 4 in turn analyses the early part of the period of credit contraction, 1990–1992. There, the main issue is whether capital insufficiency or borrower quality or both were important factors contributing to the contraction. Finally, in chapter 5 we sum up the main results and provide a few concluding remarks.

## 1.2 Why financial factors may matter

### 1.2.1 Financial markets are not frictionless

In all developed economies there exist substantial amounts of private debt and a large variety of financial instruments, firms' capital structures vary a great deal and the financial system uses non-trivial amounts of resources. Abstracting from these facts for the purpose of macroeconomic analysis leaves us with the notion of a smooth, frictionless financial system.

Two prerequisites are crucial for frictionless financial markets. First, transaction costs must be insignificant relative to the value gained from financial transactions. Second, agents must be able to agree and complete transactions concerning all relevant contingencies. Under the assumptions of symmetric information and complete markets, financial transactions can be conducted just as any other transactions.

The standard view is that the value of a firm is independent of its capital structure (Modigliani and Miller 1958) and thus that banks are irrelevant with regard to the allocation of capital (Fama 1980). However, this analysis has been challenged on both counts: transactions costs may be significant and informational asymmetries may prevent efficient contracting. Gurley and Shaw (1955) argued on the grounds of transaction costs that the financial system is not just a veil over real transactions but that it also affects their outcomes. Whatever the merit of such arguments may have been in the 1950s, it is difficult to argue that transactions costs, at least in the usual narrow meaning of the term, could be a significant factor in modern financial markets, given the rapid progress of information technology.

Much more important is likely to be the degree of knowledge that economic agents have about certain aspects of financial contracts, which by definition deal with uncertain future contingencies.

In a pathbreaking paper Akerlof (1970) shows how a market can collapse if the seller has better information than the buyer regarding the quality of a good. This asymmetry of information implies that lowering the price may not induce more demand as the potential buyers have a valid reason to expect that only low quality products – lemons – will be sold at low prices. This type of adverse selection may well be a fairly common phenomenon, not limited to Akerlof's used-car example. In particular, entrepreneurs are likely to know the quality of their investment projects much better than outsiders from whom financing may be needed to realize the project.



Another problem caused by asymmetric information is moral hazard. The behaviour of the funds user may be unobservable to the funds provider. As a result an entrepreneur may invest the funds in a riskier project than was indicated to the lender. With limited liability, such behaviour is advantageous to the borrower as long as the lender does not take this risk-taking incentive into account in pricing the funds. A rational lender of course takes precautions against such behaviour, either by setting a default premium on funds or by quantitatively rationing the amount of funds to be lent.

Asymmetric information may also cause difficulties in the verification of project outcomes. If the lender cannot costlessly verify the outcome of the project financed, borrower's incentive to cheat is likely to create a friction in intermediation (Townsend 1979).

Based on these ideas a voluminous literature has emerged to explain why external financing is more expensive than internal financing and why in certain circumstances the 'lemons premia' can become effectively infinite so that some potential borrowers are altogether denied credit (credit rationing).<sup>1</sup> Furthermore, rationing need not be limited to debt financing but may also concern equity financing (equity rationing).<sup>2</sup>

Moral hazard can also lead firm 'insiders' (managers, principal shareholders) to behave in a way that does not maximize the value of the firm. Jensen and Meckling (1976) argue that these types of agency costs lead to an optimal debt-equity structure even in the absence of taxes, in contrast to the Modigliani–Miller irrelevance result.

### 1.2.2 A role for balance sheets and cash flows

The theories discussed above suggest that on the basis of informational asymmetries that result in adverse selection, moral hazard, and verification problems, the observed or shadow cost of external funds exceeds that of internal funds. Furthermore, the smaller the net worth of a firm the more difficult it is to align the interests of external providers of funds and firm insiders and the higher the premium on external financing.

Therefore, the greater the amount of readily available internal financing (cash flow) the less the firm's need to resort to external financing and the lower the marginal financing costs. Similarly, the greater the amount of collateralizable assets in the firm the smaller the

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<sup>1</sup> Gertler (1988) provides an early survey of the relevant literature. See also Bernanke (1993).

<sup>2</sup> For a comprehensive survey of the credit rationing literature see Jaffee and Stiglitz (1990).

premium on external funds. As a consequence, the effects of many macroeconomic variables are transmitted through the balance sheet rather differently from what would obtain in the absence of informational asymmetries. For example, Gilchrist, Bernanke and Gertler (1994) show how a small net worth affects the firm's spending. An increase in the expected real interest rate reduces spending through its impact on the discounted value of collateral. In addition, unlike in the case with no net worth constraints, an increase in the real rate applied to the existing debt reduces spending through its impact on the debt service burden. Finally, a decline in asset prices lowers the value of collateral and thus spending.

The above arguments are essentially of a partial equilibrium nature. Several models have however been constructed to show how borrower balance sheets can play a role in macroeconomic processes as well. One such analysis of the aggregate effects of borrower net worth is provided by Bernanke and Gertler (1989). The analysis demonstrates the effects of costly state verification. In the absence of informational asymmetry, costs of capital and investment are constant in the face of productivity shocks. Production varies with serially uncorrelated shocks, while consumption is smoothed over time and thus displays serial correlation. Introducing positive verification costs makes the cost of capital positively related to borrower net worth. Current investment and, through increased capital stock, future investment then respond to productivity shocks. Serially uncorrelated shocks are propagated through a 'financial accelerator' into cyclical fluctuations, which would not be present without friction in the capital market. Furthermore, a redistribution of wealth from borrowers to lenders in one period leads to lower investment for several periods.<sup>3</sup>

### 1.2.3 A role for intermediaries

The idea that information problems may cause frictions in financial intermediation can also provide rational for the existence of intermediary institutions. The literature, concisely surveyed by van Damme (1994) and Davis (1994), provides several reasons for why intermediaries may alleviate information problems.

First, intermediaries can evaluate potential borrowers to determine whether they are good risks or bad risks. Second, when the information problem is that of verifying the outcome of the project for which

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<sup>3</sup> Many other models with different information problems produce analogous results of net worth propagating the effects of shocks. Examples of such models are Bernanke and Gertler (1990), Greenwald and Stiglitz (1993), Kiyotaki and Moore (1995) and Lamont (1995).

financing is sought, an intermediary can be delegated the task of monitoring the project outcome. Third, and somewhat differently, intermediaries can be motivated as a way of allowing for high yielding long-term investments despite the lender's need for liquid assets. The informational problem in this case is that a lender's liquidity need is private information.<sup>4</sup>

The existence of intermediaries may also be rationalized by the idea that intermediaries may help in creating efficient long-term relationships, which would not otherwise be possible given the difficulties of writing complete and binding contracts.

Finally, in a related way, intermediaries may have a special role in exercising control over borrower assets in the case of default. In the absence of complete contracts, a debt contract may be an optimal way of allocating control rights. Banks or other intermediaries in turn may be better in exercising such control than (a typically large number of) bondholders, as the latter's involvement may be hampered by free rider problems.

The basic point of the above theories of financial intermediation is that financial intermediaries provide valuable service in facilitating financing for high-yielding projects that otherwise would not materialize to the same extent. Intermediary and particularly bank credit is special in that it cannot be easily or perfectly replaced by other types of financing. Therefore any change in the supply of intermediary credit is likely to change the overall supply of credit.<sup>5</sup> And, just in the case of non-financial borrowers, intermediary capital can be a crucial constraining factor.

Again, it has been shown that these partial equilibrium arguments may hold also in a general equilibrium framework. Bernanke and Gertler (1987) focus solely on intermediated credit on the premise that, owing to

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<sup>4</sup> The provision of highly liquid liabilities, demand deposits, is a special feature of the intermediaries known as banks. Combining supply of liquid liabilities and information – intensive risky lending may be motivated by the advantages of using information on the loan customer's transactions account in the monitoring his performance (Fama 1985). On the other hand, demand deposits can serve as a means of disciplining bankers in the case of bad performance indications. Allowing such an instrument lowers the cost of capital for the banker. Both arguments suggest that banks supplying liquid liabilities are not only accidently in the business of risky lending.

<sup>5</sup> Furthermore, the theories predict that certain types of firms and projects are particularly dependent on financing from banks and other intermediaries. First, firms with high net worth relative to the projects need less uncollateralized financing and therefore need less evaluation and monitoring. Second, firms that have a reputation for honoring their financial commitments may not need to be monitored or evaluated, and may therefore efficiently use direct financing from ultimate lenders. Thus particularly new and small firms are likely to be 'information intensive' and depend on intermediated financing.

technological advantages in project evaluation and monitoring, only bank credit is available to risky investments. The basic message is that both borrower net worth (value of collateralizable assets) and intermediary capital are essential for risky investments to find financing. A collapse of either would be sufficient to shift financing from risky projects to safe assets.

Holmström and Tirole (1994) nicely combine the roles of borrower net worth and intermediary net worth. In their model both direct financing from ultimate investors and intermediated financing can be used to realize investments for which the entrepreneur's own funds are not sufficient. External financing is limited by borrower capital, because only by investing own capital in a risky project can the entrepreneur credibly commit to not shirking, ie choosing an inferior project that generates private benefit. Monitoring by an intermediary (only intermediaries are assumed to have this capacity) may eliminate the most inferior projects. But the intermediary also has an incentive problem vis-à-vis the investors, and to overcome the problem it needs to invest some of its own capital in the project. Intermediation is thus constrained by intermediary capital. The model predicts that high net worth firms rely on direct financing, which is cheaper than intermediated financing due to monitoring costs involved in the latter. Firms with less capital resort to intermediated financing and low capital firms may be forced to skip investment. Negative shocks to firm capital ('collateral squeeze'), bank capital ('credit crunch') and savings ('savings squeeze') all reduce investment, and the first to do so are low net worth firms.

#### 1.2.4 Intermediaries may also be induced to take 'excessive' risks

Adverse selection and moral hazard typically create frictions in financial intermediation so that external financing for risky undertakings takes place to a lesser degree than would be the case in the absence of incentive problems. However, this need not always be the case. Depending on the precise incentive problem, also 'excessive' risk taking by the intermediaries can take place relative to the case of no incentive problems.

One source of such excessive risk-taking is misguided government policies. In the aftermath of large-scale bank failures during the Great Depression in the United States and a number of other countries, financial markets and banking in particular were seen as inherently unstable in the absence of government regulation. The result was that financial

institutions in most industrialized countries were subjected to tight regulations of different kinds. One important such regulation is compulsory deposit insurance.

Starting with the analyses of Merton (1977) and Kareken and Wallace (1978), the side effects of deposit insurance schemes have received considerable attention during the last 20 years. The basic argument is very simple. Deposit insurance removes bank risk from depositors, eliminating depositors' incentives to monitor bank behaviour and to limit the banks' risk taking through risk-based pricing or rationing. Therefore, provided the premium paid by the bank for deposit insurance does not adequately reflect bank risk, bank value can be increased by increasing the riskiness of the bank's portfolio. This is the standard moral hazard problem. The amount of equity capital is an important determinant of this moral hazard. If there is little equity to begin with, the moral hazard incentives are strong, as there is little for the owners to lose in the case of negative returns. Thus particularly banks which have lost most if not all of their equity due to earlier losses are likely to engage in a 'gamble for resurrection'.

However, an explicit deposit insurance scheme is only one way of eliminating the incentives of bank creditors to limit banks' risk taking. Qualitatively, the same outcome emerges if the creditors can trust that the authorities would not let a bank to fail because of the anticipated negative macroeconomic consequences. Particularly large banks, which play a central role in payments systems, have been argued to benefit from this type of 'too big to fail' policy (see eg Kaufman 1992).

Some recent analyses have suggested that also conflicts of interest between bank management and bank owners can result in excessive risk-taking by banks.<sup>6</sup> They are based on the idea that management ability varies and is private information about which outsiders can infer only from the return on the portfolio chosen by the management. And a manager of low ability makes risky short-run decisions in order to conceal his bad quality from outsiders.

Gorton and Rosen (1995) consider a model in which a manager can keep his position and thus continue to earn a salary only if the return on the portfolio he has chosen is good enough for the owners. Managers who do not have the ability to find good projects to finance tend to choose excessively risky portfolios (relative to the situation of no

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<sup>6</sup> This differs from the traditional view on the potential differences in the interests of managers and owners, according to which manager behaviour is thought of as being too conservative relative to value maximization. The reason is that managers are induced to behave in a risk-averse manner, as they cannot diversify their human capital which tends to be firm-specific.

asymmetry of information as to manager ability). If most managers are of bad quality, their choices determine aggregate risk taking in banking. Identifying the case where most bankers are of poor quality with overcapacity when banks typically cannot be very profitable leads to the conclusion that overcapacity may induce bank managements without sufficient equity stake in the bank to take excessive risks. Rajan (1994) simply assumes that the bank manager values short-term profit at the expense of value maximization, and particularly so when other firms are doing well. The main implication of the Rajan model is that in 'good times', ie when the industry is on average doing well, banks whose lending has turned out to be 'bad' have an incentive to postpone revealing the result to a period when all banks' results are bad. A bank can do this through further lending to the troubled customers. There is thus an expansionary bias to lending in good times.

But there are many other, more general arguments according to which financial intermediation may contribute to excessively risky investment. A popular claim is that fierce competition in the financial markets leads to excessively risky lending. This intuition has led to different types of more rigorous arguments. One of them is directly associated with the aforementioned moral hazard incentives of underpriced deposit insurance or implicit creditor protection. Stiffer competition – say due to deregulation or technological development – is likely to reduce the margins of intermediation, ie banks' net worth. As noted above, weaker bank net worth strengthens the latent moral hazard incentives of equity holders (and perhaps the management) for risk taking.<sup>7</sup>

But competition may affect loan supply behaviour in other ways as well. One idea is that competition may lead the banks to pay too little attention to borrower quality. For example, Riordan (1993) argues that banks' efforts to screen borrowers may be reduced by increased competition as the benefits from such activity decline with more competition.<sup>8</sup> But it is not at all clear that less information gathering necessarily means more risky lending. As Broecker (1990) shows, the lesser profitability of screening due to increased competition may in fact make lenders more conservative in their lending policies in fear of what is called the 'winner's curse'. An increase in banking competition may also lead to higher interest rates and less lending, due to interactions with the

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<sup>7</sup> See Boot and Greenbaum (1993) for a theoretical analysis in which increased competition eliminates monopolistic rents which hinder underpriced deposit insurance from inducing strong moral hazard behaviour.

<sup>8</sup> See also Kanninen and Stenbacka (1996).

imperfectly competitive product markets, even though loan quality may decline (see Koskela and Stenbacka 1996).

Other ideas about the role of bank competition pay no explicit attention to credit risk but rely instead on changes in strategic behaviour. In particular, it has been argued that liberalization of financial regulation induces additional competition, as banks attempt to capture market shares early on in an expanding market (see eg Vives 1991). It has also been argued that, independently of regulatory changes, monopolistic competition can lead to price wars in times of high demand, as the benefits from aggressive pricing relate to a greater-than-average overall demand while the retaliation of the competitors will have an effect at a later stage with more normal demand (Rotemberg and Saloner 1986).

### 1.3 Empirical evidence

Even though the case can be made on theoretical grounds that financial intermediation is plagued by distortions that matter for real outcomes, whether they indeed matter is an empirical question. Both the significance of the potential distortions and their variation over time depend on a host of factors whose importance is difficult to assess a priori. Therefore a vast empirical literature has emerged to explore the importance of financial intermediation in various historical episodes.

One group of studies has focused directly on the intermediation process, attempting to establish whether the observed patterns of financial stocks or flows and financial prices are inconsistent with the standard Modigliani–Miller assumptions but consistent with some alternative hypothesis. Another approach is to examine whether the behaviour of real quantities such as production, sales, purchases of goods or employment displays patterns which would be inconsistent with the standard assumptions but consistent with some hypothesis about the role of financial factors. Both types of analysis have been conducted with both aggregate and disaggregated micro data, although the latter have been more typical, reflecting the nature of the potential financial distortions.

In this section the main empirical findings are briefly summarized. Evidence concerning Finland is not discussed at length at this point but will be taken up in the next section.

### 1.3.1 Functioning of the financial system as such

One set of questions concerns the nature of equilibrium in the financial markets. As noted above, some theories based on asymmetric information suggest that the price mechanism may not equilibrate the demand and supply for credit but that there is quantitative rationing in the sense that at least for some borrowers increasing the price of credit does not result in increased supply of funds. However, attempts to directly test credit rationing have given rather mixed results. Although some studies have found that bank loan rates have indeed been 'sticky', the evidence cannot necessarily be interpreted as supportive of credit rationing. The observed stickiness may relate more to long-term credit relationships than to rationing.<sup>9</sup>

Another line of research is to examine the uniqueness of bank or intermediary lending in general, ie whether there is evidence that access to bank loans is valuable so that it cannot be costlessly replaced by external financing from other sources. On balance, the evidence seems to support the idea of imperfect substitutability. For example, Kashyap, Stein and Wilcox (1993) find that the aggregate stock ratio of bank loans to commercial paper declined after a tightening of monetary policy in the United States in the period of the mid-1960s through 1989. They interpret this as suggesting that bank loans and commercial papers are imperfect substitutes and that monetary policy works through a bank credit channel. Also evidence based on price data have been presented in support of the imperfect substitutability hypothesis.<sup>10</sup>

### 1.3.2 Credit or capital crunch in the early 1990s

As discussed above, bank capital limits banks' borrowing and as a consequence credit supply in many theories of adverse selection and moral hazard. In addition, capital regulation may limit banks' possibilities to expand lending. The slowdown and even contraction of bank lending in many countries, particularly in the United States in the early 1990s, has

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<sup>9</sup> See Berger and Udell (1992).

<sup>10</sup> For example, Fama(1985) concludes on the basis of interest rates paid by American banks for money market funding (CDs) relative to commercial paper rates that bank loans are valued over other financing. James (1987) finds that in a sample of 300 American firms announcements of new bank credits resulted in significant positive abnormal returns on firm equity while corresponding announcements of bond issues did not result in such responses.



provided fresh data for examining these hypotheses. This phenomenon, usually called a credit crunch but also a capital crunch, has become the subject of a large number of studies, almost exclusively using American data.

The American literature, which has recently been surveyed by Passmore and Sharpe (1994) and Sharpe (1995), has given rather mixed results. Several studies examining aggregate time series data on lending, interest rates, economic activity etc conclude that bank lending indeed contracted in the early 1990s more than demand conditions and the stance of monetary policy would have warranted.<sup>11</sup> In addition, most studies using cross-section data have discovered bank capital as an important constraining factor, ie that the issue indeed is one of a 'capital crunch' (Bernanke and Lown 1991). Some studies have furthermore implicated capital regulation or rather its tightening through higher requirements or through stiffer enforcement as the reason for capital insufficiency (Peek and Rosengren 1995a). However, the results tend to depend a great deal on how extensively the analyses control for other factors: the more care is taken of eg borrower quality, monetary policy conditions etc, the less important bank capital turns out to be in the regressions (see Berger and Udell 1994).

There are also some studies on Japanese data, but the results are equally mixed (Baba 1996). Studies using European data are few.<sup>12</sup> While all of them find some support for the existence of a credit crunch, the evidence is rather weak. Furthermore they do not go far in controlling for factors other than the hypothesized effects.

### 1.3.3 Excessive risk taking

The argument that underpriced deposit insurance leads to excessive risk-taking has often been cited in the context of bank failures. The behaviour of American thrift institutions in the early 1980s is one frequently mentioned example of such moral hazard in action (see eg White 1991). But the findings of systematic empirical studies vary a great deal.

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<sup>11</sup> See Akhtar (1994) and Lown and Wenninger (1994).

<sup>12</sup> The only studies directly examining the potential role of banks' changed supply behaviour using European data seem to be O'Brian and Browne (1992), partially on European countries, Llevellyn and Drake (1994) on the UK, and Solttila and Vihriälä (1992) and Saarenheimo (1995) on Finland. The analyses of Solttila and Vihriälä and Saarenheimo will be discussed somewhat further in section 1.4.

Several studies based on the options pricing approach have investigated the possible underpricing of deposit insurance with American data. The results are quite mixed, and eg Gorton and Rosen (1995) conclude that 'empirical research has not reached a conclusion on whether deposit insurance is underpriced'. Furthermore, although the insurance schemes are found to be underpriced, it does not necessarily follow that banks had taken excessive risks as a result. Risk aversion, regulatory actions and market discipline imposed by uninsured creditors may constrain risk taking. Some recent studies have recognized this, but yet the results have been rather conflicting (see Duan, Moreau and Sealey 1992 and Hovakimian and Kane 1996).

Other types of studies have also yielded mixed results. Keeley examined the 150 largest American bank holding companies over the period 1970–1986. He found evidence that low underlying profitability, or rather low 'charter value' of a bank as measured by the ratio of market value to book value of bank assets, had a positive impact on banks' risk taking. Risk taking was measured by the ratio of market value of equity to market value of assets (the higher the ratio the lower the default risk) and by CD rates (the higher the rates the higher the default risk). Keeley argues that the driving force behind moral hazard was increased competition in the market for banking services, which lowered banks' charter value. Underpriced deposit insurance promoted risk taking but was not a problem as long as the owners' equity stake remained high due to the privileged position of banking.

Also Park (1994) reports evidence of the importance of moral hazard. He examines data on essentially all FDIC-insured banks for the years 1984–1988. He finds negative bivariate relationships between lending growth and other measures of risk taking, on the one hand, and capital asset ratios and earnings on assets, on the other hand.

However, using a different methodology and examining some 1800 FDIC-insured commercial banks over the years 1983–1987, Shrieves and Dahl (1992) provide evidence of a positive relationship between bank capital and bank risk, which is in conflict with the moral hazard hypothesis. Corroborating evidence is also provided by Randall (1993) and Furlong (1988).

In the aforementioned studies all the banks investigated are insured and thus it is difficult to identify the specific effect of deposit insurance. To overcome this problem Wheelock (1992) analyses 257 insured and uninsured Kansas banks from the 1920s. He finds that the banks whose deposits were insured chose riskier portfolios and were more likely to fail than the uninsured banks.

Studies using European data seem to be almost nonexistent. An important exception is Hein (1996), who focuses on the few Finnish banks listed on the stock exchange. Like the American studies, his options pricing analysis yields rather mixed results depending on the assumptions made. On balance, Hein's results are in line with the interpretation that in the early 1990s Finnish deposit insurance was subsidized, thus inducing excessive risk taking.

There have also been some attempts to examine the more general hypothesis advocated by Minsky and Kindleberger that banks' credit expansion tends to become 'excessive' in times of 'optimism', leading to excessive risk taking and in the end to bank failures. Kindleberger himself provides evidence of such episodes by investigating 37 financial crises between 1720 and 1976. Several authors have however strongly criticized Kindleberger's evidence on the grounds that he does not define a financial crisis properly and in particular does not take into account the role of the money supply.<sup>13</sup>

#### 1.3.4 Financial factors and real variables

A large number of studies have examined directly the existence of a link between financial factors and real quantities (output, investment, employment, sales). Studies with aggregate data have produced quite mixed results. In contrast, analyses using micro data fairly consistently suggest that real decisions indeed are affected by financial factors. Their overall importance however remains unclear.

As the American Great Depression is one of the main impetuses for academic interest in the potential role of financial intermediation in aggregate economic behaviour, many studies have focused on it. In an influential contribution Bernanke (1983) argued that increased frictions in financial intermediation caused by both a reduction of borrowers' net worth and failures of intermediaries reduced production, even when monetary factors are controlled for. Bernanke's empirical analysis consists essentially of adding (lags of) the deposits of failed banks and liabilities of failed businesses or a spread between yields of corporate bonds and government bonds in a monetary supply equation, where (lags of) unanticipated changes in money or price level are used to explain output variation. The estimated effects of the financial factors, while not diminishing the significance of the money or price variables, were clearly significant for the estimation period 1/1921–12/1941. However,

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<sup>13</sup> See Schwarz (1986) and Benston and Kaufman (1995).

Bernanke's findings do not seem to generalize to Canada, which did not experience any banking panics, suggesting that disturbances of intermediation other than those associated directly with the creation of bank money may have been quantitatively insignificant in North America in the 1930s.<sup>14</sup>

Following Bernanke, some studies have tried to incorporate the condition of the banking sector into the analysis of aggregate time series from the more recent past. Samolyk (1994) examines whether personal income growth depends on lagged income and a number of variables reflecting the 'health' of banks' balance sheets. The data are US state level aggregates for 1983–1990. Her results are consistent with the idea that banking conditions matter for real outcomes. However, some studies report quite the opposite results.<sup>15</sup>

Many studies have investigated the relative merits of credit aggregates as opposed to monetary aggregates in forecasting various aggregate demand and production variables in the post-war period. The conclusions have varied a great deal depending on the exact formulation and data set.<sup>16</sup>

The highly mixed results of the aggregate analyses have induced much interest in using micro level – cross-section or panel – data to examine the dependence of real decisions on financial factors. For example, Fazzari, Hubbard and Petersen (1988) investigate the dependence of investment on cash flow with data on listed American companies. They separate dividend paying companies from other companies. The latter ones are assumed on a priori grounds to be more likely to have higher costs of funding than the former ones. Controlling for the nature of investment opportunities with a Tobin-Q variable, they find that cash-flow variables strongly affect investment by a priori financially constrained firms but only to a minor degree that of the

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<sup>14</sup> Haubrich (1990) finds that in Canada the financial factors played no role, and interprets this to imply that without banking panics, which did not emerge in Canada, the role of financial intermediaries was not important. However, in a survey on the role of financial factors in the Great Depression, Calomiris (1993) contests Haubrich's interpretation.

<sup>15</sup> Guenther et al (1995), for example, find no effect of banking conditions on real variables in a VAR analysis with data on the State of Texas for 1976Q1–1990Q4.

<sup>16</sup> See King (1986), Bernanke (1986), Friedman and Kuttner (1993) and Ramey (1993).

dividend paying firms. Similar results have also been found with data on other countries.<sup>17</sup>

A somewhat different approach is to examine Euler equations with and without a debt constraint. Whited (1992) does so with a sample of large American firms which he distinguishes according to whether the firm has a bond rating or not. The firms with a bond rating are assumed to be financially stronger, ie to face less borrowing constraints. The unconstrained equation is rejected both for pooled data and for the group of no bond listing while it cannot be rejected for the group consisting of rated firms.<sup>18</sup>

Most of the micro data studies on the effect of liquidity constraints on consumer demand support the hypothesis of imperfectly functioning financial intermediation. The studies typically find excess sensitivity of demand to current income for households that are a priori classified as potentially credit-constrained (see eg Zeldes 1989). The role of household balance sheets has been emphasized particularly in the context of deep recessions (see Mishkin 1978 on the American Great Depression and King 1994 on the UK recession in the early 1990s).

### 1.3.5 Overall conclusion on evidence

There is substantial evidence that financial intermediation is plagued by frictions that raise the cost of external finance to many firms and households relative to what it would be in 'perfect capital markets' and that the extra cost varies over time. Furthermore, banks appear to be a valuable source of external finance to many firms and households, so that variations in their loan supply affect the overall supply of external financing to the private sector.

In addition, the frictions seem to be significant enough to affect real decisions. Investment is affected not only by the profitability of investment projects and 'the rate of interest' but also by the cost of external funds on top of that rate and/or quantitative constraints. A similar conclusion holds for consumption.

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<sup>17</sup> Hoshi, Kashyap, and Scharfstein (1991) examine the dependence of investment on cash flow with data on Japanese firms. The so-called keiretsu firms, which are supposed to be less financially constrained, display less sensitivity of investment to cash flow than other firms.

<sup>18</sup> Studies with European data have yielded similar results, see Bond and Meghir (1994) on UK data and Estrada and Vallés (1995) on Spanish data.

However, the exact mechanisms through which the financial factors affect behaviour are not clear. More important, the quantitative significance of financial factors relative to other factors in explaining the observed patterns of aggregate economic fluctuations seems uncertain.

On balance, it seems plausible that financial factors have contributed significantly to deep recessions and retarded recovery from some recessions. But whether the 'financial accelerator' is more generally an important element of aggregate economic fluctuations seems an open question. In particular, no solid evidence exists to support the hypothesis that 'excessive' risky lending by banks and other financial intermediaries has contributed to economic booms. Finally, a vast majority of the empirical analyses of the role of financial factors have been conducted with American data. As many institutional arrangements differ a great deal between different countries, these studies do not necessarily tell much about the situation in Europe.

## 1.4 The Finnish boom-bust cycle in the light of financial intermediation theories

### 1.4.1 Background: the financial system and deregulation

As in several countries that experienced a vigorous debt-financed economic boom followed by a deep recession with stagnating or declining credit stocks after the mid-1980s, so in Finland was financial liberalization the backdrop of the credit cycle.

Until the early 1980s, the Finnish financial markets were in several important respects regulated. First, capital imports and exports were tightly controlled by the central bank. Most cross-border borrowing and lending was subject to quantitative restrictions. Second, interest rates on bank loans and deposits were regulated at low levels, either directly by the central bank or indirectly by tying tax exemption on interest earnings to a given uniform deposit interest rate. As inflation often was high relative to regulated lending rates and even households could deduct from taxable income interest expenses on loans up to a relatively high ceiling, regulation likely resulted in excess demand for credit for long periods of time. Regulation therefore induced credit rationing quite independently of any potential 'equilibrium credit rationing'.

Bank intermediation was heavily subsidized through tax exemption of deposit interest earnings. The securities market remained small and for the most part illiquid. The result was a highly bank-centred financial

system, in which even large corporates relied on banks as the main source of not only short-term but also longer-term external financing. The predominance of banks implied that any changes in banks' credit supply would very likely significantly affect also the overall supply of credit to the non-financial sector.<sup>19</sup>

Bank legislation in force in the mid-1980s distinguished between four types of banks: commercial banks, savings banks, cooperative banks, and the state-owned post office bank (Postipankki or PSP).<sup>20</sup> The types of business allowed to the different banking institutions did not differ a great deal, although there was definite specialization. The commercial banks provided a much wider spectrum of services than the cooperative or savings banks. A restriction on the business activities of the saving and cooperative banks was that, unlike the commercial banks, the local banks were not generally allowed to effect transactions in foreign currency in their own name. In the 1980s the cooperative and savings banks neither had direct borrowing facilities at the Bank of Finland nor were their certificates of deposit accepted for the central bank money market operations.

In terms of market behaviour it was typical to distinguish between five different banks or banking groups: two major commercial banks, KOP and SYP (Unitas), the Post office bank, the savings bank group and the cooperative bank group. In the mid-1980s, the savings bank group consisted of some 250 savings banks and a commercial bank owned by the savings banks, Skopbank. Similarly, the cooperative bank group consisted of over 360 cooperative banks and a commercial bank owned by the cooperative banks, Okobank. Skopbank and Okobank conducted on behalf of the savings and cooperative banks, respectively, many transactions which were prohibited for these banks themselves, eg borrowing from the Bank of Finland and from abroad.

An implication of regulation was that the banks were induced to compete through quality of services and in particular through branch network density. The result was high costs of operation and – by international comparison – relatively weak profitability.<sup>21</sup> This implied

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<sup>19</sup> Also insurance companies that accumulate pension contributions have been significant lenders to the private sector. However, about half of their lending has been guaranteed by deposit banks. Thus, in terms of credit risk, the deposit banks have accounted for approximately 2/3 of the private sector's borrowing even in the recent years.

<sup>20</sup> As of the beginning of 1988, the legislation on the post office bank has been essentially harmonized with that of commercial banks, so that it can for all practical purposes be considered a commercial bank.

<sup>21</sup> See eg Vesala (1995a) for an international comparison.

that some banks had considerable difficulties in meeting capital adequacy requirements, even though the requirements were not particularly demanding before the introduction of new regulations in the 1990s.<sup>22</sup> Although the regulatory capital requirements were more lenient for the savings banks and cooperative banks than for other banks, the capital adequacy problems were more serious for these banks. Given their legal nature as foundation-like entities (the savings banks) or cooperatives (the cooperative banks) they could not augment their capital via equity issues. Instead they had to rely on retained earnings, which particularly for the savings banks were typically even smaller than the (low) average for Finnish banks.

Deposits of all types of banks were fully covered by deposit insurance, provided by the respective 'security funds' of the commercial banks, savings banks and cooperative banks. Membership in a security fund was mandatory, and the insurance premium was a flat rate and generally very low so that the accumulated funds remained small.

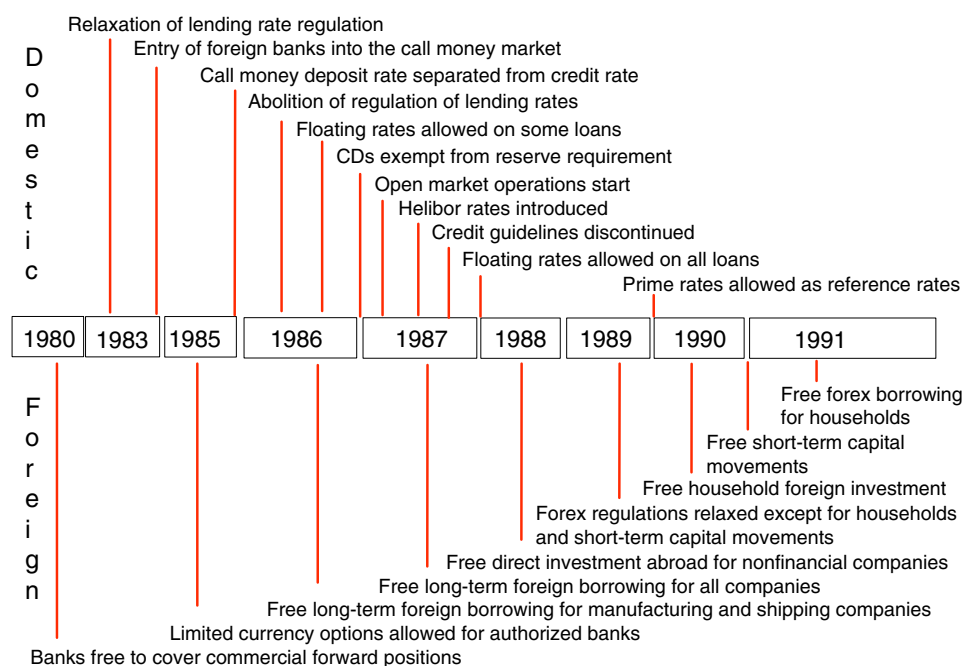
In the early 1980s, a process of gradual deregulation began (Figure 1). As a result, towards the end of 1987 capital imports and pricing of bank lending had been liberalized in an important way, while tax rules continued to favour bank deposits and borrowing in general. Prudential regulation and supervision of banks and other financial intermediaries remained effectively unchanged, although preparations to tighten capital regulations began in the mid-1980s. The new, tighter regulations came into force at the beginning of 1991.

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<sup>22</sup> The capital requirement was 4 per cent of bank liabilities for commercial banks and 2 per cent of bank liabilities for savings banks and cooperative banks. The regulations are described in more detail in Appendix 1.



Figure 1. **Deregulation of financial markets**



Liberalization of lending rates and the simultaneous changes in the central bank's operating procedures contributed to an emergence of a true money market. On the one hand, banks could now pass through to the borrowers the cost of money market funds. On the other hand, as the central bank chose its own certificates of deposits (CDs) and those of the banks as the instruments for market operations in early 1987, bank CDs became liquid instruments. The CD market provided a basis for the rapid development of markets for other instruments such as forward contracts. On the whole, the money market allowed the banks much more freedom in choosing the speed of credit extension, as they were no longer as dependent on deposit financing as before. The change was particularly significant for the savings banks and cooperative banks, which had previously been able to finance lending in excess of deposits only by borrowing from their 'central banks', Skopbank and Okobank. For some larger savings and cooperative banks, conditions in the CD market became close nearly identical to those of commercial banks in 1991, as several banks' CDs were then accepted for use in the Bank of Finland's money market operations.

At the time the major financial liberalization measures were taken, Finland's overall economic conditions were quite favourable. The economy had been largely unaffected by the second oil shock at the end of the 1970s and had grown at a relatively rapid and stable rate over a period of several years. The general government budget showed a slight

surplus, and the public sector had hardly any net debt. There was no pressing need for fiscal consolidation. Tax reforms worked instead in the opposite direction. Monetary policy was geared towards maintaining a fixed parity of the markka vis-à-vis a trade-weighted basket of currencies with in a relatively narrow fluctuation band. The central bank also succeeded in defending the existing parities with exceptionally high interest rates for a short while in autumn 1986. This presumably increased the credibility of the fixed exchange rate policy, leading many borrowers to discount the future possibility of a significant depreciation of the markka.

#### 1.4.2 The salient features of the cycle

The financial liberalization was followed by an almost immediate surge of new borrowing by the private sector. Both firms and households increased their indebtedness substantially in 1987–1990. During the era of regulation, the export sector had been favoured in the allocation of credit. The new opportunities opened up by financial liberalization thus concerned particularly industries (including services) producing for the domestic markets and for households. Firms invested heavily in new capacity in retail trade, hotels and restaurants and recreational facilities, which all involved substantial construction activity. Dwellings remained the main object of household investment, although purchases of durables and services also increased strongly. Given the inelastic supply of land and dwellings, this led early on to a steep rise in housing and real estate prices, which increased the wealth of households and firms considerably.

Credit expansion credit was strongest in the savings bank sector. While aggregate bank credit roughly doubled between the end of 1986 and 1990, the rates of growth for the savings banks and Skopbank were 120 and 300 per cent, respectively. The difference was particularly noteworthy in the second half of the boom period, in 1989 and 1990, when the growth of bank credit was already decelerating. Bank profitability improved relative to that of the early 1980s, as revenues increased rapidly while cost increases were much more subdued.

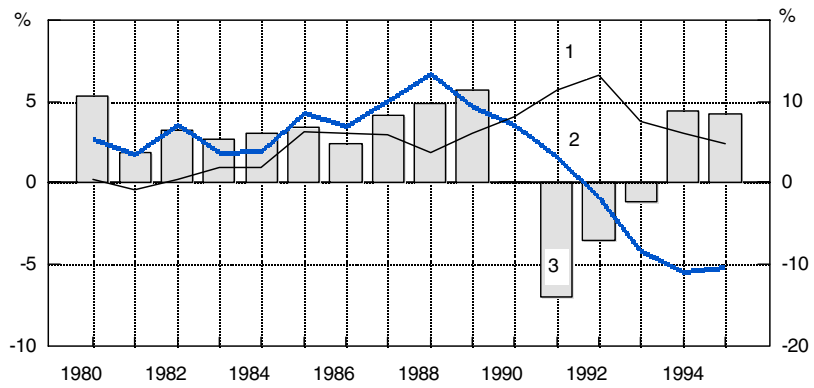
The boost to domestic demand was reinforced by buoyant demand in the western export markets in 1988 and 1989. Output responded very strongly; GDP growth exceeded 5 per cent in both 1988 and 1989, which brought the unemployment rate down to slightly over 3 per cent in early 1990. But also the external balance weakened, first mainly due to a weakening of the goods and services account but later increasingly due to increased expenditure on the rising foreign debt.

In response to the very rapid growth of credit, weakening external balance and accelerating inflation, monetary policy was tightened in late 1988 and early 1989. The markka was effectively revalued by some 4 per cent in March, which led to higher short-term interest rates. Furthermore, an extra cash reserve requirement was levied on deposit banks of up to 4 per cent of deposits and certain other funding items, the purpose being to penalize those banks whose lending growth did not decelerate below a target path by the end of 1989. Most banks had to hold these zero-yielding deposits at the central bank, but only in the case of the savings banks were they quantitatively significant. The extra reserves were paid back in 1990.

Stock prices and housing prices peaked in 1989 and credit growth started to decelerate. Economic activity also decelerated rapidly; on a year-on-year basis there was no growth in 1990. On top of the weakening domestic demand and decelerating growth of western export markets, eastern exports collapsed with the political turmoil in the Soviet Union and other Eastern European countries. As a result GDP declined by over 7 per cent in 1991. At the same time, the exchange rate came under repeated speculative attacks, and in November 1991 the markka was devalued by 12.6 per cent, despite record high interest rates. Interest rates remained high, and production and asset prices continued to decline in 1992. GDP dropped by a further 3.8 per cent in 1992 and in September 1992 the markka was floated. The currency depreciated further so that in February 1993 a trade-weighted basket of foreign currencies cost 36 per cent more than prior to the 1991 devaluation. The output decline started to decelerate in 1993, but 1994 was the first year to show positive GDP growth year on year. Unemployment increased in the process to an unprecedented level of almost 20 per cent of the labour force. The resumption of output growth did not however lead to a renewed growth of credit. Credit stocks continued to decline through 1994 and 1995. Stock prices rebounded strongly but prices of both residential and commercial property still remained historically low in 1994 and 1995.

Figure 2.

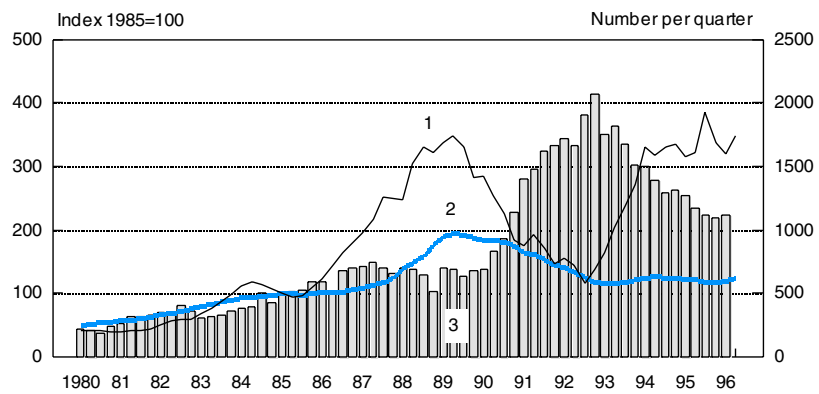
### GDP, credit and the lending rate



- 1 Real bank loan rate (GDP-deflator, right scale)
- 2 Annual growth of real private credit (GDP-deflator, right scale)
- 3 Annual GDP growth (left scale)

Figure 3.

### Stock Prices, housing prices and bankruptcies

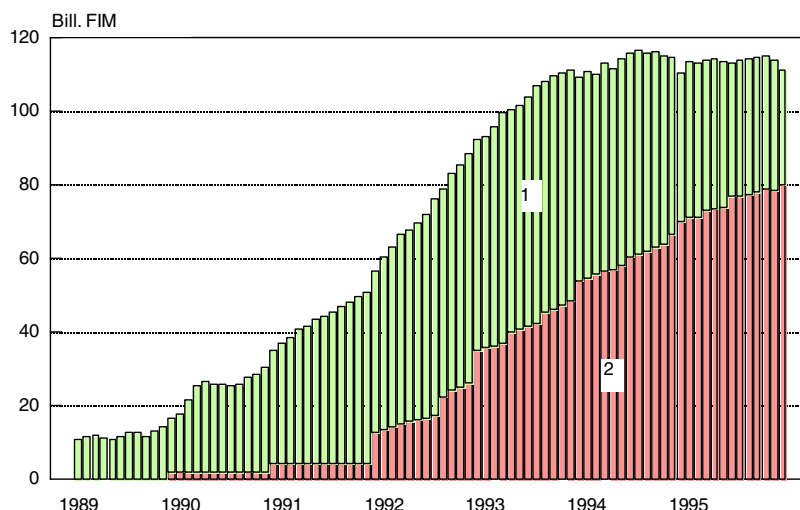


- 1 Stock prices (left scale)
- 2 Housing prices (left scale)
- 3 Number of bankruptcies (right scale)

### 1.4.3 The banking crisis<sup>23</sup>

The dramatic decline in borrowers' incomes starting in 1991 substantially reduced their capacity to service debt. Higher short-term rates increased the nominal debt service burden for many borrowers. For those borrowers who had financed investment with loans denominated in foreign currencies, the burden was similarly increased by the depreciation of the markka. Many of these firms sold primarily or solely to the domestic market, so that the exchange rate change did not have a compensating effect on revenues. Not surprisingly an increasing share of borrowers became unable to service their debts. As banks account for some two-thirds of the credit risk of the private sector – either directly in the form of loans or through guarantees given to borrowers using other financing sources – their loan stocks became increasingly non-performing, many guarantee obligations were triggered and in due time unprecedented amounts of loans had to be written off.

Figure 4. **Banks' problem assets and credit losses**



- 1 Nonperforming assets incl. guarantees and zero-interest loans
- 2 Cumulative credit and guarantee losses since December 1989

The banking problems started to emerge already in 1989. Higher short-term interest rates, declining asset prices, weaker credit growth and increased credit losses weakened bank profitability. Particularly the

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<sup>23</sup> The evolution of the Finnish banking crisis and the measures taken by the authorities are described in more detail in Nyberg and Vihriälä (1994). Koskenkylä (1995) provides international comparisons of the extent of banking problems and the costs of bank support.

highly expansionary Skopbank, which had accumulated significant securities holdings, started to see its profitability weakening in the course of 1989. In 1990 the situation worsened, but most banks still made positive profits. Skopbank's difficulties increased, however. Although it managed to show a positive profit – thanks to capital gains associated with property sales – the savings banks found it necessary to increase Skopbank's equity by subscribing FIM 1.3 billion in new shares. The authorities put Skopbank under special surveillance.

In 1991 banks generally made losses, and in September an acute crisis of confidence in the money market nearly forced the closing of Skopbank. The Bank of Finland took over the bank, injected fresh capital on the order of FIM 2 billion and removed those assets with the greatest risk for writeoffs to separate holding companies. The Skopbank rescue was followed by more general measures to support the functionality of the banking system in early 1992. In March the Government announced a programme of action consisting of two major support measures. First, the Government offered Finnish deposit banks an aggregate capital injection, to be effected by the end of 1992 and amounting to FIM 8 billion or about 14 per cent of the sectors' regulation-prescribed capital. The allocation to each bank was related to its risk-weighted assets and off-balance sheet commitments. Although the capital instrument employed – a preferred capital certificate – had many of the features of equity capital, it did not imply government ownership of a bank, unless the bank were unable to meet the conditions set for the capital injection. Almost all of the FIM 8 billion offered was in fact subscribed by the banks, even though many smaller banks refused the offer. Second, a new body, the Government Guarantee Fund (GGF), was created 'to safeguard the stable functioning of the deposit banks and the claims of the depositors'. GGF was authorized to use up to FIM 20 billion for necessary support operations.

In 1992 the situation deteriorated rapidly in parts of the banking system. Many of the larger savings banks were on the brink of collapse by summer. In June the newly created GGF stepped in, merging the problem banks and a number of other savings banks to form the Savings Bank of Finland (SBF). In the process, existing capital was fully written off to cover losses and the SBF was transformed into a joint-stock company in government ownership. By the end of the year the GGF had given the SBF bank support on the order of FIM 12 billion in the form of purchases of preferred capital certificates and subordinated debt. In November 1992 a relatively small commercial bank, STS-bank, came

close to collapse.<sup>24</sup> The government took over the risky assets and the remaining assets were sold to a private bank.

In winter 1992/1993 confidence in the Finnish economy weakened considerably. The credit ratings of the Finnish state, major Finnish banks and nonfinancial corporations had been lowered several times during 1992, the rate premium on Finnish government debt in foreign currency rose to almost 1 percentage point by the end of the year, and anecdotal evidence suggests that the Finnish banks and large corporations were unable to borrow from abroad long term and faced significant rationing in short-term borrowing as well. To stem the erosion of confidence in the banking system, Parliament published in February 1993 an unprecedented resolution in which it undertook to guarantee that the Finnish deposit banks would be able to meet their contractual commitments on time.<sup>25</sup> Simultaneously the government bank support authorization was doubled to FIM 40 billion.

Through 1993 the situation stabilized, but almost all banks continued to make substantial losses. Also the prospects for the newly created SBF remained bleak, and the Government decided in October 1993 to sell the sound SBF assets to the savings banks' four major domestic competitors. The risky assets were transferred to an asset management company operating under government guarantee. Even though the overall economic situation improved, banks still made substantial losses both in 1994 and 1995.

During the five-year period 1991–1995, the Finnish deposit banks, including the government-run asset management companies formed from the failed banks' bad assets, posted losses on the order of FIM 62 billion.<sup>26</sup> This was over 8 per cent of banks' total assets at the end of 1990 and clearly exceeded the regulatory capital of deposit bank groups (FIM 54 billion) at the end of 1990. With losses of this magnitude most if not all banks would have failed without massive government intervention. The total bank support commitment of the authorities (capital injections and guarantees) amounted to over FIM 80 billion at the end of 1995. The final cost of the support operations for the public sector has been

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<sup>24</sup> STS-bank was also originally a savings bank. In the course of the 1980s it nevertheless gradually separated itself from other savings banks and it was legally converted into a commercial bank at the beginning of 1990.

<sup>25</sup> The Swedish parliament had adopted a similar resolution already in November 1992, which was in a sense an even more radical measure, as unlike in Finland, there was no formal deposit insurance scheme in Sweden.

<sup>26</sup> This is a consolidated loss estimate, which takes into account that about 4 billion of the losses by the savings banks were due to loss of value of investments in Skopbank.

estimated by the GGF at FIM 45–55 billion or some 10 per cent of annual GDP. This is by a wide margin the largest bank support undertaking in countries having experienced banking crises in the last decade; for example, in Sweden the total support *commitment* amounts to some 6 per cent of GDP.

Table 1. **Banks' cumulative losses and public bank support, 1991–1995**

	Total assets, bill. FIM 31 Dec 1990	Regulatory capital (RCAP) bill. of FIM 31 Dec 1990	Losses, 1991–1995		Bank support (incl. guarantees)	
			bill. FIM	% of RCAP	bill. FIM	% of RCAP
Bank group <sup>1</sup>						
KOP	164	12.5	11.8	94.4	3.5	28.0
Unitas (SYP)	138	13.6	5.8	42.6	2.7	19.9
Postipankki	97	6.9	2.5	36.2	0.9	13.0
Savings Bank group	173 <sup>2</sup>	10.1 <sup>2,3</sup>	34.6	342.6	70.3	696.0
STS-bank	15	1.4	3.2	228.6	3.0	214.3
Cooperative Bank group	134 <sup>2</sup>	9.3 <sup>2,3</sup>	3.7	39.8	2.4	25.8
All deposit banks	724 <sup>2</sup>	54.1	61.6 <sup>2</sup>	116.3	82.7	153.0

<sup>1</sup> Bank groups consolidated

<sup>2</sup> Savings banks and SKOPBANK and cooperative banks and OKOBANK, respectively, consolidated

<sup>3</sup> Estimated

Bank losses and even more so bank support are very unevenly distributed. The savings banks, their central institution Skopbank and STS-bank (which also was a savings bank until the change in legal form at the beginning of 1990) account for over 60 per cent of the banking sector's total losses in 1991–1995 and for almost 90 per cent of the total bank support commitment of the authorities.

The banking problems have led to a large-scale restructuring of the banking system. As a direct consequence of solvency problems, more than half of the savings bank units of the time were merged to form the Savings Bank Finland, which later was dismantled. The two major commercial banks (KOP and SYP) merged at the beginning of 1995. This too can be seen, at least in part, as a response to the significant depletion of bank capital experienced in the crisis years by these banks, particularly by KOP. And all banks have been busy cutting costs by shedding labour, closing branches etc. For example, the number of bank



employees declined by over a third from the peak in 1989 to the end of 1995.

#### 1.4.4 Interpreting the cycle

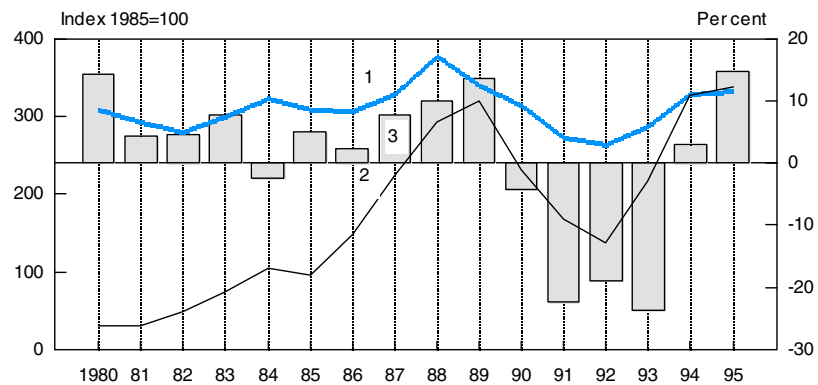
As noted above, the 'financial factors' story can be conceptually decomposed into two elements, 'the balance sheet mechanism' and 'the intermediary mechanism'. The former essentially says that the availability and cost of external funds is positively related to borrower net worth. Thus spending is constrained by the generation of internal funds – cash flow – and collateralizable assets, the value of which crucially depends on asset prices. The intermediary mechanism says that at least a part of the borrowers cannot substitute perfectly for intermediary financing, and therefore their spending decisions are affected by changes in the supply of intermediated funds. Of course, the two mechanisms are not truly independent but are likely to work simultaneously and reinforce each other. In what follows we discuss very briefly the likely role of borrower balance sheets. After that we take up more in depth the likely role of the supply of bank credit in the credit cycle of 1986–1995. Here we look at aggregate data as well as at differences in behaviour between the five major banking groups.

##### 1.4.4.1 Borrower balance sheets

The evolution of many aggregate economic variables in the period 1985–1995 certainly is consistent with a balance sheet mechanism. The period of rapid growth of private investment coincides with a rapid rise in asset values, favourable developments in cash flows and rising household incomes. Similarly the deep decline in investment is accompanied by falling asset prices, weak cash flow, particularly after interest payments, and decelerating and in the end declining external financing. Correspondingly, residential construction and household expenditure on durables go hand in hand with changes in the real price of the main household asset, dwellings.

Figure 5.

### Stock prices, corporate cash flow and investment

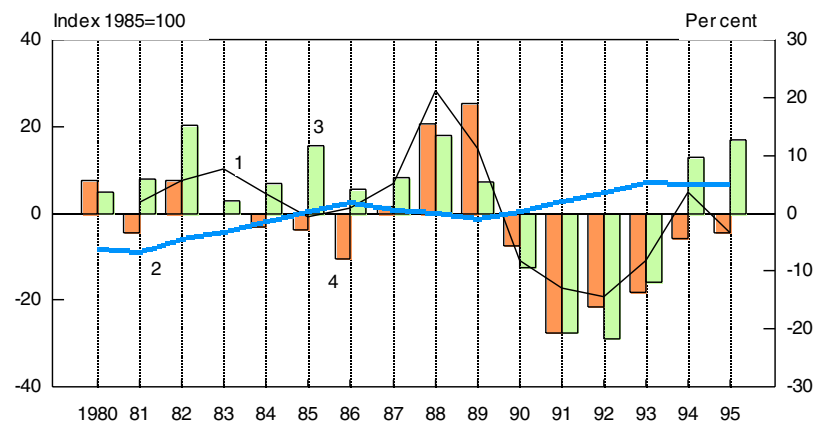


- 1 Corporate cash flow, per cent of turnover (right scale)
- 2 Real stock prices (left scale)
- 3 Growth of private investment (right scale)\*

\* excl. residential construction

Figure 6.

### Housing prices, interest rate, residential construction and durables consumption



- 1 Growth of real housing prices (left scale)
- 2 Real after-tax rate housing loan rate (right scale)
- 3 Growth of durables consumption (right scale)
- 4 Growth of residential construction (right scale)

However, these patterns as such are also consistent with the standard neoclassical explanation: investment is determined by the marginal productivity and cost of capital (approximated by the tax- and inflation-adjusted rates of interest). In this explanation high asset prices merely reflect high future returns on the existing capital stock as do high cash

flows. And the correlation of credit and investment is due solely to demand side effects. More careful analysis is obviously needed.

Several studies on investment behaviour with Finnish data prior to the financial liberalization suggest that private investment is affected by cash flows; see Koskenkylä (1985) for an analysis with aggregate data and Peisa and Solttila (1984) for an analysis with panel data. However, these results may be mainly due to intermediation frictions created by regulation, and the suspicion remains that changes in investment opportunities were not adequately taken into account.

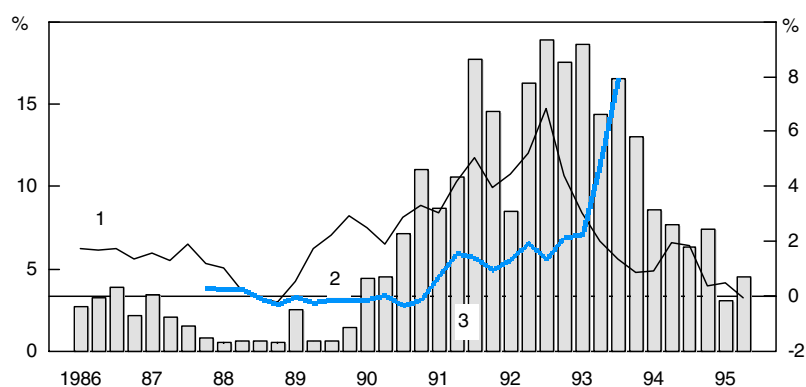
A couple of recent studies have shed some light on the determinants of private investment during the boom-bust period. Kajanoja (1995) estimates three types of investment equations for both manufacturing and non-manufacturing sectors with quarterly data through the second quarter of 1993. Each of the 'flexible accelerator', 'neoclassical' and 'Tobin's-q' specifications contains an indebtedness variable (the ratio of gross long-term debt to capital stock). Kajanoja finds that for the manufacturing sector indebtedness is of no consequence. However, investment in the nonmanufacturing sector is significantly negatively affected by the debt ratio. And even quantitatively the effect on investment in 1993 can be assessed as non-negligible: investment would have been 6–15 per cent higher had the debt ratio been at the 1980 level. But, given the steadily increasing debt ratio in 1980 through 1992, changes in indebtedness as measured in the study cannot explain the rapid growth of nonmanufacturing investment in the late 1980s.

Brunila (1994) investigates corporate investment using panel data on 280 large firms for the years 1985–1992. Investment opportunities are controlled for by sales growth and cost of capital by the average rate of interest on existing interest bearing liabilities. Both obtain significant coefficients with the expected signs. In addition, investment is affected positively by cash flow and negatively by indebtedness. Consistent with the aggregate time series results of Kajanoja, the indebtedness variable exerts a more powerful influence on the nonmanufacturing firms, even though the effect is now significant for both types of firms. The difference may reflect the nature of the available collateral assets in the two sectors. The cash flow effect is equally important for the two sectors, quantitatively as well as in terms of statistical significance. Consistent with panel data studies on other countries, the effects of both cash flow and leverage are highly nonlinear in the degree of leverage: the impacts are clearly stronger for the high-leverage firms.

Surveys on management sentiment yield results broadly consistent with the above econometric findings. Thus in the aftermath of deregulation, with asset prices on a steep rise and cash flows improving,

the perception of financing as a constraint on production was very rare among manufacturing firms. The situation was completely reversed some years later.<sup>27</sup> Surveys also indicate that availability of acceptable collateral has been the most important perceived problem in obtaining financing during the period of low asset values.

Figure 7. **Financing difficulties, interest rate and corporate risk premium**



- 1 Real rate on new bank loans to firms (gdp defl., left scale)
- 2 Risk premium: secondary market yield difference between corporate bonds and bank-guaranteed bonds (right scale)
- 3 Per cent of firms reporting availability problems (left)

The little data that exist on corporate bond premia suggest that significant risk of corporate defaults began to be perceived in early 1991 with the steep decline of production, increasing numbers of bankruptcies and the continuing decline of asset prices. The secondary market for corporate bonds, thin even in the best of times, more or less disappeared in winter 1992/1993, suggesting the perception of extreme risk.<sup>28</sup> Anecdotal evidence corroborates the message of the corporate risk premia: the availability of external financing was very tight for even larger

<sup>27</sup> Actually the share of firms that report financing as a constraint on production is relatively small even in the worst of times. The importance of the financing difficulties of the corporate sector may nevertheless be underestimated in the survey, as the sample covers only manufacturing firms and has a strong overrepresentation of large enterprises.

<sup>28</sup> Data on secondary market yields of corporate bonds have been collected since 1988, although the number of bonds for which quotations exist has always been small. Furthermore, the data is contaminated by the fact that some of the bonds have had bank guarantee. Thus the recorded price premia are likely to underestimate companies' cost of bond financing. In early 1993 quotations on relevant bond prices became rare and highly volatile, preventing the calculation of reliable yields.

companies in winter 1992/1993 and was alleviated substantially by the following autumn.

As a whole, there seems to be little doubt that a balance sheet mechanism was in operation during the recent Finnish cycle, even though its exact role is difficult to assess. The overall behaviour of the Finnish economy appears to resemble very much that of other countries having recently been subject to large scale swings in asset prices and cash flows (see Jonung et al 1996 and Borio et al 1994).

#### 1.4.4.2 Intermediaries' behaviour at the aggregate level

Should the supply of intermediated funds have been a significant factor affecting the boom-bust cycle, one would expect to find expansionary shocks to intermediaries during or prior to the boom period and contractionary shocks during or prior to the bust period. For the boom period financial liberalization provides an obvious potential series of shocks. For the contractionary period, several negative shocks can be contemplated: the tighter credit policies of 1989, tighter capital regulations in 1991 and (for the cooperative and savings banks) again in 1994, depletion of capital since 1991, resource-consuming restructuring and rationalization measures particularly since 1992, and the impact of realized losses and their consequences for bank managers' attitudes to risk. In addition, the reductions in the tax advantages for bank deposits may have made a contribution.

In what follows the role of the supply of bank credit is discussed both in the period of rapid growth and the subsequent period of deceleration and decline of credit. We consider specifically the composition of firms' and households external financing, the issuance of corporate bonds, bank interest margins and an indicator of bank risk.

#### Composition of external financing

When a given class of intermediaries is hit by shocks involving any of the above areas, one would expect, *ceteris paribus*, a change in the share of financing provided by the source of funds in question. Similarly one would expect to see a change in the relative price of financing. However, the latter is more difficult to identify, given the measurement problems associated with the multidimensional nature of financing prices and the potential for rationing. Importantly, changes in borrower credit quality should not imply changes in the shares of any single sources of

financing, unless some class of borrowers can rely solely on a single source.

The composition of corporate sector external funds is perhaps the most useful piece of financial mix information. As firms have in principle many alternative sources of funds, the relative contribution of bank financing should change in a systematic way when the supply of bank credit is hit by shocks. Also the evolution of household credit may be of some interest, although the scarcity of alternatives probably makes it difficult to distinguish between demand shocks and shocks to a particular type of supply.

It seems obvious that while the liberalization of capital controls and lending rates and the emergence of the money market implied a positive shock in the supply of credit to the private sector in general, it affected most significantly bank lending.

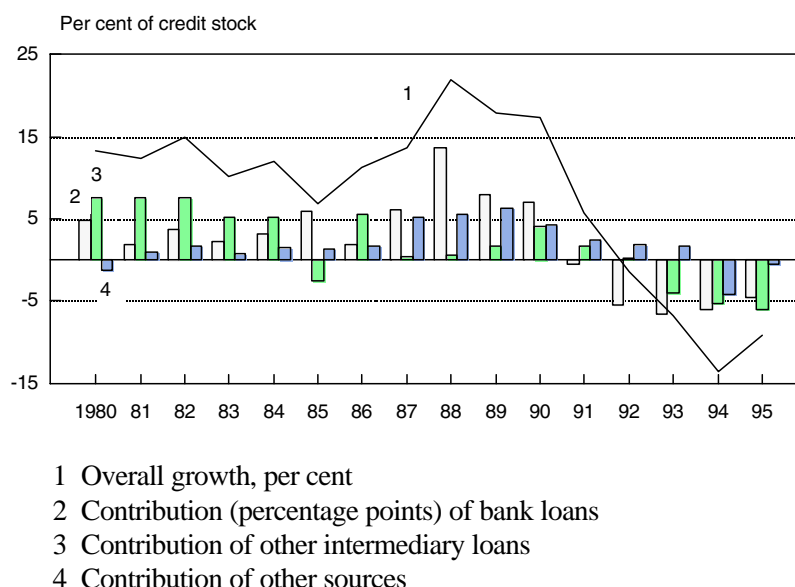
In part the liberalization of capital movements in 1986 and 1987 eased the direct foreign currency borrowing of firms from abroad. But this effect probably was not very important in itself, such as only large firms could and did resort to that type of financing; even in the early 1990s the firms borrowing directly from abroad numbered under 100. And these large firms had even earlier been granted licences for importing capital. A more important immediate consequence of the liberalization of capital controls was that banks could now intermediate long-term foreign-currency financing from abroad to their corporate customers. Thus the liberalization of capital controls provided banks a new source of funds to finance the supply of credit.

Similarly, the emerging money market probably improved banks' financing possibilities more than the availability or cost of short-term credit to firms from the securities market. Only large firms can use commercial paper, at least without credit enhancement by banks, and these firms very likely had faced the least constraint on short-term credit earlier. Finally, the abolition of lending rate controls also made the pricing of bank credit easier while leaving other sources of credit unaffected.

Consistent with these predictions about the effects of financial liberalization, the composition of firms' external financing moved strongly towards bank financing in 1987 and 1988. Most of the substantial growth comes from this source. In 1987 this may have been partly due to 'reintermediation' as financing moved back to banks' balance sheets from bank-owned finance companies. These companies had expanded rapidly during the two or so preceding years, as they provided a way of circumventing the still existing lending rate

regulations. But also in 1988 bank lending was by far the dominant element of overall credit expansion.

Figure 8. **Corporate sector external financing by source**



The growth of private sector credit started to decelerate from the beginning of 1989, but firms' external financing (mainly credit) nevertheless increased quite robustly in 1989 and almost throughout 1990. However, the share of bank credit declined in both years, suggesting that the supply of this type of financing became relatively more scarce. The introduction of the special cash reserve requirement is one readily available explanation for the relative decline of bank lending in 1989, but not anymore in 1990 when the cash reserve deposits were paid back.

In 1990 the supply of bank credit may have been constrained by the imminent tightening of capital regulations at the beginning of 1991. But this shock to the supply of bank credit may have been less important for the share of bank loans than for two other factors. First, the possibilities for direct foreign financing improved as constraints on the sale of markka bonds abroad were lifted. Second, financing from insurance companies in the form of relending of pension contributions became

attractive relative to bank credit, as the regulated price of this financing did not rise along with the general level of interest rates.<sup>29</sup>

In the first year of declining output, 1991, bank lending to firms came to a virtual standstill, while borrowing from other financial institutions, particularly from insurance companies, continued at a relatively robust pace. Again, the continuing relative decline of the price of insurance company relending may account at least for a part of the decline in the share of bank lending. However, no obvious positive shocks can be attributed to the other alternatives to bank credit. Thus it is likely that the supply of bank credit was hit by a negative shock. As already noted, the tightened capital regulation is one such potential shock. But one cannot exclude that also prospects for capital losses due to weak profitability played a role as well, given the increasing amounts of nonperforming loans and bankruptcies through out the year.

In 1992 bank credit contracted strongly while the stocks of other types of credit remained largely unchanged. Therefore, it appears likely that the supply of bank credit was hit by a strong negative shock. Given the unprecedented losses of the banks as a whole and the complete wiping out of the capital of the savings banks, capital insufficiency is a natural candidate for the cause of the decline.<sup>30</sup> In addition, the on-going restructuring in the savings bank sector may have negatively affected the credit supply. By 1992 at the latest senior bank managers probably also had become aware that large losses imply significant changes in bank management; risk attitudes probably changed as a result.

In 1993 the picture started to change as large firms increased their external funding from the bond market and the stock market. Also, in 1994 large firms raised substantial amounts of equity capital. Bond financing nevertheless collapsed, presumably in response to the steep rise

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<sup>29</sup> The automatic relending of pension contributions is a special feature of the Finnish earnings-related pension system. Firms that make pension contributions are entitled to borrow two-thirds of their contributions at regulated rates, provided they post acceptable collateral. In 1990 finding adequate collateral (bank or equivalent guarantees, good real estate collateral) did not seem to be a problem. Banks and a government agency selling such guarantees started to raise their guarantee fees only in 1991. The median fee for manufacturing firms, 50 basis points in 1989 and 1990, more than doubled to 120 basis points by 1993.

<sup>30</sup> It seems clear that by the first half of 1992 banks had become aware that huge losses of capital could not be avoided. Prospects for raising private capital were weak even for banks that in principle could issue equity and corresponding Tier-I capital instruments. Furthermore, although the Government had promised a capital injection of FIM 8 billion for the Finnish banks, its terms were regarded as rather stiff by the banking community. And the terms at which additional support would be available from the GGF – although not well articulated by the authorities – were considered very harsh. The treatment of the Savings Bank of Finland in autumn 1992 very likely confirmed these conjectures.

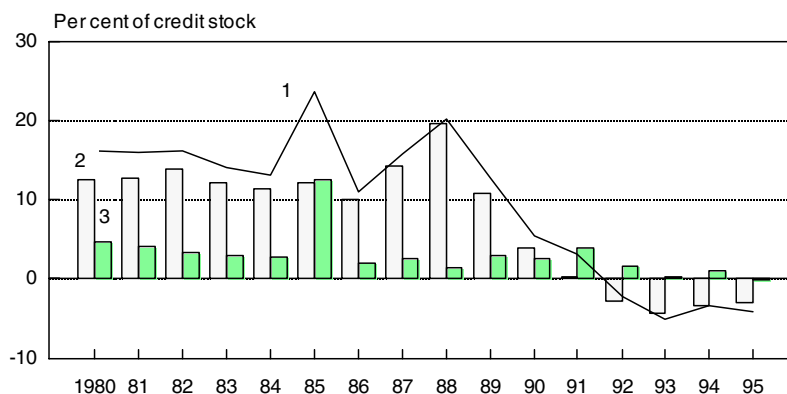


of long-term interest rates in the spring. Bank lending however continued to decline in both years. But so did borrowing from other financial intermediaries and in 1994 also directly from abroad. Although in 1993 a further decline of the supply of bank credit looks quite possible, and presumably for the same reasons as in 1992, also other factors very likely contributed. In particular, the open sector dominated by large corporations started to experience improving cash flows and balance sheets, and this had a positive effect on their creditworthiness. On the other hand, the nonmanufacturing sector dominated by small businesses continued to be depressed, with demand for credit and borrower quality weak. This asymmetry – most likely not present during the early phase of the recession – may imply that low demand for all types of intermediated credit and the weak quality of borrowers that were dependent on such credit were the reasons for declining bank and other intermediated credit in 1993 and particularly in 1994. It probably affected behaviour also in 1995.

The composition of household borrowing is consistent with the above interpretation of corporate sector borrowing mix. In the wake of the early deregulatory measures, bank lending to households increased rapidly while other financing was relatively modest. However, after 1989 the contribution and share of bank loans declined, falling essentially to zero in 1991, just as in the corporate sector. Thereafter, household borrowing from banks has declined. However, as noted, the information value of the composition of household borrowing is likely to be less than that for firms. The main alternative financing sources for households are various subsidized public credit schemes – chiefly for housing. Given their advantageous terms, these loan facilities are usually used up to the regulated maximum. Bank loans are thus a more expensive residual source of finance. Therefore a change in the mix is likely to reflect overall demand conditions to a greater extent than relative supplies.

Figure 9.

### Household credit



- 1 Overall growth
- 2 Contribution (percentage points) of bank loans
- 3 Contribution of other credits

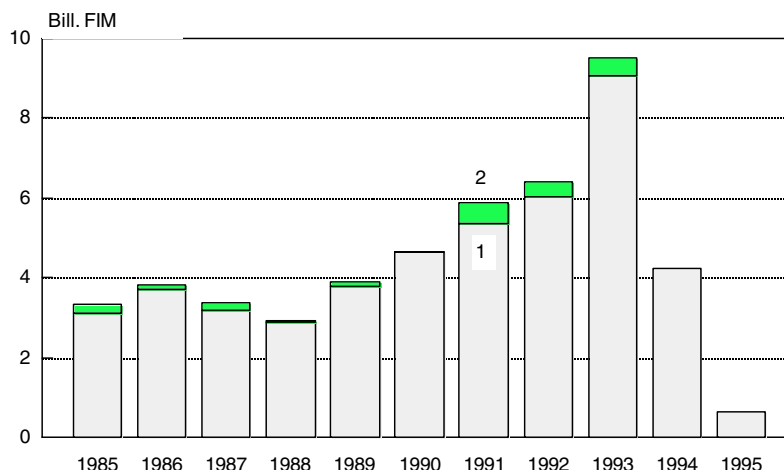
Also the evolution of gross issues of corporate bonds corresponds closely to the above story about shocks to bank credit supply. Despite the rapid overall credit growth in 1987–1988, bond issues in fact declined. They started to increase at the same time that bank lending was decelerating in the wake of the special cash reserve requirement in 1989. And the rapid growth (relative to earlier years) continued in 1990–1993. Although at least in part this may have been due to the noted lifting of restrictions on the sale of markka-denominated bonds, substitution for increasingly scarce bank lending cannot be excluded as a reason.<sup>31</sup>

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<sup>31</sup> However, only a small fraction of bonds have ever been issued by non-listed corporations without bank or equivalent guarantee. Thus bond finance has been a true alternative to bank and other intermediary loans only for a very small corporate segment.

Figure 10.

### Issues of corporate bonds



- 1 Other firms
- 2 Small, own risk

Small, own risk = public bonds issued by non-listed companies without guarantee. 1994 and 1995: no distinction available between public and private issues.

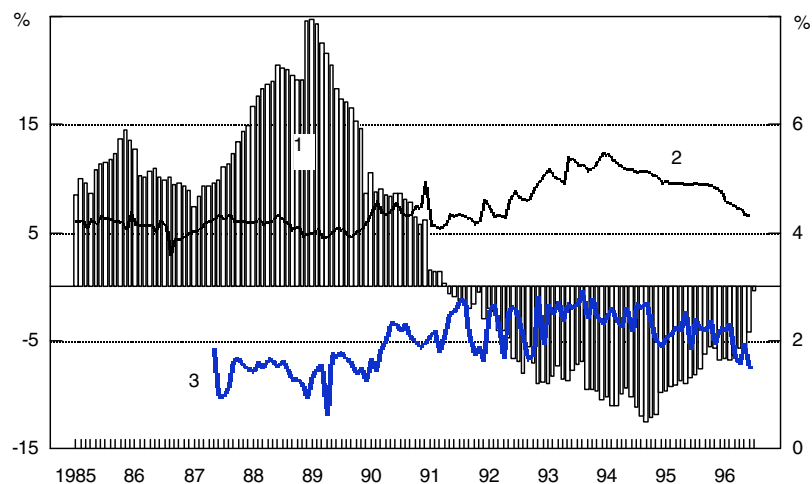
As noted, the decline in bond issues in 1994 probably was due to the sharp increase in long-term interest rates in spring 1994. But another factor was probably the easing of borrowing needs due to strong cash flows of large (mainly export orientated) corporations that can borrow in the bond market in the first place. This factor very likely became even more important in 1995 when long-term rates were already declining. In any event, resorting to the bond market was not necessary to replace possibly lacking financing from banks. The general improvement of the availability and terms of financing is supported also by the surveys on management sentiment discussed earlier.

#### Price data

Bank margins (differences between lending and funding rates) may be informative as to the relative roles of supply and demand shocks. In the absence of rationing phenomena and assuming constant borrower quality, an outward shift in the demand for bank loans should increase the margin and an outward shift in the supply should decrease the margin, *ceteris paribus*.

Figure 11.

### Bank lending and interest rates



- 1 Real growth of lending (deflated by CPI), left scale
- 2 Interest margin on the loan stock, percentage points, right scale
- 3 Interest margin on new loans tied to 3-month Helibor, right scale

The margin between the average rate on the bank loan stock (markka loans) and the average funding cost (weighted average of deposit rates and money market rates) declined somewhat from 1987 until 1990, increased thereafter until late 1993, after which it has again been declining.<sup>32</sup> In a simple demand-supply framework the observed price and volume patterns suggest the following interpretation. Positive supply shocks were dominant from the time major liberalization measures were taken at least until loan growth peaked around the turn of the year 1988/1989. After this, the decline of loan growth in 1989 and 1990 reflected equally both slackening demand and declining supply, while in 1991 through late 1993 negative supply shocks were dominant. From 1993 on, weakness of demand more so than weakness of supply is suggested as the cause of declining bank credit.

Unfortunately the overall interest margin is also changed by changes in the yield curve. A better indicator of the relevant relative price of bank credit may be the margin between the average rate applied to new loans linked to a given money market rate and the relevant reference rate. The most representative such margin is the one between variable-rate loans linked to the three-month money market rate, data on which exist from

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<sup>32</sup> A steep temporary hike in the margin can be observed towards the end of 1990. It presumably reflects more or less solely the effects of the expected change in the taxation of interest income on deposits in January 1991. A substantial part of the maturing long-term tax free deposits with relatively high rates were not renewed in 1990 but the funds were left in low-yielding transaction accounts to wait for the new high-yielding savings outlets subject to a low withholding tax.

mid-1987. It behaves somewhat differently but leads broadly to the same conclusions as the overall margin of markka intermediation. Despite very rapid credit growth until the end of 1988, this margin did not widen but if anything showed a marginally narrowing trend. From some time in 1989 until mid-1993, the margin was widening, after which it narrowed again. The main difference between the two margins is that the margin on new loans suggests that negative supply shocks dominated declining demand already from 1989.

Conclusions based on interest rate margins nevertheless require several caveats. The most important problem is that it is not only shocks to the supply of credit and shocks to the willingness of the potential borrowers to borrow (pay for loans) that change the margin. Borrower quality is also reflected in the margin. Thus narrow margins in the growth period and wide margins in the contraction period may reflect (perceived) good borrower quality in good times and bad quality in the bad times, rather than changes in supply. The only way to distinguish between the two is to explicitly analyse borrower quality, which can hardly be done with aggregate data. Fortunately, there exists a study of this period using micro data.

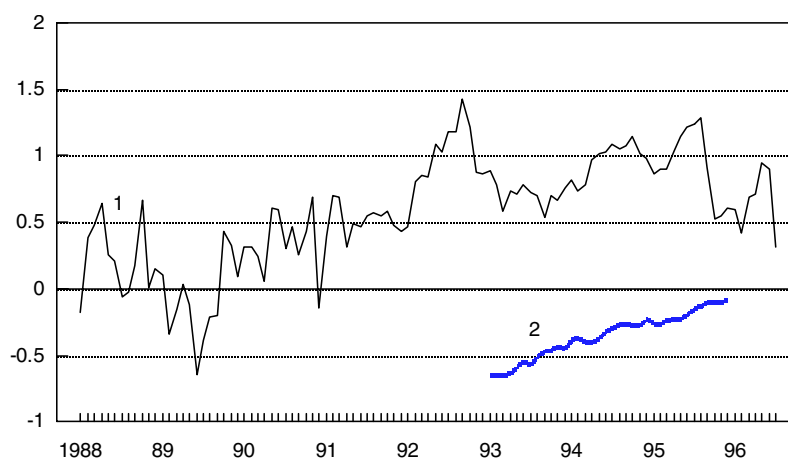
Murto (1994) investigates the pricing of bank loans with data on some 1900 savings bank customers over the period 1987–1992. He finds that after controlling for many characteristics of borrowers (and also some characteristics of the lending banks) the margin over and above the reference rate was narrower in the boom years than in the early crisis period covered by the study. This is consistent with our aggregate observation that margins were on the decline during the boom years and on the increase during the early crisis years and thus supports the above conclusion that supply shocks at least in part explain the margin changes both in the boom period and in the crisis years.

A second problem is that the increase in margins in 1989–1993 is likely to underestimate both the weakening of borrower quality and the tightening of credit supply. First, adverse selection and moral hazard problems are likely to be more important in bad times than in good times. Therefore rationing as a means to control these problems is likely to increase in bad times. Second, the loans extended in the crisis period include renegotiated loans to ailing customers. Renegotiation usually implies lower rates. Thus the rates applied to other (healthy, new) customers must be clearly higher than the average rates, while such a difference is unlikely to exist in good times.

Another type of price data concerns the risk premia applied to banks' uninsured funding. For Finnish banks such data of reasonable quality exist only for five-year bonds guaranteed by the banks, the yields of

which can be compared with the yields of corresponding government debt. The time series for such a spread variable is broadly consistent with the pattern of the private sector financing mix. Until late 1989 there was no systematic bank credit risk over and above the government debt risk. In late 1989 through early 1992 the yield premium hovered around 0.5 percentage point, to increase in 1992 to clearly over 1 percentage point. Thus in the period of rapid expansion, no premium can reliably be observed while in the period of deceleration and contraction the premium was high.<sup>33</sup>

Figure 12. **Bank risk and sovereign risk**



- 1 Bank risk: The yield difference between 5 year bank and government bonds
- 2 Sovereign risk: The yield difference between US and Finnish government bonds

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<sup>33</sup> The behaviour of this measure of bank risk is somewhat puzzling in 1994 and 1995, however. It seems to increase even though banks in the same time reported an easing of financial conditions, and banks' relative share in corporate borrowing did not decline anymore. The main factor is probably that the rapid growth of bank deposits (subject 100 % deposit insurance) made banks less dependent on purchased funds. Thus even though buyers of money market instruments may have attached a higher default premium than before, banks lending opportunities have not been constrained by financing, as deposit funding has been plentiful. In part, also the decline in the sovereign risk of the Finnish state could explain why the increase in the bank-debt/Finnish state-debt spread is not reflected in the perceived funding difficulties of the banking sector.

### A preliminary conclusion

Based on aggregate level observations as to the composition of firms' and households external financing, the corporate bond market and price data on bank lending and funding, a tentative interpretation emerges for the evolution of the supply of bank credit.

Starting in 1987, financial liberalization was followed by an outward shift in the supply of bank lending. Positive supply shocks dominated until some time in 1989. After the peaking of the growth rate of bank lending at the end of 1988, both the demand and supply schedules started to shift backward. Through 1990, the last year of overall credit growth, negative supply shocks increased in importance and continued to contribute to the decline of the credit stock, at least in 1991 and 1992, and perhaps also in 1993. From 1993 on, weak demand and questionable borrower quality were likely behind the continued decline in the stock of bank loans.

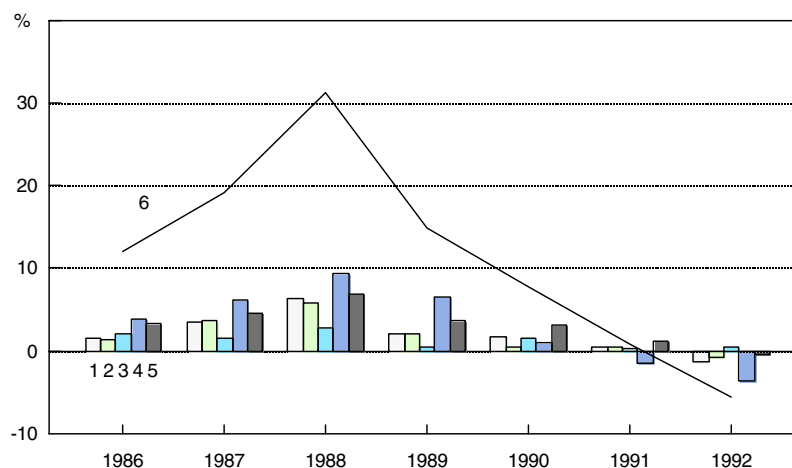
The patterns of lending growth and interest margins suggest that in the expansion phase financial liberalization very likely increased bank lending quite directly through its impact on the availability and cost of banks' refinancing, both in the domestic money market and in the foreign capital market. But whether moral hazard associated with potentially underpriced bank liabilities or changes in banks' lending policies due to increased competition or simply myopic expectations contributed to the speed of credit growth cannot be assessed on the basis of aggregate observations. In any case, the findings of Vesala (1995b) suggest that bank competition increased in the second half of the 1980.

Similarly, for the contraction phase several potential explanations exist for a backward shift in banks' credit supply. Tightening of capital regulations, the substantial depletion of bank capital, changed risk attitudes and disturbances caused by restructuring are all possible explanations of the negative supply shocks of this period. Thus, in particular, a credit crunch due to bank capital problems seems possible in 1991 and 1992. The results of the only study that has attempted to discover a relationship between bank capital and lending with Finnish data are consistent with this conjecture. Following the approach of Bernanke and Lown (1991), Soltila and Vihriälä (1992) find a statistically significant negative relationship between the growth of lending by individual savings banks in 1991 and their projected capital adequacy indicator. However, the effect was even smaller than that found by Bernanke and Lown. Furthermore, the analysis suffers from a very inadequate treatment of the potential demand factors, and there is no attempt to account for differences in borrower quality.

### 1.4.4.3 Diversity of bank behaviour and risk taking

The overall evolution of bank credit hides very disparate speeds of credit extension by different banks. As noted, the savings bank group (the savings banks and their central bank Skopbank) expanded credit far faster than its competitors during the boom period. The difference is particularly pronounced in 1989, when the savings banks continued the rapid expansion while other banks were already showing significant restraint in lending. This is clearly problematic from the point of view of the above hypothesis that financial liberalization as such is the only positive supply shock of the boom period. The new opportunities to finance credit expansion were open to all banks.

Figure 13. **Contributions of bank groups to the growth of bank credit**



- 1 KOP
- 2 SYP
- 3 PSP
- 4 Saving banks (incl. Skop)
- 5 Cooperative banks (incl. Oko)
- 6 All

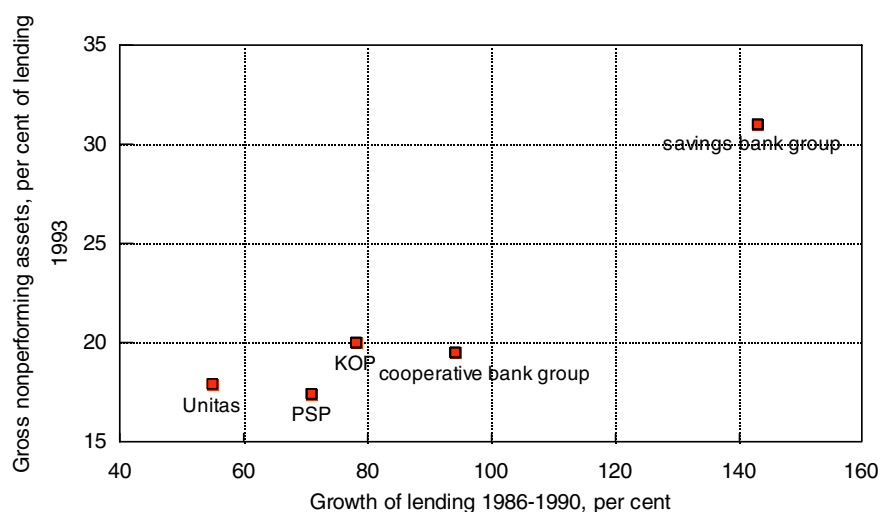
One can argue that the development of the money market favoured particularly the savings banks and the cooperative banks, which did not have direct access to central bank facilities. These two classes of banks may also have obtained particular advantage from the liberalization of capital controls, as their traditional clientele (households and small businesses) had not earlier had any access to foreign borrowing, unlike the large industrial firms that relied on commercial banks for their bank financing. But even these explanations fall short of accounting for the



observed differences among banks. They do not explain why the cooperative banks on average did not seize upon the new opportunities as did the savings banks.

Another important aspect of credit growth becomes obvious when one considers the differences between banks: rapid growth was very risky. A clear positive relationship exists between realized risks in the crisis period and the speed of credit expansion in the boom period. The savings banks (including Skopbank) expanded far faster than other major banks, and ended up with largest shares of problem assets (Figure 14).

Figure 14. **Lending growth and nonperforming assets**



An analysis of individual savings and cooperative banks confirms this conclusion. Solttila and Vihriälä (1994) find that even after controlling for sectoral composition of bank lending and a number of other factors, the speed of credit growth in the boom period is the main explanatory factor in differences between bank groups as regards problem assets in the crisis period. For the savings banks, hardly any other factor is of importance.

The moral hazard explanation of excessive risky lending would require that the banks that took the most risk were also the banks with the weakest net worth. In fact, this seems to be the case in the Finnish credit boom of the late 1980s. Plotting the rate of growth of bank lending in the second half of the 1980s against the average operating profit in the first half of the 1980s shows that the bank groups that chose to expand lending most also were the bank groups with the weakest underlying

profitability (Figure 15).<sup>34</sup> The most expansive group, the savings bank group, stands out as also the least profitable group.

A popular explanation of the rapid growth of lending by Finnish savings banks in the 1980s is that the savings banks tried to overcome what was perceived to be a serious profitability problem in the early 1980s by expanding their scale of operation in order to lower unit costs. A good opportunity to do so was perceived when deregulation lifted constraints on nondeposit funding and unleashed repressed demand for credit. Kuusterä (1995) provides ample documentation of decisions consistent with this hypothesis.

How does this explanation square with the moral hazard explanation? In a sense, the 'lower unit costs through growth' story is very different from the moral hazard hypothesis and the related managerial theories. The moral hazard hypothesis explains rapid growth of lending by deliberate risk-taking facilitated by inadequate pricing of bank funding while the popular explanation refers to a reduction of unit costs through growth and is silent about credit risk. But the two stories share essential features. Both require that the lenders to banks do not price the funds they provide too high, otherwise financing the new business opportunities would not be profitable. The stories also share the prediction that high costs imply more lending. The real difference thus is whether the bankers and their creditors perceived lending to be risky or not.

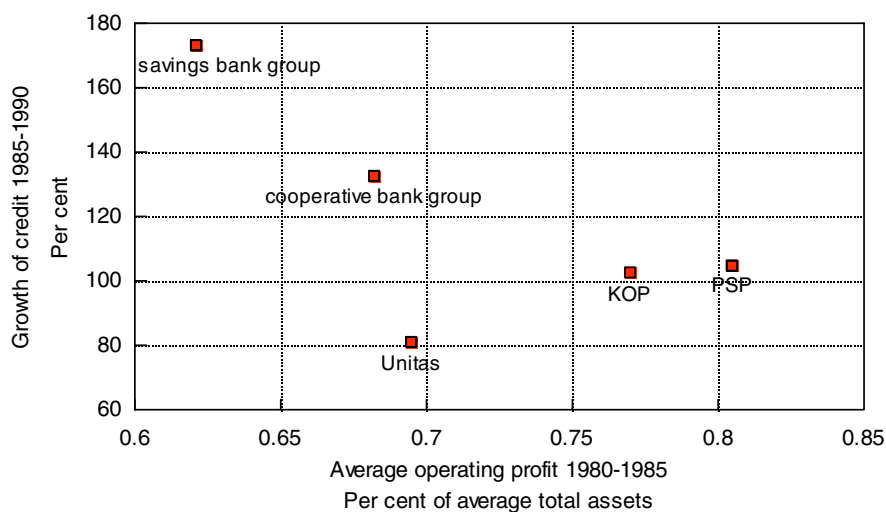
But banks differ also in respects other than costs or underlying profitability. In particular, clientiles are different in terms of geographic location and sector. Such differences need to be taken into account in order to draw inferences about the moral hazard hypothesis.

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<sup>34</sup> Operating profit excludes depreciation, extraordinary items and taxes, the first two of which have varied a great deal in part to minimize taxes. Operating profit is likely to be the best available measure of a bank's underlying profitability and therefor also its 'charter value'.

Figure 15.

### Bank profitability and lending growth in the 1980s



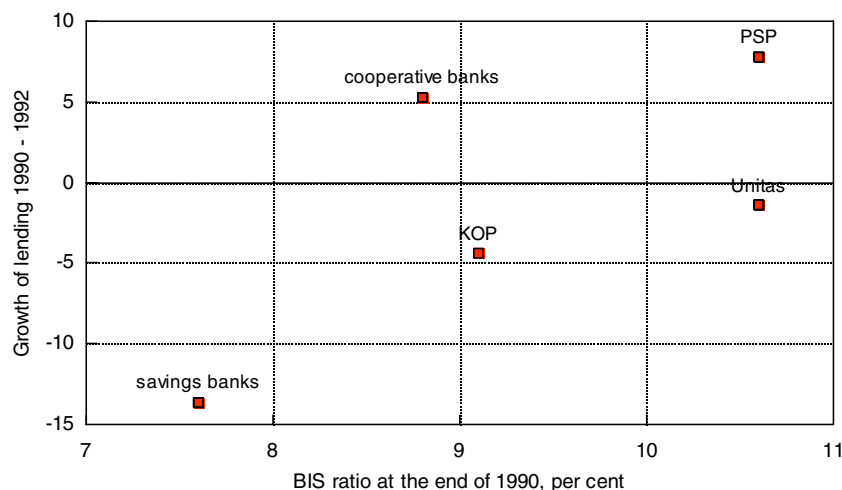
Also the pattern of deceleration and contraction of credit were quite different for the different bank groups. Following the slower-than-average deceleration of lending in 1989 and 1990, the savings banks cut lending sharply in 1991 and 1992.<sup>35</sup> Given that these banks faced the gravest of capital adequacy problems, a capital crunch seems a possible explanation (Figure 16). But equally well, a credit crunch for reasons other than capital inadequacy is possible. The savings bank group also was subject to the most stringent supervisory actions applied to any of the banks, as Skopbank was taken over by the Bank of Finland in 1991 and a major part of the individual savings banks ended up in government ownership in 1992. As a result, additional risk taking by these institutions was presumably strongly constrained and the radical restructuring measures of these failed institutions may have disturbed their lending business significantly.

But as noted, different banks have had somewhat different clienteles as well, and this may at least partly explain the observed inter-group differences. In particular, the savings banks may have had more customers in those sectors and areas that were most severely hit by the recession: the real estate and services sectors and those towns and regions that which grew most rapidly in the boom period. Thus both demand (customers' willingness to pay for credit) and borrower quality may have declined more for the savings banks than for other banks.

<sup>35</sup> After 1992 assessing the evolution of credit by individual institutions is difficult given the drastic changes in the banking structure.

Clearly, to isolate the effect of bank capital and other bank characteristics, these factors have to be incorporated into the analysis.

Figure 16. **Capital ratios and lending growth in the early 1990s**



#### 1.4.4.4 Real effects of bank lending?

Even if it could be established that banks' credit supply has been hit by significant shocks either in the boom period or in the bust period or both, such shocks may not be important from the point of view of real outcomes. First, hardly any agent is fully dependent on bank credit. It is indeed clear from the data reported above that substitution has taken place. The question thus is to what extent substitution can and does mitigate the effects on real decisions of shocks to banks' supply of credit. Second, variation in spending due to factors other than the cost and availability of external financing may be quantitatively much larger than that due to these financial factors.

The traditionally predominant position of deposit banks as sources of funds for the private sector in Finland suggests that the scope for substitution must be much less in Finland than, say, in the United States. Shocks to banks' credit supply should thus be more powerful in Finland. Given that even some studies with recent US data have found quantitatively significant real consequences of banking problems, one would expect that at least in the distress period of the 1990s shocks to banks' credit supply could have had observable effects on spending in Finland. However, precisely at the same time borrower quality and probably willingness to borrow also declined. Thus, as noted earlier, we

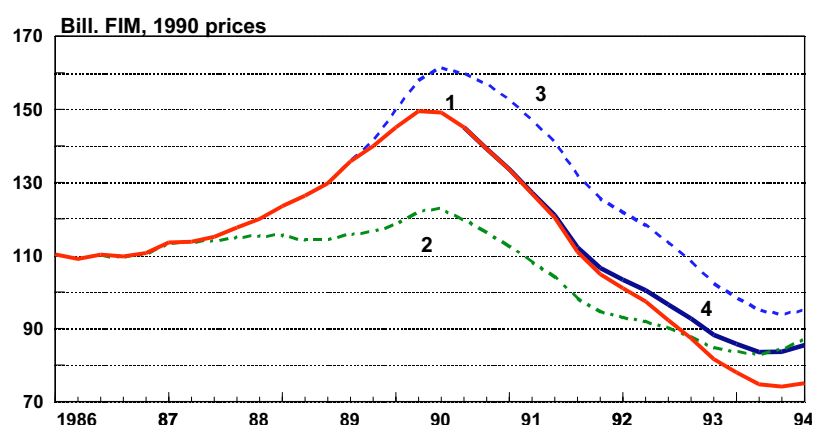
need an analysis that combines borrower quality and bank characteristics. This in practice requires firm level (preferably panel) data.

But some insight into the role of bank credit may also be gained from aggregate analysis. Saarenheimo (1995) provides a relevant exercise. He examines in a VAR framework the relative roles of money (M2) and bank loans (the sum of markka and foreign currency loans to the private sector) in the determination of private fixed investment using data from the first quarter of 1970 through the second quarter of 1994. The basic result of the analysis is that, even after allowing for the contribution of money stock and loan rate, bank credit exerts a significant independent effect on investment in dynamic simulations. Money and credit are strongly contemporaneously correlated but the importance of credit remains even if all of this correlation is attributed to shocks in money. However, money loses all of its impact on investment if the 'ordering' is the other way round.

Simulations in which the shocks to credit are set to zero from a given quarter onwards suggest that had no credit shock taken place since 1986:3, investment would hardly have increased in the boom years and would have ended up in 1993 and 1994 slightly higher than it did in fact. Zeroing the shocks since 1989:1 would have resulted in substantially higher investment in all years 1990 through 1994. However, if only the shocks since 1990:3 had been eliminated, the deviation of investment from the true path had been much smaller.

Figure 17.

### Private investment: actual and simulated



- 1 Actual private investment (four-quarter moving sum)
- 2 Simulation from 1986:3; no shocks to credit
- 3 Simulation from 1989:1; no shocks to credit
- 4 Simulation from 1990:3; no shocks to credit

Source: Saarenheimo, T., Bank of Finland, Discussion Paper 6/95.

Conditional on the assumption that the estimated shocks to bank credit indeed represent supply shocks, Saarenheimo's results suggest that changes in the supply of bank credit can explain a substantial part of both the rapid growth and the steep decline of investment over the boom-bust cycle. However, in the years of the banking crisis shocks to credit supply appear to have been of relatively modest magnitude. Furthermore, in the light of earlier discussion, it is unlikely that all shocks to Saarenheimo's credit equation are due to changing bank behaviour. Thus in particular, the quantitative significance of a 'credit crunch' caused by banking problems may have been limited.

#### 1.4.5 Conclusions

There is little doubt that a 'financial accelerator' based on borrower balance sheet quality and cash flow has played a role in the Finnish credit cycle of 1986–1994. Given the highly non-linear effects predicted by theory, the balance sheet mechanism can be assumed to have been especially important in the transformation of the economic downturn into a deep and long recession.

However, it remains unclear what was the importance of the weakening of firm and household balance sheets and cash flows relative to the standard mechanisms of cyclical variation based on interest rates and income and profitability expectations.

In the light of aggregate and some bank-group level observations, it also seems plausible that changes in the credit supply of financial intermediaries have contributed to the credit cycle. Financial liberalization undoubtedly created a positive shock to the supply of bank credit. Similarly, a series of negative supply shocks seems capable of explaining at least a part of the subsequent decline in bank credit, i.e. a credit crunch is quite possible.

But many issues remain unclear. Why was the reaction of credit growth to liberalization so strong and why was it so unequal among the banks? Were the obvious impulses stemming from better financing possibilities augmented by distorted incentives to take excessive risks? Some broad observations suggest that such moral hazard may have been played in part.

Similarly the period of declining bank credit raises many questions. Although the preliminary aggregate level analysis gives some support to the credit crunch hypothesis, its importance relative to the balance sheet mechanism is very difficult to establish, as borrower quality weakened at the same time as banks' credit supply was hit by potentially important

negative shocks. And even if one concludes that there was a shift in banks' credit supply, it is not at all clear that this was due to a shortage of bank capital, as suggested by the typical credit crunch stories.

## 2 Bank Capital, Capital Regulation and Lending

### 2.1 Introduction

This chapter explores the theoretical reasons for bank behaviour which may have contributed to the credit cycle of the Finnish Economy since the mid-1980s. By contribution is meant the role of banks' credit supply behaviour which may have caused the supply of credit to become in some sense 'excessive' in the aftermath of financial liberalization in the late 1980s and 'too small' in the early 1990s. The benchmark is a situation in which credit growth is determined simply by the return on the projects to be financed and 'the rate of interest', ie a situation where banks' behaviour and characteristics do not play any role.

As discussed in chapter 1, several broad stories exist in the literature to explain why bank behaviour may matter, and in particular why it may vary in such a way as observed in the Finnish credit cycle. Many of these stories give a central role to bank capital or net worth.

A large literature based on asymmetric information argues that the firms' net worth affects its cost and availability of external financing. Thus weak bank capital may force banks to restrain lending as refinancing becomes increasingly expensive or cannot be obtained at all due to lemons premia. Bankruptcy costs or 'costs of financial distress' may also have the same effect even under symmetric information (see eg Berger, Herring and Szegö 1995). These 'market-based' capital effects may be reinforced by capital regulation imposed by the authorities. As a consequence, depletion of bank capital, say due to credit losses, may lead to a 'credit crunch' or more specifically a 'capital crunch'.

Bank capital plays an important but rather different role also in one of the leading explanations for potential excessive risky lending by banks. Under limited liability the value of bank equity can be increased by increasing the riskiness of bank assets provided the cost of bank liabilities does not respond sufficiently to the increased credit risk. Starting with Merton (1977) and Kareken and Wallace (1978), flat-rate deposit insurance has been considered an important source of underpricing of bank funding and therefore of 'moral hazard' incentives. The smaller bank capital or net worth to begin with, the greater are these incentives. Thus although underpricing of bank liabilities is the



fundamental cause of excessive risk taking, the amount of capital greatly affects the size of the problem.

In what follows we examine the roles of bank capital and capital regulation in a model, which incorporates the most typical features of Finnish banks and the capital regulation applied to them. The aim is to illustrate how bank lending can be either too expansionary and too small relative to a Modigliani–Miller situation within a simple model, depending on the precise assumptions as to the pricing of bank liabilities and the penalties associated with bank default. In doing so we develop testable implications of the 'excessive lending due to moral hazard' and 'credit crunch due to capital inadequacy' hypotheses applicable to Finnish banking since 1985.

The analysis will be conducted in a fairly standard static framework, which assumes value maximization as the objective of the banking firm. The simplicity of the framework allows us to use a relatively rich liability structure and incorporate a reasonably realistic capital regulation while keeping the comparative statics largely unambiguous. The assumptions of the model are made with particular regard to the characteristics of the Finnish savings and cooperative banks in the late 1980s and early 1990s, as data on these banks will be used in the subsequent empirical analyses. The framework used is very similar to that of Dermine (1984, 1986) in his analyses of banks' deposit and credit pricing. Of the recent theoretical models used to study the credit crunch, the model of Passmore and Sharp (1994) is perhaps closest to our set-up.

This chapter is organized as follows. The basic assumptions of the model are laid down and discussed in section 2.2. The case of fair pricing of marginal funding with a liability-side capital regulation is analysed in section 2.3 while the cases of underpricing and overpricing are analysed in section 2.4. Section 2.5 shows how the model works with an asset-side capital regulation. Finally in section 2.6 we summarize the main results and discuss some specific implications of the model for explaining the Finnish credit cycle.

## 2.2 The model

We take as the point of departure the so-called Klein–Monti model of bank behaviour augmented with credit risk (Klein 1971). Such a model has been used eg by Dermine (1984, 1986). It is thus assumed that the bank owner/manager maximizes the value of equity or expected end-of-period net worth. Also the providers of funds to the bank are assumed to be risk-neutral.

The asset and liability structure is constructed so as to embody the essential features of the Finnish savings and cooperative banks.

The basic assumptions are as follows:

(i) Bank balance sheet:  $L + B = K + D + S + M$ ,

where L = loan(s) to risky investment project(s)

B = riskless bonds

K = equity capital (exogenous)

S = subordinated debt

D = (core) deposits (exogenous)

M = money market debt or other senior debt

Assuming equity capital to be exogenous in the static setting is a very close approximation of the situation of the Finnish saving and cooperative banks. Until 1991 the savings banks had in practice no instruments to augment equity capital; equity could be increased only through retained earnings.<sup>1</sup> Since 1991 the savings banks have been allowed to issue 'basic fund shares' and the cooperative banks 'investment shares' which are counted as equity. Their importance however has been miniscule.

Instead, the banks have been able to issue freely subordinated debt, which functions as a cushion vis-à-vis senior debt in the case of insolvency. Up to a limit, as will explained later, subordinated debt also counts as regulatory capital.

Senior debt is divided here into exogenous 'deposits' and endogenous 'money market debt' (or other senior debt). The former is assumed to represent the retail deposits that the banks may obtain, owing eg to tax privileges and full deposit insurance, at such low rates that all such deposits are accepted under all circumstances. Although Finnish regulations have varied over time, the rates on tax-exempt transactions and time deposits have been constrained clearly below market rates by law. The underpinning of these so-called core deposits represents a legislated privilege given to banking firms. It can be said to create 'charter value' to the firms licenced to do banking business. A problem for empirical analysis is that the empirical content of core deposits has changed significantly over time and one may not be able to identify a meaningful core deposit variable throughout the period of interest.

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<sup>1</sup> The significance of cooperative capital as a source of equity was very small also for the cooperative banks; furthermore, the right of the members of a cooperative to withdraw their share of cooperative capital under certain circumstances makes such capital questionable as equity that could be used to cover losses.

The rest of senior debt is assumed to be available at posted rates or posted marginal cost at or above the bond rate. Such funds are denoted by  $M$  and called money market debt. In the Finnish context this item contains, apart from true money market debt in the form of certificates of deposit (CDs), interbank borrowing and possibly also taxable time deposits.

It is assumed that  $D$  is senior to  $M$  in the case of bankruptcy. This is not strictly in accord with Finnish legislation, but it simplifies the analysis without distorting the qualitative results.

(ii) Interest rates and returns:

L:  $R(L) = 1 + r(L,x)$  is the contract rate. It is assumed that the marginal contractual revenue,  $MR \equiv \partial(R(L)L)/\partial L$ , is diminishing in  $L$  due to local or temporary monopoly power. This rather standard assumption in this type of model can be rationalized, for example, by the monopoly power created by informational advantages of customer relationships (see eg Rajan 1992).  $x$  is a demand shift variable: borrowers are willing to pay more for a given stock of loans when  $x$  increases, ie  $\partial MR/\partial x > 0$ .

$a$  is a stochastic return on the fixed-size project financed by the bank loan, with d.f.  $f(a,z)$  and c.d.f  $F(a,z)$  known by all agents. The lower and upper bounds of the return distribution are denoted by  $a^{\min}$  and  $a^{\max}$ .  $z$  is a parameter affecting borrower quality in the sense of first-order stochastic dominance. The higher the value of  $z$ , the better the borrower quality:  $\partial F(a,z)/\partial z \leq 0$ ,  $\partial f(a,z)/\partial z < 0$  for small  $a$  and  $\partial f(a,z)/\partial z > 0$  for large  $a$ .

The structure implies that the larger the value  $L$ , the larger the set of the realizations of the project returns in which the firm does not meet the contractual commitment and the bank incurs a credit loss. In particular, the ratio of credit losses over the contractual commitment increases with loan volume, mimicing the empirical findings of Solttila and Vihriälä (1994).

B:  $R^B$  is exogenous constant

K: residual claim

- S:  $R^S$  is determined so as to make the expected return on an investment in S,  $E(R^S S)$ , equal to the return on an investment of the same size in the safe asset B. The posted rate, which is greater than or equal to the bond rate, is thus fair from the point of view of a risk neutral investor.
- D:  $R^D < R^M$  is an exogenous constant. Apart from representing the average cost of the exogenous cheap funds,  $R^D$  may be interpreted as any exogenous cost element that is independent of other liabilities.
- M: The posted rate  $R^M$  is assumed to be equal to or greater than the bond rate. In one version of the model,  $R^M$  is assumed to be determined just as is  $R^S$ , ie to make the expected return on an investment in M equal to that of a bond portfolio of the same size. Apart from this fair pricing of M, also the version is analysed where  $R^M(M)$  is an exogenous non-decreasing function of M. The exogenous cost schedule can reflect rather different underlying assumptions. On the one hand, a relatively flat schedule could be consistent with the assumption of an implicit form of creditor protection (or if M is interpreted as time deposits, a flat rate explicit deposit insurance). On the other hand, a steeply rising cost schedule could stand in for a rapidly rising lemons premium associated with (unmodelled) asymmetric information about bank behaviour. This is a rather standard motivation of this type of exogenous schedule (see eg Kashyap and Stein 1994).

(iii) Capital adequacy regulation:

Prior to 1991 Finnish banks were required to have capital equal to at least 4 per cent (commercial banks) or 2 per cent (savings banks and cooperative banks) of total liabilities (excluding some specific items) and half of the off-balance sheet commitments. Subordinated debt was among the items subtracted from the liability base and could be counted as capital (to a maximum of 50 per cent of proper capital). Since 1991 the regulations (following BIS recommendations) have required that banks have

capital amounting to at least 8 per cent of risk-weighted assets and off-balance-sheet commitments.<sup>2</sup>

There are in principle several ways of introducing capital constraints into the analysis. The simplest approach is to set an ex ante constraint in the form  $K > k(D + M)$  or  $K > kL$ . That is what, for instance, Peek and Rosengren (1995b) do in their credit crunch analysis. This is, however, rather unsatisfactory, as it does not take into account the possibility that banks may sometimes fail to fulfil the requirement and that the regulation is enforced with different degrees of strictness.

A more natural way of introducing capital regulation is to postulate a non-pecuniary cost to the bank (owners/managers) in the case of non-fulfilment of the requirement. Direct empirical counterparts of such penalties could be the costs associated with law suits for negligence and prohibition of further banking activities on the part of the management and exclusion of the owners from the privileged banking market with a positive charter value. Here it is assumed that this cost is proportional (coefficient  $c \leq 1$ ) to the shortfall of regulatory bank capital (the sum of net worth and subordinated debt) (the fraction  $k$  of the base). Thus with the pre-1991 rules, the cost of non-fulfilment of the requirement can be written:  $c(k(R^D D + R^M M) - (a + R^B B - R^D D - R^M M - R^S S + R^S S))$ . The capital with which the bank meets the requirement thus consists of bank net worth (the sum  $a + R^B B - R^D D - R^M M - R^S S$ ) and the value of subordinated debt  $R^S S$  which is counted towards regulatory capital up to a given maximum,  $S^{\max}$ . The regulatory cost is incurred when project outcome  $a$  falls short of  $a^k \equiv (1 + k)(R^D D + R^M M) - R^B B$ .

The cost  $c$  can be interpreted as the product of the probability of inspection of capital adequacy and the penalty imposed in case of non-performance. The value  $c = 1$  would correspond to unlimited liability in the sense that the cost would be equal to a capital injection sufficient to make the bank just meet the regulatory constraint in every state of the world. The value  $c = 0$  represents the case of no effective capital regulation. Finally, one may even contemplate a perverse case with  $c < 0$ , if a failure to meet the capital requirement is rewarded by government bank support, say in the form of subsidized loans, purchases of assets at inflated prices, injection of capital etc.

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<sup>2</sup> For details, see Appendix 1.

The above formulation corresponds to that of Dermine (1984). However, in his model the threshold for the project return is set at the point where the bank is just able to meet its contractual commitments ( $k = 0$ ). Furthermore, our interpretation of the cost of capital insufficiency is somewhat different.<sup>3</sup>

One can postulate an analogous cost of capital insufficiency to depict the current (as of 1991) capital regulation. In this case the threshold for the project return is  $a^k \equiv kRL + R^D D + R^M M - R^B B$ .

It is reasonable to assume that the bank must always meet the capital requirement ex ante, ie that the supervisors would not allow a bank to operate if the contractual loan rate were so low that the bank would be sure to fail the capital regulation.

In order to simplify the presentation, two typical features of this type of model are left out: the reserve requirement and the deposit insurance premium. The former would in our setting be a tax on reservable deposits, and their effects can be analysed by altering the exogenous cost of such funds.

Similarly, the existing flat-rate deposit insurance premium levied on the balance sheet total would be very easy to incorporate by simply postulating that the bank has to pay an ex ante tax of size  $p(L + B)$ . However, if it is flat rate (as in Finland), it has no interesting implications, so it is left out of the present analysis.

Given the seniority structure of the various claims on the bank, the returns contingent on the project outcome are, under the pre-1991 capital regulation, as follows:

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<sup>3</sup> Dermine interprets these costs, which he assumes to be always positive, as bankruptcy costs. If by bankruptcy cost is meant administrative costs and the reduction of the value of a firm's assets in liquidation, such costs should reduce the value of the claims of the creditors, ie the costs ought to be pecuniary rather than non-pecuniary, as here. In that sense a bankruptcy cost interpretation would seem somewhat questionable.

Here, as in Passmore and Sharpe (1994), the penalty is interpreted in the first place as a regulatory punishment by the authorities. As such the non-pecuniary nature of the penalty would seem quite appropriate. On the other hand, sticking strictly to a regulatory cost interpretation may be unnecessarily narrow. The banks which fail to meet the capital adequacy standards may in fact be penalized also by the 'market' even in the absence of a bankruptcy. For managers, loss of reputation may be a significant factor. Uncertainty about the value and fate of a bank failing a capital requirement may temporarily hamper the bank's possibilities to conduct business and make the equity stake illiquid for a while even if the bank need not in the end be reorganized in a way that creates dead-weight costs.

### Return on S

$$\begin{cases} R^S S, & \text{when } a \geq a^S \equiv R^S S + R^D D + R^M M - R^B B \\ a + R^B B - R^D D - R^M M, & a^S > a \geq a^M \equiv R^D D + R^M M - R^B B \\ 0, & a < a^M \end{cases} \quad (1)$$

### Return on M

$$\begin{cases} R^M M, & \text{when } a \geq a^M \\ a + R^B B - R^D D, & a^M > a \geq a^D \equiv R^D D - R^B B \\ 0, & a < a^D \end{cases} \quad (2)$$

### Return on D

$$\begin{cases} R^D D, & \text{when } a \geq a^D \\ a, & a < a^D \end{cases} \quad (3)$$

### Return on K

$$\begin{cases} RL + R^B B - R^S S - R^M M - R^D D, & \text{when } a \geq RL \\ a + R^B B - R^S S - R^M M - R^D D, & RL > a \geq a^k \equiv \\ & (1+k)(R^D D + R^M M) - R^B B \\ a + R^B B - R^S S - R^M M - R^D D - c(a^k - a), & a^S \leq a < a^k \\ -c(a^k - a), & a < a^S \end{cases} \quad (4)$$

Note that  $a^S < a^k$  is equivalent to the requirement that  $R^S S < k(R^D D + R^M M)$ , ie that subordinated debt alone can never meet the capital requirement. Given the constraint that subordinated debt can be counted as regulatory capital only up to 50 per cent of the core capital K, this condition is always fulfilled when subordinated debt is needed for capital adequacy reasons.

## Expected returns

The expected return of subordinated debt is

$$E(R^S) = \int_{a^S}^{a^{\max}} R^S S f(a) da + \int_{a^M}^{a^S} (a + R^B B - R^D D - R^M M) f(a) da. \quad (5)$$

Adding and subtracting  $R^S S \int_{a^M}^{a^S} f(a) da$ , integrating by parts and utilizing the definitions of  $a^S$  and  $a^M$  allows (5) to be written as

$$E(R^S) = R^S S - \int_{a^M}^{a^S} F(a) da. \quad (6)$$

Equating (6), with the return on a safe investment of the same size yields the condition for the fair pricing of subordinated debt:

$$R^S S = R^B S + \int_{a^M}^{a^S} F(a) da. \quad (7)$$

In (7) the second term of the RHS is the required default premium, which is a highly nonlinear function of the portfolio composition.

Similarly, one obtains the rule for the fair pricing of money market debt:

$$R^M M = R^B M + \int_{a^D}^{a^M} F(a) da. \quad (8)$$

It is obvious that (7) and (8) imply the following bounds for the fair posted rates:

$$\frac{R^B}{1 - F(a^M)} \leq R^S \leq \frac{R^B}{1 - F(a^S)} \quad (9)$$

$$\frac{R^B}{1 - F(a^D)} \leq R^M \leq \frac{R^B}{1 - F(a^M)} \quad (10)$$

As one would expect, the fair posted rate is higher for subordinated debt than for money market debt. If there is no risk that the bank will default on money market debt or subordinated debt, ie  $F(a^M) = F(a^S) = 0$ , the posted rates naturally collapse into the safe bond rate.

In the same fashion, the expected value of equity  $K$ ,



$$\begin{aligned}
E(V) = & \int_{RL}^{a^{\max}} (RL + R^B B - R^S S - R^M M - R^D D) f(a) da \\
& + \int_{a^S}^{RL} (a + R^B B - R^S S - R^M M - R^D D) f(a) da \\
& - \int_{a^{\min}}^{a^k} c(a^k - a) f(a) da,
\end{aligned} \tag{11}$$

can be written after some manipulation as

$$E(V) = RL + R^B B - R^S S - R^M M - R^D D - \int_{a^S}^{RL} F(a) da - c \int_{a^{\min}}^{a^k} F(a) da. \tag{12}$$

## 2.3 Maximization of bank value with fair pricing of subordinated debt and money market debt

We consider first the case where all endogenous funding takes place at a fair rate, ie that risk neutral investors require an expected return  $R^B$  on both subordinated debt and money market debt. At that expected rate the supplies are fully elastic. Later we examine the situation in which the price for money market debt deviates from the fair price.

### 2.3.1 The optimization problem

Given the assumption of risk neutrality, the objective of the bank (owner/manager) is to maximize bank value subject to the balance sheet constraint, pricing constraints, non-negativity constraints and the constraint  $S \leq S^{\max}$ . The decision variables are the balance sheet items  $L$ ,  $B$ ,  $S$  and  $M$ . The Lagrangean is

$$\begin{aligned}
Z = E(V) + \lambda_1 (L + B - K - D - S - M) + \lambda_2 (R^S S - R^B S - \int_{a^M}^{a^S} F(a) da) \\
+ \lambda_3 (R^M M - R^B M - \int_{a^D}^{a^M} F(a) da) \\
+ \mu_L L + \mu_B B + \mu_S S + \mu_M M + \eta_S (S^{\max} - S)
\end{aligned} \tag{13}$$

Differentiation of the Lagrangean with respect to the decision variables and the prices  $R^S$  and  $R^M$  (to guarantee the fulfilment of fair pricing in the markets for subordinated debt and money market debt) yields the Kuhn–Tucker conditions:

$$\begin{aligned}
Z^L &= MR(1 - F(RL)) + \lambda_1 + \mu_L = 0, \quad MR \equiv \frac{\partial(R(L) \cdot L)}{\partial L} \\
Z^B &= R^B(1 - F(a^S)) + cR^B F(a^k) + \lambda_1 \\
&\quad + \lambda_2 R^B(F(a^S) - F(a^M)) + \lambda_3 R^B(F(a^M) - F(a^D)) + \mu_B = 0 \\
Z^S &= -R^S(1 - F(a^S)) - \lambda_1 + \lambda_2(R^S(1 - F(a^S)) - R^B) + \mu_S - \eta_S = 0 \\
Z^M &= -R^M(1 - F(a^S)) - c(1+k)R^M F(a^k) - \lambda_1 \\
&\quad - \lambda_2 R^M(F(a^S) - F(a^M)) + \lambda_3(R^M(1 - F(a^M)) - R^B) + \mu_M = 0 \\
Z^{R^S} &= -S(1 - F(a^S)) + \lambda_2 S(1 - F(a^S)) = 0 \\
Z^{R^M} &= -M(1 - F(a^S)) - c(1+k)M F(a^k) - \lambda_2 M(F(a^S) - F(a^M)) \\
&\quad + \lambda_3 M(1 - F(a^M)) = 0 \tag{14} \\
Z^{\mu_L} &= L \geq 0, \quad L \cdot \mu_L = 0; \quad Z^{\mu_B} = B \geq 0, \quad B \cdot \mu_B = 0 \\
Z^{\mu_S} &= S \geq 0, \quad S \cdot \mu_S = 0; \quad Z^{\mu_M} = M \geq 0, \quad M \cdot \mu_M = 0 \\
Z^{\eta_S} &= S^{\max} - S \geq 0, \quad \eta_S(S^{\max} - S) = 0; \quad Z^{\lambda_1} = L + B - K - D - S - M \\
Z^{\lambda_2} &= R^S S - R^B S - \int_{a^M}^{a^S} F(a) da; \quad Z^{\lambda_3} = R^M M - R^B M - \int_{a^D}^{a^M} F(a) da.
\end{aligned}$$

Noting that  $\lambda_2 = 1$  ( $\Rightarrow \lambda_3 = 1 + \frac{c(1+k)F(a^k)}{1 - F(a^M)}$ ) and making the substitution  $\lambda_1 = -MR(1 - F(RL))$  on the assumption that the portfolio always contains some amount of loans, we can restate the first-order conditions for the three endogenous variables:

$$Z^B = R^B (1 - F(a^M) + cF(a^k)) + \lambda_3 R^B (F(a^M) - F(a^D)) + \mu_B - MR(1 - F(RL)) = 0 \quad (15)$$

$$Z^S = MR(1 - F(RL)) - R^B + \mu_S - \eta_S = 0 \quad (16)$$

$$Z^M = MR(1 - F(RL)) - R^M (1 - F(a^M) + c(1+k)F(a^k)) + \lambda_3 (R^M (1 - F(a^M)) - R^B) + \mu_M = 0. \quad (17)$$

Adding (15) and (17) yields

$$(R^B - R^M)(1 - F(a^M)) + cF(a^k)(R^B - (1+k)R^M) + \lambda_3 (R^M(1 - F(a^M)) - R^B + R^B(F(a^M) - F(a^D))) + \mu_B + \mu_M = 0. \quad (18)$$

Substituting  $\lambda_3 = 1 + c(1+k)F(a^k)/(1-F(a^M))$  in (18), multiplying by  $1-F(a^M)$ , and rearranging terms yields

$$[R^B(1 - F(a^M))^2 - (1 - F(a^M)) + cF(a^k)(1 - F(a^M))(R^B - (1+k)R^M) + c(1+k)F(a^k)(R^M(1 - F(a^M)) - R^B)] + (1 - F(a^M))(\mu_B + \mu_M) = 0. \quad (18')$$

In (18') the first term in the brackets is negative for all  $F(a^M) \geq 0$  and strictly negative for all  $F(a^M) > 0$ . Given the right inequality in (10), the second and third terms are also negative for all  $c \geq 0$ . This implies that  $\mu_B + \mu_M > 0$ . Therefore, if  $M > 0$  then  $B = 0$ , and if  $B > 0$  then  $M = 0$ .<sup>4</sup>

In the optimum the bank thus can never hold bonds and money market debt simultaneously in its portfolio. This reflects risk neutrality and the fact that the model does not have any time dimension that would make holding liquid assets (like government bonds) valuable when their posted rate is less than the marginal cost of financing such acquisitions.<sup>5</sup>

The solutions can thus be divided into two simple qualitatively different sets: one with positive money market debt and the other with no money market debt but possibly bonds in the portfolio. The first type of solution is likely to be more relevant for most of the banks in which we

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<sup>4</sup> In the perverse capital regulation with  $c < 0$ , the separation of the solutions obtains only when the absolute value of  $c$  is sufficiently small.

<sup>5</sup> Here the model differs clearly from that of Passmore and Sharpe, in which 'liquidity costs' motivate simultaneous holdings of loans and bonds even under risk neutrality.

are interested, in that it applies to a bank that actively funds itself in the market.<sup>6</sup> Demand for these banks' loans is large enough so that it can be profitably financed through the issuance of money market debt. The case of no money market funding applies to banks that face such a weak demand for loans that their main concern is how to allocate the cheap deposits, exogenous in the model, between risky lending and safe bonds.

### 2.3.2 Solution with strong loan demand ( $M > 0$ , $B = 0$ )

Substituting  $MR(1 - F(RL))$  in (17) from (16) yields

$$-(1 - \lambda_3) (R^M(1 - F(a^M)) - R^B) - c(1 + k)R^M F(a^k) - \mu_S + \eta_S + \mu_M = 0. \quad (19)$$

With  $c > 0$ , all terms other than  $\eta_S$  in (19) are negative, so that  $\eta_S$  must be positive, implying  $S = S^{\max}$ . A bank having money market debt must therefore have the balance sheet  $L = K + D + S^{\max} + M$ . This is the case because the investors require the same expected rate of return on both  $S$  and  $M$ , and for the bank the former is always more profitable because it helps the bank meet the capital requirement and thereby avoid the non-pecuniary costs associated with failure to do so. If there is no effective capital regulation ( $c = 0$ ), no specific amount of subordinated debt is implied, as subordinated debt is equivalent to senior debt for both the investors and the bank. In the perverse case of  $c < 0$ , the optimal amount of subordinated debt is zero.

The relevant first order condition for the determination of  $L$  and  $M$  is thus (17), which after substituting  $\lambda_3$  takes the form

$$MR^* \equiv MR(1 - F(RL)) = R^B \left( 1 + \frac{c(1 + k)F(a^k)}{1 - F(a^M)} \right) \equiv MC^M \geq R^B. \quad (20)$$

Given the assumption that  $MR$  is decreasing in  $L$ , it is easy to see by differentiation that the first order condition indeed defines a maximum, provided  $c \geq 0$ . If  $c < 0$ , then it is required that the expected marginal

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<sup>6</sup> The assumption that banks issue money market debt certainly applies to 'a representative Finnish deposit bank' since the mid-1980, when a true money market was established. For example, at the end of 1990 the banks had certificates of deposits (the primary money market instrument) outstanding of the order of FIM 70 billion or some 25 per cent of their markka loans outstanding. Of the Finnish cooperative and savings banks, only 11 per cent had debts to other banks and to 'the market', which was less than 10 per cent of their lending at that time.

revenue declines faster than the expected marginal cost of money market debt. The second order condition is shown in Appendix 2.

(20) says that the expected marginal revenue from loans must equal the expected marginal cost of money market debt including the cost associated with capital requirement. The absence of a penalty for failing to meet the capital requirement,  $c = 0$ , would imply a straight equalization of the expected marginal revenue on loans with the required expected return on money market debt, ie the bond rate. In this case the optimal loan volume does not depend in any way on bank characteristics. The bank balance sheet is inconsequential in the sense of Modigliani–Miller. And, as already noted, in the no-penalty case, the bank would not distinguish between subordinated debt and money market debt.

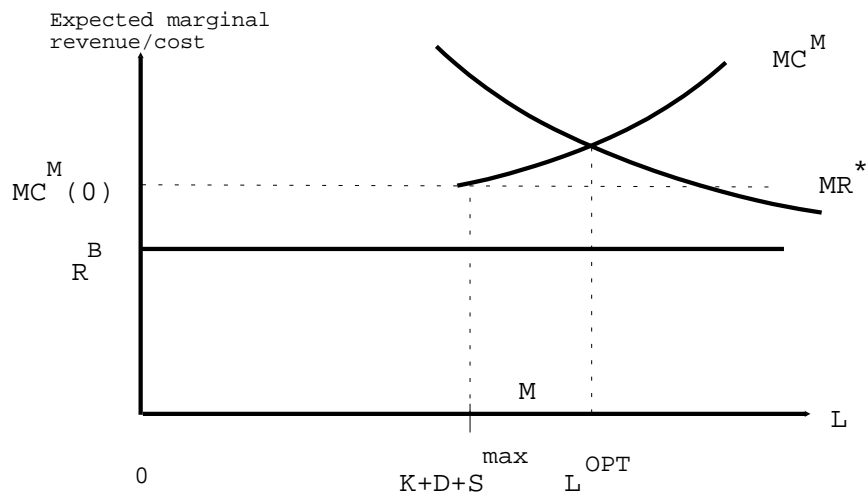
However, with a positive  $c$ , the marginal cost for the bank exceeds the expected return to the holders of  $M$  by a factor which in fact is the shadow value of the pricing constraint on  $M$ ,  $\lambda_3$ . The denominator term in this factor,  $1 - F(a^M)$ , reflects the fact that every unit of  $M$  increases the posted rate of  $M$  (or the posted liability of the bank vis-à-vis the holders of  $M$ ). Therefore the capital requirement is also increased by more than what would happen if  $R^M$  did not react to increased indebtedness.

It is worth noting that even in the absence of capital regulation ( $c=0$ ), the assumed fair pricing of money market debt eliminates the possibility of exploiting money market investors: however large the expected benefit to the owners from default, the default premium compensates it exactly.

The optimum can be described graphically by drawing the  $MR^*$  and  $MC^M$  schedules based on equation 20 (Figure 1).

Figure 1.

**Solution with high demand for loans,  $M > 0$**



$$MC^M(0) = \lim_{M \rightarrow 0} R^B \left( 1 + \frac{c(1+k)F(a^k)}{1-F(a^M)} \right)$$

The reactions of  $M$  and  $L$  to changes in various exogenous factors can be obtained by differentiating (20) implicitly. The exogenous factors examined are (in addition to the already-introduced capital regulation parameters  $c$  and  $k$ ) equity capital  $K$ , the cost of exogenous deposits  $R^D$ , the volume of exogenous deposits  $D$ , a demand shift variable  $x$  and a borrower quality variable  $z$ . An increase in the demand shift variable  $x$  is assumed to have a positive impact on the willingness to pay, ie the derivative of  $MR$  w.r.t  $x$  is assumed positive. An increase in the borrower quality variable  $z$  (eg an increase of asset values) is assumed to shift the distribution function  $F(a)$  to the right.

The deposit rate  $R^D$  can be interpreted either literally as the cost of deposit funding or as a general exogenous cost variable reflecting eg operating costs.

The comparative statics are shown not only for the 'normal' case of positive penalties for capital insufficiency ( $c > 0$ ), but also for the case of no penalties ( $c = 0$ ) and the perverse case of negative penalties for capital inadequacy. The derivatives are reported in Appendix 2. Their signs are shown in Table 1.

Table 1. **Comparative statics when  $M > 0$**

Penalty parameter	Endogenous variable	Exogenous variables							
		$R^B$	$c$	$k$	$K$	$R^D$	$D$	$x$	$z$
$c > 0$	M	-	-	-	-	-	-	+(-)	+
	L	-	-	-	+	-	+	+(-)	+
$c = 0$	M	-	..	0	-	0	-	+(-)	+
	L	-	..	0	0	0	0	+(-)	+
$c < 0$	M	-	-	+	-	+	-	+(-)	+(-)
	L	-	-	+	-	+	-	+(-)	+(-)

+(-): both possible but + more likely

The effect of the bond rate  $R^B$  on lending (and money market funding) is unambiguously negative, as the bond rate is the opportunity cost for investors in subordinated debt and money market debt. A rise in this cost increases the expected marginal cost of funds and thus the required expected marginal revenue on loans.

The effects of capital regulation depend critically on whether there indeed is a positive penalty for non-performance. If there is, then both the size of the penalty and the requirement as such affect lending negatively. With no penalty, the requirement obviously has no bearing on lending, and with a negative penalty, higher requirement leads to more lending as a failure to meet the requirement gets rewarded.

Similarly, the effects of equity capital and the deposit rate (other exogenous costs) depend on the stiffness of capital regulation. More equity capital, with unchanged lending, implies less money market debt. As long as the penalty for a failure to meet the capital requirement is positive, the smaller amount of  $M$  reduces the expected penalty and thus the expected marginal cost for the bank as well. This facilitates increased lending, which is subject to decreasing returns. In the absence of capital regulation the marginal cost of money market debt is the constant bond rate  $R^B$  required by investors. In this case lending does not respond to equity capital at all, but instead all changes are compensated by an equal negative change in money market debt. By the same token, the exogenous cost element  $R^D$  affects the marginal condition for lending only to the extent that it changes the expected cost for not meeting the capital requirement.

The effect of exogenous deposits resembles very much that of equity capital. It lowers the use of money market debt in every case. The

marginal condition is only affected to the extent the expected capital insufficiency penalty is affected. Quantitatively the positive effect of deposits on lending, in the case of a positive  $c$ , is nevertheless weaker than that of bank capital as deposit funding carries the cost  $R^D$ .

A change in loan demand in the sense of customers' willingness to pay for any given loan stock will in principle have an ambiguous effect on loan volume. The reason is simple. Although marginal revenue increases in the case of no borrower default, greater liability for the borrower also implies *ceteris paribus* greater likelihood of default. However, when the density of the project return is small at the level of the contract commitment  $RL$ , ie the change in the default probability is small, then a higher contract rate also implies a higher expected marginal revenue and a higher loan stock.

But also the distribution of the return on the project for which financing is demanded or the value of the collateral assets may change. The effects of such changes depend crucially on how the distribution function  $F(a)$  changes; they are difficult to condense into a single impact. Changes which affect the distribution of  $a$  only for  $a > RL$  are inconsequential. Changes that mainly shift probability mass from the range  $a^k < a < RL$  to the range  $a > RL$  increase the expected marginal return on loans and thus the loan stock. A shift of probability mass from the range  $a < a^k$  and within this range have effects on the expected costs of the capital regulation penalty. Thus an increase in borrower quality, in the sense that the distribution function shifts to the right, increases lending also in this range, unless perverse regulation makes low return realizations highly attractive.

### 2.3.3 Solution with weak loan demand ( $M=0$ )

When the demand for loans is not high enough to make the expected marginal revenue on loans  $MR^*$  equal the expected marginal cost of money market debt  $MC^M$ , the relevant marginal conditions are (15) and (16). Note that in (15) the second term disappears, as  $a^M = a^D$  when  $M=0$ , resulting thus in the marginal conditions:

$$R^B (1 - F(a^D) + cF(a^k)) - MR^* + \mu_B = 0 \quad (21)$$

and

$$Z^S = MR^* - R^B + \mu_S - \eta_S = 0 \quad (16)$$



The outcome depends thus on the relative sizes of  $MR^*$  and the expected marginal revenue on bonds  $MR^B \equiv R^B(1 - F(a^D) + cF(a^k))$  and the posted bond rate  $R^B$ , which is the expected marginal cost of subordinated debt for the bank. As a consequence, many possible solutions exist depending on the parameter values. Given the small practical importance in the late 1980s and early 1990 of the banks which did not borrow in the money market, we do not analyse here in further detail the behaviour of this type of highly liquid bank. A brief discussion of various outcomes is given in Appendix 3. The main implication of this discussion is that the comparative statics vary substantially depending on the exact parameter values.

Although the behaviour of these liquid banks as such is of limited interest, the highly varying responses of loan volumes to changes in exogenous factors have implications for empirical analysis. To the extent that the sample includes banks whose behaviour is determined as in this section, estimating loan supply may be very difficult as one probably cannot a priori classify the banks within this group in different regimes. It may even be difficult to distinguish between banks that rely (essentially) on money market debt from the banks which face too-weak demand for loans to borrow in the money market at all. The banks with weak demand for loans are likely to appear as outliers in loan equations estimated for samples containing different types of banks.

## 2.4 Pricing of money market debt is exogenous

Here we relax the assumption that the bank's endogenous senior debt is fairly priced while keeping the assumption of fairly priced subordinated debt. Two types of differences in (the markets for) the respective claims could rationalize this discrepancy of pricing.

First, subordinated debt typically is not subject to any sort of formal creditor protection. In contrast, some senior bank liabilities, which are priced very close to proper money market debt, are covered by deposit insurance schemes. In the Finnish context, taxable fixed-term deposits are such instruments. In addition in the case of bank bailouts, holders of senior debt are typically fully covered for losses while holders of subordinated debt may incur some losses or at least be forced to inject further capital into the bank; implicit creditor protection applies with a higher probability to senior debt than to subordinated debt. Therefore, on the whole, holders of senior debt have less reason to worry about the default risk of their claims on banks than holders of subordinated debt.

Second, buyers of such risky instruments as subordinated debt (presumably mainly professional investors) probably are better informed about the risks and behaviour of the issuers than are the typical buyers of senior debt. Therefore the former may be in a better position to price the default risk than the latter. The latter – to the extent they see reason to consider credit risk – are more likely to resort to the use of quantitative restrictions (quotas). This may result in a highly convex marginal cost curve for senior debt.

Allowing for underpricing of money market debt  $M$  in the analysis means simply dropping the fair pricing constraint for  $M$  and postulating an exogenous marginal cost function instead. Let us denote this posted function by  $MC$ . In general this may be a constant or a fixed increasing function of  $M$ . With this change, the first order conditions corresponding to (15) through (17) are:

$$R^B (1 - F(a^M) + cF(a^k)) + \mu_B - MR^* = 0, \quad (22)$$

$$MR^* - R^B + \mu_S - \eta_S = 0 \quad (23)$$

and

$$MR^* - MC(1 - F(a^M) + c(1+k)F(a^k)) + \mu_M = 0 \quad (24)$$

Again, on the basis of the reasonable assumption that  $MC \geq R^B$ , there cannot be bonds and money market debt simultaneously on the balance sheet, as can be seen by adding (22) and (24). Obviously, the case where no  $M$  is issued is the same that was already discussed in the preceding section. The case with positive  $M$  is however different. As the posted price of  $M$  is fixed (exogenous) rather than set so as to make the expected return equal to  $R^B$ , the expected marginal cost of money market debt takes the form

$$MC^{Mf} \equiv MC(1 - F(a^M) + c(1+k)F(a^k)). \quad (25)$$

This quantity,  $MC^{Mf}$ , need not be at least equal to  $R^B$ , as  $MC^M$  in (20), but may be smaller. Only with a very strict capital regulation ( $c(1+k) \geq 1$  is sufficient) is  $MC^{Mf}$  always above  $R^B$  and increasing. In that case,  $S$  is necessarily always at the maximum,  $S^{\max}$ , and the second order condition is fulfilled so that there is a finite  $M$  at which the expected marginal cost,

$MC^{Mf}$ , is just equal the expected marginal revenue on loans,  $MR^*$ . This result can obtain even with a constant MC, ie the posted rate need not increase.

However, with a more lenient, 'normal' capital regulation,  $MC^{Mf}$  is decreasing, unless MC is rising steeply enough. At the extreme, an infinite portfolio could result: The expected marginal cost declines with increasing probability of default while the expected return on lending does not decline as fast. As the expected marginal cost of subordinated debt is  $R^B$ , no such debt would be issued and all funding would take the form of underpriced senior debt.

A more reasonable assumption is that MC is more or less constant at low values of M while it increases steeply with high enough M. For instance, simple rules of thumb could result in the setting of quotas on the amount of any investor's purchases of the money market debt of any individual bank. Once the quotas start to bind, the marginal costs of additional funds increase steeply.

Such a contractual marginal cost schedule, MC, would imply a U-shaped expected marginal cost schedule,  $MC^{Mf}$ , which may or may not be above  $R^B$  for all values of M (Figure 2). With sufficient convexity of MC, the  $MC^{Mf}$  schedule intersects  $MR^*$  at some point.<sup>7</sup> That of course guarantees the existence of a finite solution. Depending on whether this point of intersection is above or below  $R^B$ , the bank issues the maximum allowed amount of subordinated debt or no such debt at all.<sup>8</sup>

An important consequence of this U-shaped expected marginal cost schedule is that the intersection of the expected marginal cost and expected marginal revenue curves can take place either in the downward sloping section at the upward sloping section of  $MC^{Mf}$ . The latter occurs when demand for loans is high enough, as  $MR_1^*$  in Figure 2. The former can happen, if demand for loans is not too high, as  $MR_2^*$  in Figure 2.

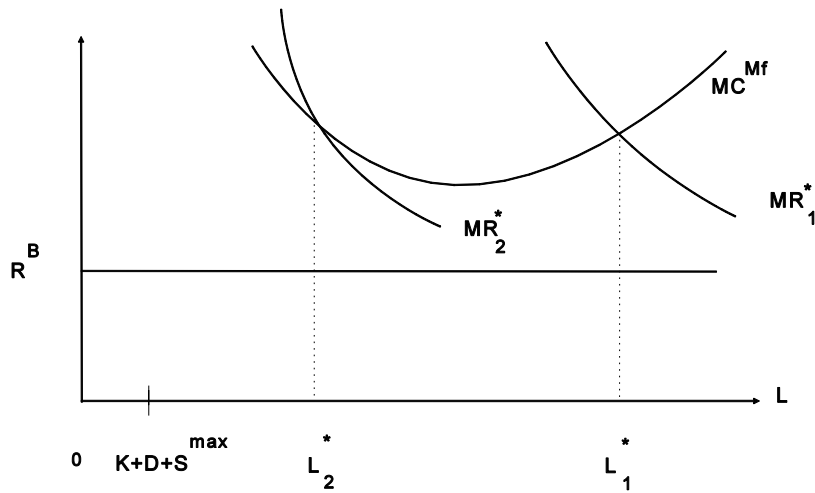
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<sup>7</sup> The second order condition requires that only the  $MR^*$  schedules which intersect  $MC^{Mf}$  from above produce a maximum.

<sup>8</sup> One may argue on the basis of arbitrage that the expected marginal revenue on loans cannot decline much below the safe rate  $R^B$ , at least not for any individual bank of small size. Borrowers may namely invest the borrowed funds in bonds, which they pledge as collateral for borrowing and thus make lending safe for the bank.

Figure 2.

**Solutions with a U-shaped expected marginal cost curve**



The comparative statics hinge essentially on the point of intersection of the expected marginal return on loans schedule and the expected marginal cost schedule for money market debt. The qualitative results are shown in Table 2; the derivatives can be found in Appendix 2. The most interesting case is the positive penalty situation, as in this case the results differ in an essential way from those obtained assuming fair pricing of money market debt.

Table 2.

**Comparative statics with a fixed marginal cost schedule MC**

Penalty parameter	Endogenous variable	Exogenous variables								
		$R^B$	$m$	$c$	$k$	$K$	$R^D$	$D$	$x$	$z$
$c > 0$	M	0	-	-	-	-	+(-)	+/-	+(-)	+(-)
	L	0	-	-	-	+/-	+(-)	+/-	+(-)	+(-)
$c = 0$	M	0	-	..	0	-	+	+/-	+(-)	+(-)
	L	0	-	..	0	+/-	+	+/-	+(-)	+(-)
$c < 0$	M	0	-(+)	-	+	-	+	+/-	+(-)	+(-)
	L	0	-(+)	-	+	+/-	+	+/-	+(-)	+(-)

$m$  denotes an increase in the contractual marginal cost of  $M$  at any level of  $M$

+/-: both possible depending on circumstances

+(-): both possible but + more likely

The role of the bond rate as the marginal cost of money market funding is replaced here by the shape of the cost schedule. An upward shift in the contractual schedule implies less such funding and lending. The penalty

parameters work just as with fair pricing. However, the roles of bank capital, deposit costs and deposit volume change radically.

An increase in equity capital shifts the  $MC^{Mf}$  schedule to the right. Thus a positive shock to equity capital increases lending if  $MR^*$  intersects  $MC^{Mf}$  in the upward sloping section ( $MR_1^*$  in Figure 2). However, if the intersection happens to be in the downward sloping range of  $MC^{Mf}$ , the opposite is true. The economic explanation of the perverse effect is that the expected marginal benefit to the bank from defaulting on M declines more than does the sum of contractual marginal cost plus expected marginal cost of failing the capital regulation, in response to an increase in capital. This induces the bank to reduce money market borrowing at a given level of lending by more than enough to compensate for the additional funding in the form of equity capital ( $MR_2^*$  in Figure 2).

The effect of  $R^D$  is also ambiguous in principle. Higher deposit costs increase the likelihood of defaulting on the money market debt and thereby decrease the expected cost of such liabilities. Expansion of lending follows. The capital requirement on D nevertheless counteracts this moral hazard incentive, but unless the penalty parameter  $c$  is very high (close to 1) the capital requirement  $k$  is high and the density function  $f(\cdot)$  has a rather exceptional shape, the effect on default probability dominates.

Similarly, the effects of deposit volume are ambiguous. Higher deposit volume lowers the contractual marginal cost of M and lowers the expected marginal benefit from defaulting on M (which is higher than that on D, as  $R^M > R^D$ ). As long as  $c > 0$ , the capital requirement works to keep the incentives correct. The outcome depends crucially, as with equity capital, on the shape of the  $MC^{Mf}$  schedule. It being rising is sufficient for a positive lending response to D. However, a rising  $MC^{Mf}$  schedule is not necessary for a positive lending response, but such a response may obtain also with a decreasing  $MC^{Mf}$  schedule. Thus an increase in deposits can have a positive effect on lending while at the same time that an increase in capital has a negative effect.

The effects of loan demand are the same as with fair pricing. However, the effects of borrower quality become in principle ambiguous, as an improvement of borrower quality makes defaulting on M less likely and thereby increases the expected marginal cost of funding.

In sum, if the pricing of the marginal funding for the bank does not sufficiently reflect the riskiness of the bank's portfolio, moral hazard incentives may make the bank response perversely to changes in bank capital, costs, deposits and even borrower quality, even if failure to meet capital requirements is effectively penalized. Thus moral hazard leading to excessively risky lending may result both from underpricing of banks'

marginal funding and ill-conceived capital regulation (bank support policies which reward capital insufficiency).

## 2.5 Capital requirement levied on the asset side

Replacing the capital requirement imposed on bank liabilities by a levy on risky assets does not significantly affect the formal analysis. What is changed is basically the equation for the threshold project return, below which the bank owners start to incur non-pecuniary costs at the rate  $c$ :

$$a^k = kRL + R^D D + R^M M - R^B B. \quad (26)$$

The threshold continues to depend on the commitments vis-à-vis depositors and holders of money market debt and investments in the safe asset, as all these influence bank net worth. The new element is that loans (the risky assets) instead of liabilities determine the level of required regulatory capital.

Assuming fair pricing of both subordinated debt and money market debt leads to the following first order conditions which correspond to the earlier conditions (15) through (17):

$$R^B (1 - F(a^M) + cF(a^k)) + \lambda_3 R^B (F(a^M) - F(a^D)) + \mu_B - MR (1 - F(RL) - ckF(a^k)) = 0, \quad (27)$$

$$MR (1 - F(RL) - ckF(a^k)) - R^B + \mu_S - \eta_S = 0 \quad (28)$$

and

$$MR (1 - F(RL) - ckF(a^k)) - R^M (1 - F(a^M) + cF(a^k)) + \lambda_3 (R^M (1 - F(a^M)) - R^B) + \mu_M = 0. \quad (29)$$

The difference between these and the earlier first-order conditions is that the marginal expected revenue on loans is affected by the capital requirement and the marginal expected cost of money market debt no longer incorporates the effect of additional required capital.

Again, the portfolio cannot contain simultaneously money market debt and bonds. Here we consider only the more relevant case of positive money market debt. The portfolio is defined in this case by

$$MR(1 - F(RL) - ckF(a^k)) = R^B \left( 1 + \frac{cF(a^k)}{1 - F(a^M)} \right) \quad (30)$$

or

$$MR(1 - F(RL)) = R^B \left( 1 + \frac{c(1+k)F(a^k)}{1 - F(a^M)} + ckF(a^k) \left( MR - \frac{R^B}{1 - F(a^M)} \right) \right). \quad (30')$$

The outcome is thus very similar to that which was obtained with liability side capital regulation. (30) says that the expected marginal revenue on loans including the expected cost of failing to meet the capital requirement equals the expected marginal cost of funds. The marginal cost of money market debt is affected by the capital requirement penalty, as the amount money market debt affects the bank's contractual commitment and thereby the threshold project return that makes the bank just meet the capital requirement.

In (30') the last term is positive, as (28) implies that  $MR > R^B/(1-F(RL)-ckF(a^k)) > R^B/(1-F(a^M))$ . This shows that the asset-side capital requirement leads to a higher marginal revenue requirement on loans and thus a lower loan volume than the liability-side requirement with the same parameter values  $k$  and  $c$ . This is due to the fact that with the asset-side regulation all loans are subject to the capital requirement whereas with liability-side regulation only the loans that are financed by  $D$  and  $M$  carry a capital requirement.

This difference implies that a shift from a capital regulation levied on the liability side to an asset-side regulation without changing the required level of capital (parameter  $k$ ) or the stiffness of enforcement (parameter  $c$ ) leads to a smaller amount of risky lending.

The effects of changes in exogenous factors do not change much with the type of capital regulation. The comparative statics in the case with positive  $M$  remain qualitatively the same with the asset-side regulation as with the liability-side regulation.

Just as with the liability-side regulation, the pricing principle for money market debt does not change the basic nature of the optimum. Also with exogenous pricing of money market debt, banks that find it optimal to issue money market debt hold loans as the only asset. In this case the marginal condition defining the loan supply takes the form

$$MR(1 - F(RL) - ckF(a^k)) = MC(1 - F(a^M) + cF(a^k)), \quad (31)$$

where  $MC$  is the exogenous marginal cost schedule of  $M$ . The comparative statics become somewhat more messy but remain qualitatively the same as in the fixed pricing case of liability-side capital regulation.

## 2.6 Discussion

The analysis of bank portfolio choice in our simple static framework with symmetric information and risk-neutral agents illustrates some basic issues concerning the importance of bank capital, capital requirement and the pricing principles of bank funding for risky lending. In addition, the model also incorporates influences from the 'demand side': borrowers' willingness to pay and borrower quality. The basic insights of the model are not new. What is new is that we show in a simple framework how both 'excessive' and 'too little' risky lending can derive from a single model, depending on the pricing principles of banks' marginal financing and capital regulation. Furthermore, the model provides testable implications of the two hypotheses – moral hazard and credit crunch – applicable to the Finnish cooperative and savings banks.

If money market debt is priced fairly, the default premium applied to funding exactly compensates for the default risk: no exploitation of the investors by the bank is possible. Now, if the bank incurs no penalty for not meeting the contractual commitment vis-à-vis depositors and holders of money market debt, the bank's loan supply is determined simply by the requirement that the expected marginal return on loans equals the safe rate of interest. In this case, banking is inconsequential in the sense that bank characteristics do not in any way affect lending.

However, if there is a positive penalty for failing the capital requirement, whether imposed by the authorities or 'the market', lending depends greatly on bank characteristics. In particular, the higher the capital and core deposits, the more lending, and the higher the charter value (the lower the rate on core deposits), the more lending. This specification of the model thus predicts several types of 'credit crunches', ie backward shifts in bank credit supply: First, a credit crunch due to disintermediation results when the amount of cheap deposits decline say due to additional competition from outside banking. Second, a reduction of the charter value of banking due to a smaller subsidy in the form of underpriced core deposits (higher deposit rate) leads to a decline of



lending. Analogous effects relate to other exogenous costs of banking, caused for example by changes in wage costs or information technology. Third, a loss of equity due, say, to credit losses incurred, reduces lending. Fourth, a tightening of capital regulation, whether in the form of a higher requirement or in the form of stricter enforcement, leads to less lending.

The behaviour of the bank may be very different if the pricing of marginal funding is not fair but follows an exogenous (non-decreasing) contractual schedule. If the marginal cost of funding rises fast enough (and the penalty for capital insufficiency is positive), the behaviour is qualitatively the same as above in the fair pricing case. In fact, bank lending may decline more say in response to a decline in equity in this case than with fair pricing.

But if the posted rate on money market debt rises too slowly, the bank can shift a part of the credit risk of its lending to the holders of money market debt (or if this is guaranteed by the authorities, to the authorities). Bank behaviour is characterized by moral hazard: it is profitable for the bank to increase risky lending beyond the point where it would be with fair pricing, as the investors in bank liabilities can be made to share in the credit risk. Furthermore, in this case a decline in equity capital, an increase in the exogenous (deposit) costs and even a decline in the volume of core deposits (the requirement for this is somewhat more stringent) can lead to an increase in risky lending.

The penalty for insufficient capital reduces bank incentives for moral hazard. The model suggests that the level of capital requirement or its type (asset-side or liability-side requirement) is not very important. What really counts is that a failure to meet the required level of capital be followed by a clear positive penalty.

A central feature of the rapid credit expansion in Finland in 1986–1990 was that savings banks expanded lending substantially more than other banks and among the savings banks (as also among the cooperative banks) the rates of growth varied a great deal. Furthermore, a clear positive relationship appears between the rate of growth of lending in the boom years and the subsequent asset quality (see Soltila and Vihriälä 1994). Similarly in the contraction phase, some banks contracted lending much more than others, and this time the savings banks typically reduced lending more than other banks. The question thus arises, what made certain banks expand risky lending so rapidly in the late 1990s and certain banks contract lending so strongly in the early 1990s.

The model provides several types of explanations for the bank-wise variation in lending growth.

First, the differences may be essentially due to demand-side factors (including borrower quality). A given bank expanded lending more than

banks on average because there was in the local credit market (1) higher demand for loans (relative to the cheap core deposits) at any given loan rate or (2) a more favourable (less risky) return distribution of the projects to be financed or higher collateral values (better borrower quality). The analysis also rationalizes why in both cases strong expansion of credit was risky in the sense that more credit implied a higher percentage of credit losses. As long as the distribution of the return to a project for which finance is sought remains given in the model, more lending implies higher credit losses relative to the outstanding loan commitment by the borrower.

As real estate businesses and many other non-manufacturing activities have traditionally been very important in savings banks' lending, one may argue that strong demand in these sectors boosted lending especially by the savings banks. And as the real estate sector was worst hit in the economic downturn, also the relative losses were the highest. And by the same token it can be argued that during the crisis years demand was weakest in this sector, leading to weaker-than-average growth of lending by the savings banks in the early 1990s. The findings of Solttila and Vihriälä nevertheless suggest that this type of 'bad luck' in terms of business specialization, although it played a role, is not the only explanation for the period of rapid growth; even if the sectoral differences are accounted for, banks that expanded faster in the 1980s also ended up with a higher shares of problem assets in the early 1990s.

The model also accommodates explanations based on subjective expectations about the project returns (borrower quality) deviating from the true ones, if one interprets the distribution function  $F(\cdot)$  as a perceived rather than true distribution of the returns to risky activity to be financed. As noted in Chapter 1, Minsky and Kindleberger, among others, have argued that such concepts as optimism, euphoria and pessimism govern changes in the expectations of bankers as well as those of the ultimate investors. Thus if one assumes that some bankers became highly and unrealistically optimistic about lending opportunities, and that this happened particularly in the savings banks sector in the late 1980s, the model would naturally predict high growth of lending for such banks. However, this sort of hypotheses are very difficult if not impossible to

test, as one cannot measure, at least not ex post, the perceptions of the bankers in question.<sup>9</sup>

But the model's main thrust concerns explanations which relate to the objective conditions of individual banks: (1) differences in the opportunities faced by the banks in terms of the pricing of marginal funding and the strictness of capital regulation and (2) differences in bank characteristics, ie in the amounts of equity capital and core deposits and the charter value implied by the underpricing of these deposits relative to the going market rate.

The theory suggests that the banks that expanded fast in the 1980s, faced an underpriced marginal cost schedule of funding and/or more lenient, if not preverse, capital regulation and also were initially weak in terms of capital and costs.

The marginal sources of funds for individual banks were the market for bank certificates of deposits, borrowing from other banks, which in the case of the savings banks and cooperative banks means their 'central banks' (Skopbank and Okobank respectively) and, mainly in the case of commercial banks, foreign banks. The argument thus suggests examining the characteristics of these markets, especially to what extent pricing there reflected bank risk and whether there were differences in this regard, say between the savings banks and cooperative banks.

The model suggests also examining capital regulation. As noted earlier, the regulations in force in the 1980s were more lenient for the cooperative banks and the savings banks than for the commercial banks. But for the savings bank group and the cooperative bank group, the requirements were the same. Thus to the extent regulation can explain differences in risky lending among the cooperative and savings banks, the

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<sup>9</sup> Another and somewhat more structured version of the explanation based on the difference between perceived and true probability distributions of the project returns is provided by Guttentag and Herring (1984). They argue that in periods of no major shocks in the economy, perceived risks tend to diminish relative to the true risks. In the case of Finnish banking in the mid-1980s, it might be argued that a virtual absence of credit losses for decades in the tightly regulated financial system had led bankers and their borrowers alike to believe that credit risks would be largely absent also in the future. Financial liberalization, which eliminated the possibility of shifting the burden of financial distress from borrowers to depositors through negative real rates of interest, however, changed the situation fundamentally but in a way which probably was not fully understood by the bankers. One might even argue that as the cooperative banks had recently experienced significant solvency difficulties, they were less likely to assume away credit risks. Nevertheless, it seems very difficult to subject even this version of the 'wrong expectations' explanation to rigorous testing. The same applies to the credit crunch explanations that are based on the argument that the bankers became very conservative in their risk assessments during the economic crisis starting in 1991.

reason can only relate to enforcement. Not very much can be said about potential differences in this regard.

But to really explain the differences in behaviour across individual cooperative banks and savings banks on the basis of the moral hazard or credit crunch hypotheses, one needs to examine the relationships between, on the one hand, bank lending and, on the other hand, bank equity capital, core deposits and bank costs.

A negative effect of bank capital (with sufficient distortions also that of core deposits) and a positive effect of bank costs would be compatible with the moral hazard explanation but in conflict with the argument that credit growth was determined purely by demand conditions (including borrower quality).

Analogous issues need to be examined for the contraction phase. Thus: are there reasons to believe that pricing of the banks' marginal liabilities and/or capital regulation became very stiff, at least for some subset of banks, and can one observe a positive relationship between bank capital (and core deposits) and lending and a negative relationship between bank costs and bank lending? Affirmative answers to these questions would suggest that some type of credit crunch was at least partially responsible for the observed credit contraction. Importantly, our analysis suggests that high costs could also lead to a credit crunch, not just to low capital, which is what most empirical credit crunch studies examine.

The model also suggests examining banks' issuance of subordinated debt. Essentially, banks having perverse incentives should not issue subordinated debt, while banks experiencing capital shortage should be using it up to the regulatory maximum. This is another significant departure from typical empirical credit crunch analyses.

## 3 Credit Growth and Moral Hazard

### 3.1 Introduction

This Chapter examines empirically the determination of bank lending in Finland in the second half of the 1980s. As was discussed in Chapter 1, there is clear evidence of an inverse relationship between growth of lending and later asset quality at the bank level: rapid growth was risky. Similarly there are broad indications that the banks that expanded most rapidly were weak, rather than strong, in terms of capital and costs. This suggests that at least in part the risk-taking through expansion of credit was deliberate, stemming from what has come to be called moral hazard.

On the basis of the discussion in the previous chapters, it is evident that the theoretical case is strong for moral hazard associated with underpriced funding. Nevertheless, empirical evidence regarding its effect on banks' risk taking is rather ambiguous. Furthermore, studies using European data are almost non-existent.

Examining the role of moral hazard is important to obtain a complete picture of the causes of the Finnish boom-bust cycle, which is perhaps the most spectacular among the industrial market economies. At the same time the recent Finnish experience provides a highly interesting test case of the moral hazard hypothesis in general. First, as in the neighbouring Sweden and Norway, the banking crisis in Finland is a first-order event in that the risks that banks took in the late 1980s caused a significant part of the banking system to lose all its capital during the depression of 1991–1993. Second, given the large number of individual banking institutions with widely varying capital positions, costs and observed lending behaviour but essentially the same regulatory environment, it should be possible to carry out reliable statistical analysis that will discriminate between various hypotheses. Thus if the moral hazard hypothesis is of practical importance, and not just a theoretical footnote, it should show up in the data.

The analysis seeks to establish whether the bank-wise variation in the lending of 483 cooperative and savings banks is consistent with the moral hazard hypothesis. The analysis is thus partial in the sense that no attempt is made to examine factors which have been common to all banks. In particular, all macroeconomic factors are left out of the analysis as are explanations of banks' supply behaviour that are essentially the same for all banks. Thus common misperceptions about the risks involved in lending are not considered.

The analysis is based on the simple value maximization model set out in Chapter 2. The findings will be interpreted primarily in the light of this model. However, in assessing the results we will also discuss the limitations of the benchmark model and alternative explanations for the findings.

The model describes how the extent of risky lending depends on bank characteristics and demand conditions under different pricing principles for marginal bank funding and under varying stiffness of capital regulation.

The model assumes that equity ( $K$ ) and core deposits ( $D$ ) and deposit (and operating) costs ( $R^D$ ) are exogenous but that the bank can choose the amount of money market debt and subordinated debt so as to finance the preferred amount of risky loans ( $L$ ), subject to a declining demand schedule. The bank is subject to a capital requirement ( $k$ ), and the owners are penalized for failure to meet the requirement by a nonpecuniary cost ( $c$ ). Although equity is exogenous, the bank can augment its regulatory capital by issuing fairly priced subordinated debt up to a maximum set by regulation.

Bank behaviour depends crucially on the pricing of money market debt and the stringency of capital regulation. If the relevant marginal liability is fairly priced, or the penalty for not meeting the capital requirement (ex post) so stiff that it simulates unlimited liability of the equity holders, no moral hazard exists, and bank lending increases with the exogenous amount of equity and decreases with costs.

However, if pricing of bank liabilities is not fully fair and capital regulation is not extremely tight, perverse effects may emerge.<sup>1</sup> Underpricing of money market debt implies that smaller equity capital and higher costs lead to more lending. And with a sufficient degree of underpricing of the money market debt, even an increase in core deposits can lead to less lending. Even under fair pricing of the bank's marginal funding, perverse effects emerge if capital insufficiency is rewarded through ill-conceived bank support policies. All in all, for those banks that use purchased funds to finance lending, the model implies the following types of relationships between bank lending  $L$  and various exogenous factors (including the demand shift variable  $x$  and borrower quality  $z$ ):

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<sup>1</sup> As discussed in Chapter 2, an exogenous pricing schedule of money market debt can be thought of as standing in for an unmodelled informational asymmetry. Thus, we encounter a moral hazard problem even if the model is formally one of symmetric information.

$$L=L( K, R^D, D, k, c, x, z )$$

+	-	+	-	-	+	+	fair pricing+normal capital regulation	(1)
-	+	?	-	-	+	+	underpricing+normal capital regulation	
-	+	+	+	-	+	+	fair pricing+perverse capital regulation	

These comparative statics suggest using the empirical relationship between bank costs and capital on the one hand and bank lending on the other as a test of the moral hazard hypothesis. Should one find, ceteris paribus, a positive relationship between lending and costs and a negative relationship between lending and capital, the finding would be consistent with the moral hazard hypothesis. Lack of any relationship would suggest the relative unimportance of the consideration of bank default in lending decisions, either because no penalty is associated with capital insufficiency or because lending is assumed by all relevant agents to be 'sufficiently' safe under all relevant circumstances. Finally, a positive relationship between lending and capital and a negative relationship between lending and costs would suggest that market forces control risk taking through risk premia (or rationing) or that the regulators do so through sufficient penalties on banks that fail to meet the requirements.

In addition, the issuance of subordinated debt can be informative about the pricing of marginal funds and/or tightness of capital regulation. Under fair pricing and positive penalties for capital insufficiency, banks that rely on money market debt also use the maximum allowed amount of subordinated debt. In contrast, underpricing of senior debt can lead to zero optimal subordinated debt. With no penalty for capital insufficiency the amount of subordinated debt is indeterminate, and with a negative penalty it is zero.

The analysis proceeds as follows. In Section 3.2 we discuss the characteristics of the banks to be analyzed. In Section 3.3 the loan equation to be estimated is specified. Section 3.4 reports the empirical results. Finally Section 3.5 sums up the results and discusses their interpretation.

## 3.2 A preliminary look at the data

### 3.2.1 The sample

The data set consists of 333 cooperative banks and 150 savings banks. Thus almost all the banks that existed at the end of 1990 are included.<sup>2</sup> The sample is balanced by aggregating the observations of the banks that merged during the sample period.

The bank data contains annual balance sheet and income statement information for the years 1985 through 1990 augmented with information on regulatory capital adequacy.

A major effort is extended to account for local market conditions. This construction of market condition variables is based on the fact that each savings bank and cooperative bank covers a definite geographical area of operation – and these areas are in general nonoverlapping within the respective groups. An area of operation is defined as the municipalities in which the bank had a branch at the end of 1990. Available data on demographic and economic conditions on the municipal level are aggregated over the municipalities of the operational area to obtain proxies for market conditions in each bank's local market. A complete description of the data is given in Vihriälä (1996).

The period of the analysis is 1986 through 1990. The choice of this particular period for analysis is based on the observation that it covers the whole 'credit boom' from the start of accelerating lending growth in the aftermath of financial liberalization (see Chapter 1). By the end of 1990 bank lending had stagnated and already in 1991 credit stocks declined.

The banking institutions examined are limited to savings banks and cooperative banks because these banks form a relatively homogenous group in terms of banking activities (almost no foreign banking business, very little activity in the capital market etc) while still having highly varied levels of capitalization, costs, and growth of lending during the period of interest. Furthermore, the most severely hit banks during the subsequent crisis period – the savings banks which in 1992 formed the Savings Bank of Finland – are all included in the sample.

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<sup>2</sup> The data set includes all savings banks. Five cooperative banks are excluded because of data problems. The included banks account for 99.3 per cent of the balance sheet total of the cooperative bank group at the end of 1990.



### 3.2.2 Salient features of the cooperative banks and savings banks

#### Group structure and decisionmaking

The cooperative banks and the savings banks form two banking groups in the sense that several activities are coordinated within each group.

This group structure has potentially important implications for the analysis of the behaviour of individual banks. First, it raises the question whether decisions taken by an individual cooperative bank or savings bank can be considered independent, ie whether the sample indeed contains a large number of independent observations. Although this is in the end an empirical question, there are reasons to presume a considerable degree of independence in decisionmaking. First, legally an individual bank and its management bear full responsibility for the bank's commitments. Second, many insider explanations in the respective banking groups suggest that a well-run member bank cannot be forced to take decisions against the will of the management.<sup>3</sup> Nevertheless, the central organizations very likely have been in a position to influence decisions of the member banks, and policies in this regard may have been different across the two groups.

Another implication is that nondeposit funding ('money market debt' in the theoretical model) of an individual cooperative or savings bank can in principle take the form of either direct funding from the money market or borrowing from the group's central bank. To the extent the member banks have not had direct access to the money market (more likely for the smaller banks than the larger ones), the pricing of nondeposit funding may have differed across the two banking groups, depending on the policies followed by the the two central banks.<sup>4</sup>

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<sup>3</sup> For example, mergers among the member banks have taken place far more slowly than recommended by the central organizations on grounds of operational efficiency. See eg Kuusterä (1995).

<sup>4</sup> In addition, the fact that nondeposit funding could have taken these two forms makes it very difficult to determine the amount of money market funding, as the 'claims of other banks' in the available statistics contain many types of instruments. Thus examining the determination of the amount of money market debt is not in practice possible with the available data.

## Lending and related funding

Lending to the public and related financing via deposits from the public is the main business of both the cooperative banks and savings banks. In 1990 loans accounted for some 70 per cent of these banks' total assets, while the deposit shares were 64 and 56 per cent respectively (Table 1).

Lending grew much faster in the savings bank group than in cooperative bank group in the second half of the 1980s, while the opposite is true for deposits. To facilitate the strong growth of lending, the savings banks substantially increased their debts to other banks (chiefly their central bank, Skopbank) and to the money market. The cooperative banks also increased borrowing from other banks (again chiefly from their central bank, Okobank) and the money market, but the contributions of these sources were clearly smaller.

The period of rapid lending growth began in both banking groups in spring 1987, peaking at the end of 1988 when many deals involving enterprise ownership, induced by tax reform, boosted both lending and deposit stocks considerably. In spring 1989 lending growth started to decelerate rapidly. During this period of deceleration the savings banks expanded their lending much faster than the cooperative banks. As there was no similar difference in respective rates of deposit growth, the loan/deposit ratio increased steadily for the savings bank group throughout the period while it stabilized for the cooperative bank group already in 1989 (Figure 1).

Approximating the rate of growth of lending  $\Delta L/L$  by the differential  $\Delta(L/D)(D/L)+\Delta D/D$ , one can decompose the change in lending into the contribution of the change in the loan/deposit ratio and the contribution of deposit growth. On the basis of the figures in Table 1, such a decomposition indicates that for the cooperative banks the contribution of the change in the loan/deposit ratio was some 11 per cent. However, for the savings banks the contribution of the change in the loan/deposit ratio was 35 per cent. Thus while financing other than deposits was just a marginal source of funding to the cooperative banks, over one-third of the growth of savings banks' lending was financed from these nondeposit sources.

A considerable part of the rapid growth of lending in the savings bank group originated in a relatively small number of large banks. Nevertheless, also the average savings bank expanded credit much faster than the average cooperative bank, increasing the loan/deposit ratio significantly. The ratio for the average cooperative bank remained essentially unchanged between 1986 and 1990 (Table 2).

The data exhibit a great deal of variation across banks in the rate of lending growth, much more so than in the rate of deposit growth. And the variability is much stronger among the savings banks than among the cooperative banks.

Table 1. **Bank balance sheet structure**

	Cooperative banks*			Savings banks*		
	Share in total assets, %		Contribution to asset growth 1986-1990	Share in total assets, %		Contribution to asset growth 1986-1990
	End-1990	End-1986	Percentage points	End-1990	End-1986	Percentage points
Loans	72.7	74.4	63.5	70.2	72.1	88.3
Bonds	3.8	3.1	4.2	2.0	2.9	1.6
Receivables from banks	12.3	13.2	10.2	11.4	13.1	13.0
Other receivables	11.1	9.3	11.7	16.4	11.9	25.5
Total assets	100.0	100.0	89.6	100.0	100.0	128.5
Deposits	64.1	71.4	50.2	55.9	77.2	50.4
Claims by banks	15.3	10.0	19.0	21.0	10.6	37.5
Other debts	14.5	13.2	14.3	16.6	7.3	30.7
Capital & reserves	6.0	5.3	6.1	6.5	4.9	9.9
Loan/deposit ratio	1.13	1.04		1.26	0.93	

\* The sector as a whole

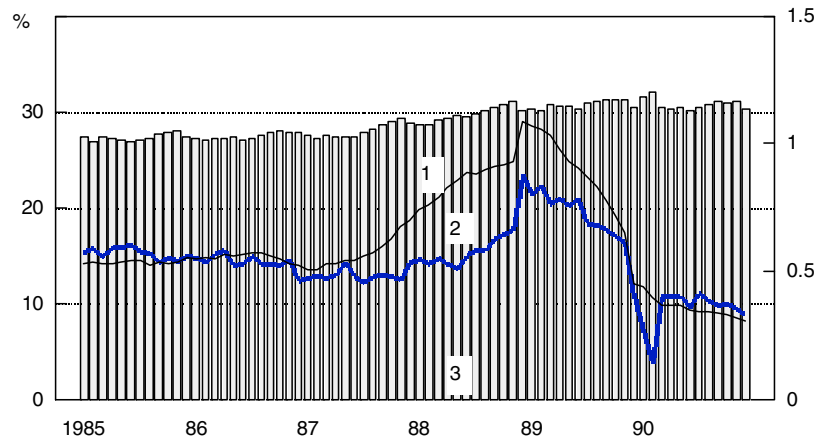
Table 2. **Local banks' lending and related funding**

		Cooperative banks		Savings banks	
		mean	standard deviation	mean	standard deviation
Growth of lending 1986-1990, %		69.9	29.8	91.5	65.4
Growth of deposits 1986-1990, %		68.7	17.2	67.9	22.3
Loan/deposit ratio	end-1986	1.03	0.16	0.96	0.15
	end-1990	1.03	0.20	1.08	0.29
	Change 1986-1990	0.00	0.15	0.13	0.25
Share in total assets, %					
Debts to other banks	end-1986	8.8	5.6	12.3	7.3
	end-1990	12.6	9.8	19.4	14.7
Net claims on other banks	end-1986	10.4	11.3	6.2	12.6
	end-1990	6.9	15.7	0.0	21.4
Other debts	end-1986	4.7	5.3	4.2	2.5
	end-1990	6.1	6.9	10.6	10.2
Capital and reserves	end-1986	5.3	1.2	5.2	1.5
	end-1990	6.1	1.5	6.6	1.8

Figure 1.

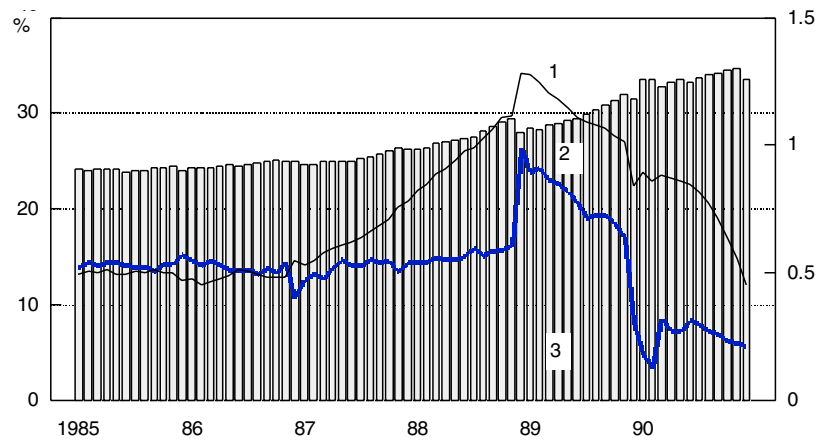
### Bank loans (L) and deposits (D)

#### a) Cooperative banks



- 1 Annual lending growth, % (left scale)
- 2 Annual deposit growth, % (left scale)
- 3 L/D (right scale)

#### b) Savings banks



- 1 Annual lending growth, % (left scale)
- 2 Annual deposit growth, % (left scale)
- 3 L/D (right scale)

## Capital and capital adequacy

Bank capital<sup>5</sup> and reserves (provisions) increased in the period studied not only in absolute terms but also relative to the balance sheet total. The savings banks increased their capital more, and had on average somewhat better equity capital/asset ratios in 1990 (Table 3).

Also the average capital ratios calculated for regulatory purposes increased in both bank groups in the second half of the 1980s. The regulatory capital concept used until the beginning of 1991 included apart from the aforementioned capital items, half of the provisions for bad loan losses and subordinated debt up to a maximum.<sup>6</sup> In contrast, the regulatory capital ratio calculated according to the new risk-based rules were on average somewhat better for the cooperative banks than for the savings banks at the end of 1990.

Table 3. **Bank capital ratios, yearend**

		1986			1990		
		mean	min	max	mean	min	max
Regulatory capital ratio according to pre-1991 rules, per cent	coops	4.75	2.39	14.7	5.88 <sup>1</sup>	1.66 <sup>1</sup>	13.7 <sup>1</sup>
	savings	4.51	2.34	9.46	6.11 <sup>1</sup>	2.00 <sup>1</sup>	15.7 <sup>1</sup>
Regulatory capital ratio according to 1991 rules, per cent	coops				13.2	2.38	35.7
	savings				11.7	3.71	23.6
Equity capital and provisions, per cent of total assets	coops	5.32	2.56	10.1	6.17	1.63	10.9
	savings	5.22	2.23	9.4	6.62	2.06	13.3
Subordinated debt, per cent of Tier-I capital	coops				18.5	0	384.3
	savings				1.8	0	32.2

(1) end of 1989

<sup>5</sup> Equity capital in a broad sense consists of the following balance sheet items: share capital (commercial banks), primary capital (savings banks), cooperative capital (cooperative banks) plus reserve fund, equalization fund (cumulative value adjustments), and 'distributable' equity.

<sup>6</sup> Table 3 reports the regulatory ratio for 1986 and 1989 only, as data do not exist for the end of 1990.

One obvious reason for the increase in capital/asset ratios in the late 1980s was the anticipated tightening of capital regulations. After being discussed by the authorities and the banking community over several years, the main lines of the reform became clear in 1988. Thus at least by that year the banks were aware that a tightening would take place in the early 1990s.<sup>7</sup>

The structure of capital differs somewhat between the two banking groups. The 'primary capital', which corresponds to share capital of joint stock companies, is minuscule in the savings banks, reflecting the legal nature of the savings banks. The corresponding 'cooperative capital' of the cooperative banks is also small, but it is nevertheless a much bigger fraction of total capital. Thus both types of banks have added to their capital mainly from retained earnings.

What may be of some importance is that the savings bank group boosted its capital between 1986 and 1989 very significantly through value adjustments particularly of fixed property. FIM 1.7 billion, ie almost half of the increase in bank capital from FIM 1.5 billion to FIM 5.0 billion, is accounted for by a change in the 'equalization fund'. The cooperative banks, which have traditionally owned less fixed property, did not, and actually could not, significantly augment their capital in this way; for them the increase in the equalization fund amounted to a mere FIM 200 million over the same period. Given the highly inflated property prices in 1989, the additional capital based on value adjustments soon turned out to be illusory.

Subordinated debt has been of substantial importance for the cooperative banks in meeting the regulatory capital requirement even though most cooperative banks failed to utilize it up to the regulatory maximum. In contrast, subordinated debt remained relatively insignificant in the savings bank sector throughout the 1980s.

### Costs

At the beginning of the boom period operating costs, ie costs other than interest expenses, were higher (relative to average total assets) in the savings bank group than in the cooperative banks. The savings banks also had marginally higher average deposit rates than the cooperative banks. However, by the end of the period the situation had changed. The savings banks had managed to reduce their ratio of operating costs to average total assets substantially, while the ratio had remained largely unchanged

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<sup>7</sup> Capital regulations and their changes are described in more detail in Appendix 1.

for the cooperative banks. By contrast, the difference in average deposit rates had marginally increased (Table 4).

Table 4. **Costs of local banks**

		1986			1990		
		mean	min	max	mean	min	max
Average deposit rate, per cent	coops	4.60	3.86	6.71	6.27	5.02	9.17
	savings	4.71	3.68	5.51	6.49	3.74	7.65
'Other costs', per cent of average total assets	coops	3.60	1.99	7.81	3.64	1.60	11.0
	savings	3.95	2.56	5.46	3.38	1.88	6.84

### 3.3 Specification of the equations to be estimated

The theoretical model implies that the signs of the hypothesized relationships between risky lending on the one hand and capital, costs, demand variables and regulatory policy parameters on the other are as shown in equation (1). But precisely what variables and functional forms one should use is left essentially open.

As far as the functional form is concerned, in principle the most straightforward approach would be to specify an equation for the stock of loans at any given point of time, as the model is formulated in level terms. Therefore some preliminary experiments were conducted with a linear equation with the logarithm of the loan stock as the dependent variable and the logarithm of deposits and various proxies for the other right-hand-side variables of equation (1) as the explanatory variables. These experiments however yielded unsatisfactory results. In each of the equations a demand variable obtained a significant coefficient with the wrong sign, and the used capital and cost variables obtained significant coefficients with the same sign, which is inconsistent with any version of

the theoretical model of Chapter 2. At the same time, the log level of lending responded with a unitary coefficient to the log level of deposits.<sup>8</sup>

These findings suggest that the implicit assumption of the level specification, that an equilibrium obtains at all points of time, may be too strong. Given the constraints on foreign borrowing and the virtual non-existence of a true money market until 1987, most savings and cooperative banks were very likely to be out of equilibrium with respect to the preferred amount of nondeposit funding. In addition, it is very plausible that the speed at which a bank can profitably adjust its lending is finite and depends on the demand conditions in the local credit market. On the other hand, given the observation of unitary elasticity of lending with respect to core deposits, one is led to focus on the ratio of loans to deposits. These considerations suggest reformulating equation (1) into a somewhat more specific dynamic form:

$$\Delta\left(\frac{L}{D}\right) = \lambda(x,z) \cdot \left( \left(\frac{L}{D}\right)^* - \left(\frac{L}{D}\right)_{-1} \right), \quad (1')$$

where  $\Delta(L/D)$  is the change in the loan deposit ratio over the period of interest,  $\lambda(x,z)$  is a positive adjustment speed factor assumed to depend positively on loan demand and borrower quality,  $(L/D)^*$  is the optimal loan/deposit ratio determined by equation (1), and  $(L/D)_{-1}$  is the loan deposit ratio at the beginning of the period.

Formulation (1') focuses explicitly on the change in lending financed by nondeposit funding. Thus it also seeks to account directly for the growth of money market funding, ie the new source of financing for the banks in the second half of the 1980s, which is central to the theoretical model of Chapter 2.

The dynamic form of (1') links our analysis also quite directly to that of Solttila and Vihriälä (1994), in which it was shown that the speed of credit expansion in the second half of the 1980s – rather than the size of the loan portfolio at the end – was a major determinant of the later asset quality. Thus, should one succeed in this analysis in accounting for the change in the growth of bank lending in the late 1980s, one could also

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<sup>8</sup> This is also inconsistent with a strict interpretation of the theoretical model; the elasticity should be less than unity. Two explanations are readily available. First, the deposit variable used in the empirical analysis contains – in addition to true core deposits – funding that is in effect equivalent to money market debt. However, given the regulatory environment of the 1980s this does not appear plausible, and a simple informal test of deposit exogeneity reported in Appendix 4, argues against this explanation. Another and more plausible explanation is that deposit growth proxies for growth of the local banking market are not fully captured by the demand-for-loans variables used.



quite directly account for the credit quality problems of the early 1990s. Our approach in focusing on the change rather than the level is also consistent with most other studies examining the effect of capitalization on bank lending.<sup>9</sup>

For the most part, we will analyze the whole period of rapid credit growth, ie the dependent variable is the change in the loan/deposit ratio between the end of 1986 and the end of 1990. The analysis will thus be essentially cross-sectional. However, it is also important to analyze whether behaviour changed over this rather long period of credit growth. For that purpose we will also analyse the change in the loan/deposit ratio over two subperiods.

To keep things simple, we linearize the right-hand side of (1') as a whole and in so doing specify the explanatory variables in a way which makes them likely to correspond to the difference form of the dependent variable. The explanatory variables thus contain bank characteristics, including the beginning-of-period loan/deposit ratio and variables reflecting conditions in the local credit market. Although the market conditions enter both through  $(L/D)^*$  and  $\lambda(\cdot)$ , they are incorporated into the empirical specification as additive terms.

The empirical counterpart of bank capital (K) should contain all the items that constitute the residual claim on bank assets. It will be operationalized as the sum of the book value of equity capital on the balance sheet and total reserves (general provisions for loan losses etc). The analysis uses the ratio of capital and provisions to balance sheet total, denoted  $K/A$ .

As far as the providers of money market funding are concerned, the relevant capital measure might also contain subordinated debt. In addition, the supervisory authority may be most interested in the bank's capacity to meet the statutory capital requirement; accordingly subordinated debt may be included in the definition of capital. Therefore also the regulatory capital ratio,  $(K/A)^{REG}$ , tested.

The rules on capital adequacy were the same for all banks considered and did not change during the period of rapid credit growth. Nor do we have any direct information about potential differences (say between the savings banks and cooperative banks) in the stringency applied to banks which did not meet the requirements (the penalty parameter  $c$  in the theoretical model). Therefore, the capital regulation parameters do not appear directly in the empirical analysis. An attempt will nevertheless be made to examine the effects of the general tightening of capital regulation

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<sup>9</sup> Almost all studies that attempt to identify potential credit crunches with cross-section data have focused on the rate of growth of credit. Similarly Park (1994) looks at the rate of growth of lending when examining the moral hazard hypothesis.

immediately after the boom period. This experiment will be described in detail later.

In the theory the exogenous cost variable is the deposit rate, but as discussed, other exogenous costs should also have an analogous effect. In the empirical analysis these two cost elements are analyzed separately, as their effect may differ depending among other things on the time frame within which these costs are likely to change. The deposit costs are proxied by the average deposit rate (RD) obtained by dividing interest expenses on deposits in a given year by the average deposit stock. Costs other than interest costs, 'operating costs', are measured by the ratio of the income statement item 'other expenses' to average total assets, C/A.<sup>10</sup>

The capital and cost variables are dated at the beginning of the period of analysis, ie at the end of 1986, or for the year 1986, to eliminate any possible problems of simultaneity.<sup>11</sup>

Growth in the demand for loans is assumed to be related positively to the rate of growth of taxable per capita income ( $\Delta\text{INC}$ ) and negatively to the change in the rate of unemployment ( $\Delta\text{UNR}$ ) over the period in question. Banks that operated in areas where the structure of the economy was tilted toward the most expansionary activities of the late 1980s – construction and services – probably faced higher demand for loans than did banks in average areas. The share of construction and service employment (CONSER) is used to depict this influence. Similarly, given the relative increase of economic activity in the urban areas over a longer period of time, the share of urban population (URPOP) is included as a variable presumed to have a positive effect on the demand for loans.

According to the theory, borrower quality also affects banks' lending decisions. Unfortunately, finding reasonable proxies for such a concept did not prove possible for the 1980s. Data on credit losses and credit loss provisions are uninformative for this period and there is no data on nonperforming assets. We therefore exclude borrower quality from the empirical analysis.<sup>12</sup>

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<sup>10</sup> The results would not change qualitatively if the two cost variables were incorporated in an aggregated form, but the fit would be somewhat worse.

<sup>11</sup> As discussed in Chapter 2, there are good a priori reasons to assume that capital and costs are exogenous, particularly in the 1980s. Rapid growth of lending may nevertheless result in short-run changes in the measured capital and operating cost ratios. A simple way to preventing this from causing simultaneity bias in the estimation is to use beginning-of-period data.

<sup>12</sup> The situation is very different for the 1990s, and in the analysis of that period borrower quality plays a crucial role.

The aforementioned variables fall out rather directly from the theoretical model. As the model abstracts from many aspects which may have been important for the observed patterns of lending growth, some variables are added to control for such potential effects.

First, bank size may be an important factor in many, albeit conflicting, ways. Access to borrowed funds is likely to be better for large banks than for small banks, as the bigger banks are better known and, at least in the upper tail of the size distribution, may benefit from an implicit 'too-big-to-fail' guarantee. Similarly, diversification possibilities are likely to be better for large banks. Also management behaviour may have differed between large and small banks. We therefore attempt to control for size effects by including an additional variable. The size variable used is the log of the number of employees (SIZE).<sup>13</sup>

Second, a bank's lending behaviour is likely to be affected by local competitive conditions. The theory assumes that every bank faces a downward sloping demand curve for credit. Its position and slope may be dependent on the presence of competing banks in the local market. To incorporate these influences, a dummy (CP0) is defined. CP0 obtains the value 1 if neither of the two largest commercial banks – KOP and SYP – has a branch in the operating area of the cooperative or savings bank analyzed and is 0 otherwise.<sup>14</sup>

Third, as discussed in Section 2, the behaviour of the cooperative banks and the savings banks may have differed, as they had different central banks as well as somewhat different regulatory regimes. It is therefore reasonable to allow the parameters to differ across the two banking groups. In a preliminary analysis such a difference is allowed for all parameters except the coefficients of the demand variables. The potential difference is incorporated by including savings bank dummies (SBDUM:constant etc) for the intercept and the respective slope coefficients.

Finally, there is the possibility that bank behaviour has been affected by factors not linked to the maximization of bank value. Criminal behaviour on the part of management is a possibility. To control for such an effect we include a dummy variable taking the value 1 for banks which have been subject to criminal proceedings and 0 otherwise

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<sup>13</sup> Using some other obvious size variable, such as the amount of loans or total assets or the number of branch offices, would not change the results as all of these are highly correlated.

<sup>14</sup> Using some more standard measure of competitive conditions, eg market share of the bank in the local loan market, does not qualitatively change the results, but the coefficients turn out to be marginally less significant.

(CRIMPRO). Of course criminal behaviour may also be an extreme way of maximizing bank value, but even in that case it is probably useful to separate such effects from more purely economic factors.

The basic linear equation to be estimated is thus of the following type:

$$\begin{aligned} \Delta\left(\frac{L}{D}\right) = & a_0 + a_1\left(\frac{L}{D}\right)_{-1} + a_2\frac{K}{A} + a_3RD + a_4\frac{C}{A} + a_5CP\emptyset + a_6SIZE \\ & + a_7\Delta INC + a_8\Delta UNR + a_9CONSER + a_{10}URPOP \\ & + a_{11}CRIMPRO + \sum a_j SBDUM:j + u, \end{aligned} \quad (2)$$

where the a's are the constants to be estimated and u is an error term assumed to be indentially, independently and normally distributed.

### 3.4 Estimation results

This section reports the empirical results. We start by estimating equation 2, where the dependent variable is the change in the loan/deposit ratio over the period from end-1986 through end-1990. Here different estimating techniques are used and the effects of bank characteristics are allowed to differ between the two banking groups. These preliminary experiments resulted in a condensed equation, in which only a few parameters differ as between the two banking groups. In addition, an alternative specification is introduced for the capital and cost effects at this point. The results of the modified equations for the whole period are reported in Section 3.4.2. Section 3.4.3 provides some checks of robustness. In Section 3.4.4 the observation period is split into two subperiods, ie the equation is estimated separately for the cross-sections covering the first two years 1986–1988 and the last two years 1988–1990. This is followed by an analysis of the behaviour of subordinated debt in Section 3.4.5. Finally, Section 3.4.6 reports some counterfactual calculations to assess the quantitative significance of the observed moral hazard incentives.

### 3.4.1 Preliminary experiments

Table 5 reports the estimation results for the specification (2) using first ordinary least squares (column a). The OLS results show that a relatively large fraction of the cross-sectional variation in the loan/deposit ratio can be explained by the variables included;  $R^2$  is over 50 per cent. Second, many bank characteristics and demand variables appear to exert significant influence on the change of the L/D ratio, including several savings bank dummies. However, the error term shows serious heteroscedasticity and non-normality according to the tests suggested by White (1980) and Jarque and Bera (1980) respectively. This calls into question the validity of inference on the basis of the OLS results.

The observed nonstandard behaviour of the error term may in principle be due to a small number of highly extreme observations. One way of handling the problems would be to exclude such observations from the sample, re-estimate the model with the truncated sample and examine the outliers separately. As discussed in Chapter 2, banks facing very weak demand for loans relative to core deposits might behave quite differently from banks using nondeposit funding. However, experiments excluding a few observations with low L/D do not change the results essentially. The remaining sample is still plagued by the same problems with the error term. Similarly, one might simply exclude the most extreme observation on the basis of the estimated residuals. But attempts to that effect do not yield normally distributed errors for the remaining sample either.

An alternative is to leave the sample untouched and use an estimation technique that takes into account the nature of the observed error term. Unfortunately, there is no obvious way of handling the two problems of heteroscedasticity and non-normality simultaneously. We therefore estimate the equation on the one hand using least squares with the heteroscedasticity correction as suggested by White (1980; LS/HEC) and on the other hand using the least absolute deviations (LAD) method. LAD has been shown to perform well in relation to least squares with many types of non-normal disturbances. (see eg Harvey 1981). The former estimation technique affects only the standard errors while in the LAD estimation both the point estimates and the standard errors in general deviate from those obtained by OLS.

The results of these alternative estimations are reported in columns b and c in Table 5. As can be seen, the heteroscedasticity correction changes the standard errors and thus the t-values markedly, although the results remain qualitatively the same. Similarly, the point estimates in the LAD estimation differ clearly from the least squares estimates as do the t-

values, although qualitatively the results are again in many respects similar.

**Table 5. Results for the basic specification**

Dependent variable Estimation method	(a)		(b)		(c)	
	$\Delta L/D9086$ OLS		$\Delta L/D9086$ LS/HEC		$\Delta L/D9086$ LAD	
Explanatory variables	coefficient	t-value	coefficient	t-value	coefficient	t-value
Constant	-55.9	-3.36***	-55.9	-2.95***	-29.9	-2.13**
L/D	-4.8	-2.71***	-4.8	-2.14**	17.2	-4.29***
K/A	-0.99	-1.56	-0.99	-1.54	-.49	-1.08
RD	8.69	3.74***	8.69	3.20***	5.09	2.93***
C/A	1.6	1.04	1.6	0.89	-0.13	-0.15
Size	2.58	2.43**	2.58	2.63***	2.70	3.11***
CP0	3.87	2.09**	3.87	2.47**	2.13	1.64
$\Delta inc$	0.17	2.72***	0.17	2.46**	.15	3.46***
$\Delta unr$	-0.31	-0.78	-0.31	-0.78	-0.11	-0.38
Conser	8.25	1.33	8.25	1.38	-0.21	-0.05
Uropop	20.8	4.52***	20.8	4.20***	23.8	7.58***
Crimpro	44.5	9.63***	44.5	6.85***	45.9	15.25***
SBDUM:Constant	0.16	0.00	0.16	0.00	-18.1	-0.68
SBDUM:L/D	13.5	1.41	13.5	1.19	4.67	0.64
SBDUM:K/A	-1.01	1.03	-1.01	-1.02	-0.82	-1.17
SBDUM:RD	-8.85	-1.87*	-8.85	-1.61	-2.88	-0.80
SBDUM :C/A	6.74	2.35**	6.74	2.22**	4.28	2.83***
SBDUM :Size	3.02	1.81*	3.02	1.80*	4.51	3.29***
SBDUM :CP0	2.99	0.87	2.99	0.84	7.08	3.00***
Number of observations	.483		.483		.483	
ADJ. R <sup>2</sup>	0.52		0.52		0.50	
White	174.1***					
JB	510.0***					

White: the White test statistic for homoscedasticity

JB: the Jarque-Bera test statistic for normality

\*, \*\*, \*\*\*: the test statistic significant at the 10 %, 5 % or 1 % level, respectively

In (b) the t-values are corrected for heteroscedasticity (White, 1980).

Given that heteroscedasticity and non-normality of the error term cannot be handled simultaneously, one either must examine the estimates based both on least squares with heteroscedasticity correction and on the LAD estimates throughout the analysis or choose between the two. For simplicity we use the more standard least squares with heteroscedasticity correction as the estimation technique. However, some important calculations based on the equation estimated with least squares will be cross-checked by performing the same computations on the basis of corresponding LAD estimates.

In order to estimate the coefficients of greatest interest more accurately, we drop the savings bank slope dummies that remain insignificant at the 10 per cent level, taking into account the heteroscedasticity correction. Almost the same variables would be dropped if the simplification was based on the LAD results.

At this point an additional modification is worth considering. According to the theory, the potential moral hazard is strongest when simultaneously capital is low and costs are high. In addition, if a bank has so much capital that it can meet its commitments under all possible (perceived) realizations of the loan returns, no moral hazard exists irrespective of costs and the principle of pricing of purchased funds. A way to incorporate these two effects is to replace RD and C/A by the cross-terms  $RD*((K/A)^{\text{safe}} - K/A)$  and  $(C/A)*((K/A)^{\text{safe}} - (K/A))$ , where  $(K/A)^{\text{safe}}$  is a capital ratio assumed to be high enough to make bank debt safe. The moral hazard hypothesis predicts that these variables will have a positive impact on lending.<sup>15</sup>

We thus end up with the following functional specifications:

$$\begin{aligned} \Delta \frac{L}{D} = & a_0 + a_1 \left( \frac{L}{D} \right)_{-1} + a_2 \frac{K}{A} + a_3 RD + a_4 \frac{C}{A} + a_5 CP\emptyset + a_6 SIZE + a_7 \Delta INC \\ & + a_8 \Delta UNR + a_9 CONSER + a_{10} URPOP + a_{11} CRIMPRO \\ & + a_{12} SBDUM:CONSTANT + a_{13} SBDUM:C/A \\ & + a_{14} SBDUM:SIZE + u, \end{aligned} \quad (3)$$

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<sup>15</sup> Defining an appropriate 'safe' capital asset ratio is naturally somewhat arbitrary. In light of the losses made by the savings bank sector as a whole in the recent crisis, three times the actual capital might have been sufficient. Although also other values for  $(K/A)^{\text{safe}}$  are tested, the value 15 per cent will be used in the analysis. It is about three times the average capital asset ratio and about 1.5 times the maximum observed value in the sample.

$$\begin{aligned}
\Delta \frac{L}{D} = & b_0 + b_1 \frac{L}{D} + b_2 \frac{K}{A} + b_3 RD * \left( \frac{K^{safe}}{A} - \frac{K}{A} \right) + b_4 \frac{C}{A} * \left( \frac{K^{safe}}{A} - \frac{K}{A} \right) \\
& + b_5 CP\emptyset + b_6 SIZE + b_7 \Delta INC + b_8 \Delta UNR + b_9 CONSER \\
& + b_{10} URPOP + a_{11} CRIMPRO + b_{12} SBDUM:CONSTANT \\
& + a_{13} SBDUM:C/A + a_{14} SBDUM:SIZE + v.
\end{aligned} \tag{4}$$

### 3.4.2 The modified equations for the entire period

The least squares parameter estimates and the t-ratios incorporating the heteroscedasticity correction for specifications (3) and (4) are reported in columns d and e of Table 6. When the parameters are allowed to differ between the two banking groups, the table reports the coefficient estimates for both types of banks in the same way, ie the savings bank estimate incorporates the dummy effect. For the nonlinear version the table contains also the derivatives of the dependent variable with respect to the capital and cost variables. Finally, the table reports  $\chi^2$  tests of the joint significance of the capital and cost variables, on the one hand, and the four demand variables, on the other.

The first observation is that the two specifications tell essentially similar stories about the determinants of the loan/deposit ratio and thus bank lending. There is no difference in fit, and comparable parameters are of the same order of magnitude. Although more complicated, the nonlinear version (4) will be used in most later experiments, as it allows for interesting counterfactual calculations.

Second, both demand factors as a group and most bank characteristics are highly significant. Thus excluding either would be misleading. Furthermore, all of the demand variables obtain coefficients with the expected signs. Both the change in income and the share of urban population have significant positive effects on the loan/deposit ratio.

Third, the message about the effects of capital and costs is striking. Both specifications suggest that capital exerts a negative impact on the change in the loan deposit ratio while both the deposit rate and the ratio of other costs to total assets exert positive effects. In the linear specification all the relevant parameters are significant at the 1 per cent level with the exception the 'other cost' variable for the cooperative banks. In the nonlinear specification, even that term becomes significant at the 10 per cent level. To the extent that the effects are allowed to differ



between the two banking groups, they are significantly stronger for the savings banks. Thus the findings are consistent with the moral hazard hypothesis for both types of banks but much more strongly so for the savings banks.

Fourth, bank size has a clear positive effect on the change in the loan/deposit ratio. This suggests that particularly large banks benefited from the new opportunities for financing lending with nondeposit funding in the second half of the 1980s. Interestingly, the size effect is significantly larger among the savings banks than the cooperative banks.

Fifth, absence of commercial bank competition in the local market seems to increase loan growth of the local bank. In the context of the simple background model, this may be due simply to the fact that the dummy proxies for geographical variation in loan demand which is not captured by the demand variables used. But it is also consistent with some recent ideas about the effect of bank competition on lending when product markets are imperfectly competitive (see Koskela and Stenbacka 1996).

Sixth, the banks whose managements are suspected of criminal activity by the authorities clearly increased their loan deposit/ratios faster than other banks.

Finally, the results give some weak support for convergence toward a common industry-wide loan/deposit ratio, as the coefficient of the beginning-of-period loan deposit ratio is negative and significant at the 10 per cent level. Yet incorporating this effect is not important in that the results for other variables would not be much different even if the beginning-of-period L/D ratio were excluded.

Table 6.

### The constrained linear and nonlinear specifications

Dependent variable		(d)		(e)	
		$\Delta L/D9086$		$\Delta L/D9086$	
Explanatory variable		coefficient	t-value	coefficient	t-value
Constant,	coops	-49.9	-3.11***	-82.1	-3.47***
	savings	-80.7	-4.73***	-105.4	-4.40***
L/D		-11.1	-1.90*	-9.7	-1.69*
K/A		-1.42	-2.92***	3.71	2.45**
RD		6.68	2.98***		
RD*(15-K/A)				0.71	2.82***
C/A	coops	1.89	1.15		
	savings	8.42	3.58**		
C/A*(15-K/A)	coops			0.28	1.70*
	savings			0.73	3.36***
Size	coops	2.80	2.92***	2.48	2.64***
	savings	5.53	4.26***	5.51	4.19***
CP0		4.57	2.92***	4.45	2.83***
$\Delta inc$		0.18	2.48**	0.19	2.62***
$\Delta unr$		-0.25	-0.63	-0.22	-0.58
Conser		8.31	1.35	8.36	1.33
Urp0p		19.6	3.90***	19.8	3.95***
Crimpro		44.4	7.00***	44.5	6.79***
Derivatives w.r.t.				Coops	Savings
K/A				-0.56	-2.50
RD				6.87	6.93
C/A				2.72	7.10
Number of observations		483		483	
ADJ. R <sup>2</sup>		0.51		0.51	
$\chi^2$ -tests for joint significance (significance levels)					
		Coops	Savings	Coops	Savings
K/A & RD & C/A		0.0002	0.0000	0.0214	0.0000
Demand		0.0000		0.0000	

\*, \*\*, \*\*\*: the test statistic significant at the 10 %, 5 % or 1 % level, respectively

The t-values are corrected for heteroscedasticity (White, 1980)

### 3.4.3 Some checks of robustness

Every model specification and every choice of sample is one among many a priori reasonable alternatives. It is therefore important to check how the results would change if some central choices had been made differently.

One question is the choice of the capital variable. The ratio used, equity capital and reserves (provisions) to total assets, seems natural from the point of view of the theoretical model. But as discussed above, the regulatory capital ratio may also be relevant. The K/A variable in the linear version (d in Table 6) is therefore replaced by the appropriate regulatory capital ratio  $(K/A)^{REG}$  which includes subordinated debt but excludes some provisions and uses a slightly different scaling factor. The estimation results of an equation modified in this way are reported in column f of Table 7. It turns out that the regulatory capital ratio is not associated at all with the dependent variable while the estimated effects of the cost variables remain essentially unchanged. The relevant capital concept thus seems to be the original variable most closely resembling the equity capital concept of the theoretical model.

Also two other issues pertaining to capital may be important. As noted above and discussed more thoroughly in Appendix 1, capital regulation changed as of the beginning of 1991. That this type of change would very likely take place, was probably understood in the banking community at least since 1988. The change implied a tightening of the requirement in general and in particular for those banks which had more than the average share of loans to the public in their assets. The latter effect can be tested with our cross-section data, as one can compute an estimate for the change in the regulatory capital ratio due to the regulatory change for every bank. Such a variable ( $\Delta REG$ ) should, according to the theoretical model, have a negative effect on lending if capital regulation imposes a positive penalty for capital insufficiency.<sup>16</sup>

Secondly, as discussed above many savings banks added substantially to their equity capital through value adjustments mainly related to fixed property. One may suspect that these banks were behaving differently from those that did not seek to expand their capital base in this, ex post highly illusory, way. To check for this possibility one

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<sup>16</sup> The variable  $\Delta REG$  is computed by subtracting from the end-1990 regulatory capital ratio calculated according to the old rules a corresponding estimated ratio according to the new rules. As data on the old ratio for the end of 1990,  $(K/A)^{REG}(90)$ , were not available, the ratio was estimated by  $(K/A)^{REG}(89) * (K/A)(90) / (K/A)(89)$ , where  $K/A(90)$  is the ratio of equity capital and reserves to total asset used elsewhere in the analysis. Due to missing data,  $\Delta REG$  cannot not be calculated for 23 banks of the original sample.

Table 7. **Some alternative specifications**

		(f)	(g)	(h)	(i)
Dependent variable		$\Delta L/D9086$	$\Delta L/D9086$	High L/D90 $\Delta L/D9086$	Low L/D90 $\Delta L/D9086$
Explanatory variable		coefficient (t-value)	coefficient (t-value)	coefficient (t-value)	coefficient (t-value)
Constant,	coops	-72.1*** (-4.19)	-62.1*** (-2.90)	-80.4** (-2.53)	23.3 (1.04)
	savings	-101.9*** (-5.59)	-87.6*** (-3.96)	-99.8*** (-3.09)	25.7 (1.13)
L/D		9.28 (-1.58)	-12.9** (-2.26)	-21.6*** (-2.72)	-51.8*** (-6.65)
K/A <sup>(1)</sup>		0.14 (-.34)	3.14** (2.35)	4.59** (2.30)	0.17 (0.13)
RD		8.28*** (3.47)			
RD*(15-K/A)			0.60*** (2.67)	0.93*** (2.96)	0.12 (0.61)
C/A	coops	2.72 (1.69)			
	savings	8.26*** (3.36)			
C/A*(15-K/A) coops			0.22 (1.37)	0.21 (0.96)	0.15 (0.86)
savings			0.71*** (3.28)	0.66** (2.52)	0.08 (0.45)
Size	coops	2.49*** (2.64)	2.48*** (2.59)	0.99 (0.81)	2.64*** (2.83)
	savings	6.14*** (4.40)	5.30*** (4.12)	3.49** (2.33)	2.79* (1.76)
CP0		4.79*** (3.07)	3.11** (2.06)	4.47** (2.49)	-0.13 (-0.09)
$\Delta inc$		0.15** (2.30)	0.14** (2.02)	0.26*** (3.09)	0.04 (1.01)
$\Delta unr$		-0.32 (-0.81)	-0.26 (-0.70)	-0.17 (-0.42)	-0.61 (-1.15)
Conser		9.07 (1.43)	9.42 (1.48)	7.74 (1.37)	5.97 (-0.87)
Urpop		18.4*** (3.59)	15.7*** (3.04)	24.9*** (4.24)	2.84 (-0.67)
Crimpro		42.9*** (6.64)	45.9*** (6.45)	41.3*** (6.40)	.. ..

	(f)	(g)	(h)	(i)
Dependent variable	$\Delta L/D9086$	$\Delta L/D9086$	High L/D90 $\Delta L/D9086$	Low L/D90 $\Delta L/D9086$
Explanatory variable	coefficient (t-value)	coefficient (t-value)	coefficient (t-value)	coefficient (t-value)
$\Delta Reg$		-0.53* (-1.85)		
Vad/K		0.05 (0.68)		
Derivatives w.r.t.	coops savings	coops savings	coops savings	coops savings
K/A <sup>(1)</sup>		-0.41 -2.51	-0.45 -2.41	-0.91 -0.72
RD		5.84 5.90	9.03 9.12	1.14 1.15
C/A		2.09 6.95	2.03 6.47	1.48 0.85
Number of observations	483	460	362	121
ADJ. R <sup>2</sup>	0.50	0.53	0.57	0.38
$\chi^2$ -tests for joint significance (significance levels)				
	coops savings	coops savings	coops savings	coops savings
K/A & RD & C/A	0.0035 0.0002	0.040 0.0002	0.029 0.0004	0.30 0.33
Demand	0.0000	0.0001	0.0000	0.54

\*, \*\*, \*\*\*: the test statistic significant at the 10 %, 5 % or 1 % level respectively

The t-values are corrected for heteroscedasticity (White, 1980)

(1) In eq. (f) K/A<sup>REG</sup>, otherwise K/A.

specification of the equation is augmented with the variable VAD/K, which measures the share of cumulative net value adjustments ('equalization fund') in total equity capital plus reserves at the time when the cumulative value adjustments peaked (1989).

Column g in Table 7 reports the results when the two additional variables are included; due to missing data the sample is somewhat smaller than in the earlier regressions. The results give some support to the conjecture that the change in capital regulation that took place in 1991 indeed constrained bank lending already in the late 1980s. Furthermore, allowing for this effect in no way alters the earlier results supporting the moral hazard hypothesis.

In principle this finding that the tightening of capital regulation (increase in  $k$  in the theoretical model) can even be used to discriminate between the two sources of moral hazard: underpricing of nondeposit funding and anticipation of perverse bank support policies (rewarding capital insufficiency,  $c < 0$ ). The negative effect is namely consistent with the underpricing hypothesis but inconsistent with the hypothesis that bankers expected that capital insufficiency would be rewarded. Nevertheless, given that the exact significance level of the  $\Delta$ REG coefficient is as high as .064, strong conclusions are not warranted.

In contrast, the degree to which the banks used value adjustments as a way to boost capital did not matter for growth of lending (column g in Table 7).

The theory suggests that the relationship between bank lending and various exogenous factors is more predictable for banks that obtain funding from the money market than for highly liquid banks, whose essential decision problem is to allocate an exogenous amount of capital and deposits between risky lending and bonds. Unfortunately, there is no way of classifying banks with any degree of certainty into the two categories on the basis of available data. One can however compare how well the specified model fits for those banks which had low L/D ratios with how well the model fits for the supposedly more standard banks using significant amounts of nondeposit funding. Columns h and i in Table 7 report estimates for two subsamples constructed on the basis of the 1990 L/D ratio. The results in column h are obtained by using only observations for which the 1990 L/D ratio was within the top three quarters (the top 75 per cent), and the results in column i relate to the banks with the lowest quarter of L/D ratios.

The results differ substantially. As predicted by the theory, the equation fits much better for the high L/D banks than for the low L/D banks in terms of both  $R^2$  and number of significant coefficients. In particular, the effects of capital and costs are insignificant for the low L/D

banks while for the high L/D banks the results are very close to those obtained for the whole sample. Qualitatively, the capital and cost effects are the same in both subsamples. Therefore, and as there is no obvious cut-off point, no attempt is made to eliminate from the sample any given number banks with small L/D ratios.

#### 3.4.4 Stability over time

The period of credit expansion studied is relatively long, spanning the years 1987 through 1990. This as such raises the question whether bank behaviour remained essentially the same over the whole period, which was characterized by rather different macroeconomic conditions during the first two year as compared to 1989 and 1990. Monetary policy was sharply tightened at the beginning of 1989 and asset prices and output growth peaked in the first half of 1989. Macroeconomic conditions turned clearly for the worse. As a consequence, examining the potential changes in bank behaviour around early 1989 may tell us something about why high-cost banks expanded lending more than others.

Table 8 reports estimation results for the nonlinear specification (4) for the periods 1986–1988 and 1988–1990. For the former period, column j, the model is fully analogous with the whole period version of the earlier tables. Thus the exogenous variables are dated either at the beginning of the period or, as in the case of income growth and change in unemployment rate, over the period in question. For the latter period, two different versions are reported. The first one, column k is again fully analogous with the whole period model; the exogenous variables are dated at the end of 1988 or over the period end-1988 through end-1990. In the second version, column l, the end-1988 exogenous variables are replaced by the corresponding end-1986 variables.

There are several interesting differences between subsample results. First, the fit is much worse for the first subperiod than for the second. Particularly the demand factors appear to influence credit growth very little in the first period while they are very important in the latter period.

Second, for all subsample regressions the fit is worse than the for the period as a whole. This suggests that at least during the growth period banks seem to have abided largely by the same strategy for the whole period.

Third, comparing the first period results with analogous second period results, column k, suggests a remarkable change in the capital and cost effects: the moral hazard incentives seem to vanish, so that no further significant effects can be detected. Taking this at the face value, one

might conclude that the observed positive relationship between costs and lending and the observed negative relationship between capital and lending for the period as a whole and for the first subperiod would not represent deliberate risk taking. Rather it would appear to be motivated by an attempt to reduce unit costs and increase capital through growth in an environment where the risks of rapid growth were not at all understood by the bankers or their lenders.<sup>17</sup> According to this story, behaviour changed radically when the macroeconomic prospects turned for the worse in early 1989 and bankers and perhaps their lenders became aware of potential credit risks. Thus a rather different story than moral hazard would be the explanation for the observed variation across banks in lending growth. However, a closer look suggests that quite the opposite is plausible in light of the data of this analysis.

Bank lending is a business in which revenues are earned upfront. Various fees and charges come in at the beginning of the loan period. In addition, hardly any customer fails to pay interest on newly taken debt. Debt service problems emerge typically toward the end of the contract period.<sup>18</sup> This is likely to be particularly characteristic for so-called 'bullet' loans, ie loans where the full principal is paid back at the maturity. These loans became very popular in the late 1980s, particularly among the savings banks. Thus banks that in 1987 and 1988 had rapidly expanded their lending not only managed to reduce their unit costs but also posted high profits and thereby added to their capital base. Therefore, if the banks that adopted a growth strategy in the early phase of the credit boom period had continued the same strategy in the latter period, there might not be any relationship between the 1988 capital and cost and the subsequent lending growth. This is what one observes in column k.

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<sup>17</sup> As noted in Chapter 1, this is the way many observers have interpreted savings bank behaviour in the late 1980s.

<sup>18</sup> Default premia in the interest rate further increase the upfront nature of the earnings on risky bank lending.



Table 8. **Estimates for the subperiods**

		(j)		(k)		(l)	
Dependent variable		$\Delta L/D8886$		EXOG.: 1988 $\Delta L/D9088$		EXOG.: 1986 $\Delta L/D9088$	
Explanatory variable		coefficient	t-value	coefficient	t-value	coefficient	t-value
Constant,	coops	-28.5	-1.67*	-16.8	-0.91	-53.9	-3.76***
	savings	-33.7	-1.94*	-35.4	-2.05**	-72.5	-4.98***
L/D		-1.53	-0.43	-12.3	-3.47***	-8.66	-2.24**
K/A		1.36	1.23	-0.26	-0.23	2.56	2.91***
RD*(15-K/A)		0.29	1.81*	0.19	0.96	0.45	2.60***
C/A*(15-K/A)	coops	0.08	0.69	-0.15	-1.21	0.20	1.87*
	savings	0.30	1.99**	0.08	0.55	0.45	2.78***
Size	coops	2.29	3.30***	1.14	1.65	0.15	0.19
	savings	1.09	1.27	5.80	5.22***	4.35	4.04***
CP0		1.31	1.36	4.07	3.20***	3.25	2.49**
$\Delta inc$		-0.01	-0.18	0.17	2.00**	0.17	1.87*
$\Delta unr$		-0.22	-0.54	-0.02	-0.07	0.04	0.11
Conser		-0.26	-0.08	12.5	1.87*	11.9	1.81*
Urpop		7.89	2.32**	16.7	4.18***	12.7	3.35***
Crimpro		9.94	2.14**	36.2	5.06***	35.0	5.10***
Derivatives w.r.t.		coops	savings	coops	savings	coops	savings
K/A		-0.29	-1.20	-0.67	-1.57	-0.24	-1.34
RD		2.87	2.89	1.83	1.78	4.39	4.44
C/A		0.78	2.89	-1.45	0.77	1.94	4.36
Number of observations		483		483		483	
ADJ. R <sup>2</sup>		.17		.46		.47	
$\chi^2$ -tests for joint significance (significance levels)							
		coops	savings	coops	savings	coops	savings
K/A & RD & C/A		0.221	0.010	.195	.045	.014	.0005
Demand		.174		.0000		.0002	

\*, \*\*, \*\*\*: the test statistic significant at the 10 %, 5 % or 1 % level, respectively  
 The t-values are corrected for heteroscedasticity (White, 1980)

But, if this conjecture of unchanged lending strategies holds (and it is supported by the earlier observation that the fit is better for the period as a whole than for the subperiods), one should find the same significant capital and cost effects in the second version (column l) of the latter period as for the first subperiod. In version (l), the capital and costs variables are namely dated at 1986, prior to the improvement caused by the early credit growth. And this is exactly what one finds. In fact, the perverse cost effects seem to be even stronger for this period than for the first period. Noteworthy is that these stronger effects obtain, even if some other interesting variables also obtain much larger coefficients in column l than in column j. Thus the coefficient of the criminal process dummy more than triples, even though it was significant to begin with. Similarly, the size effect quadruples for the savings banks between the two periods.

The evidence thus lends support to the conclusion that low-capital, high-cost banks that chose a strategy of rapid growth immediately in the aftermath of financial liberalization continued, if not stepped up, this lending policy when the macroeconomic prospects turned for the worse in 1989. Rapid growth was pursued especially by large savings banks and banks in which signs of criminal behaviour were later detected. This pattern fits very well with the moral hazard explanation. In contrast, it is difficult to reconcile with the idea that the banks expanded lending in 1987 through 1990 because they did not understand the risks, as in this case one would have expected the banks to change their behaviour radically in a conservative direction once the external conditions changed for the worse.

### 3.4.5 The behaviour of subordinated debt<sup>19</sup>

The theoretical model suggests examining also the issuance of subordinated debt in order to make inferences about banks' moral hazard incentives. More specifically, if pricing is fair and the bank is penalized by a positive penalty for capital insufficiency, banks that use money market debt also issue the maximum allowed amount of subordinated debt. In contrast, the underpricing of senior liabilities may result in zero optimal subordinated debt. On the other hand a zero penalty for capital insufficiency implies no specific amount of subordinated debt, and in the case of negative penalties the optimal subordinated debt volume is zero.

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<sup>19</sup> The data on subordinated debt is based on the records of Statistics Finland. The aggregate so obtained for the cooperative bank group does not precisely correspond to what the group reports. However, there is no practical way to identify the source of the discrepancy.

It was already noted in the preliminary discussion of data that the cooperative banks typically used relatively much subordinated debt in the late 1980s while most savings banks had no such debt at all. This broad observation is consistent with the results of the loan equation regressions: the potential problem of moral hazard was more serious among the savings banks than among the cooperative banks.

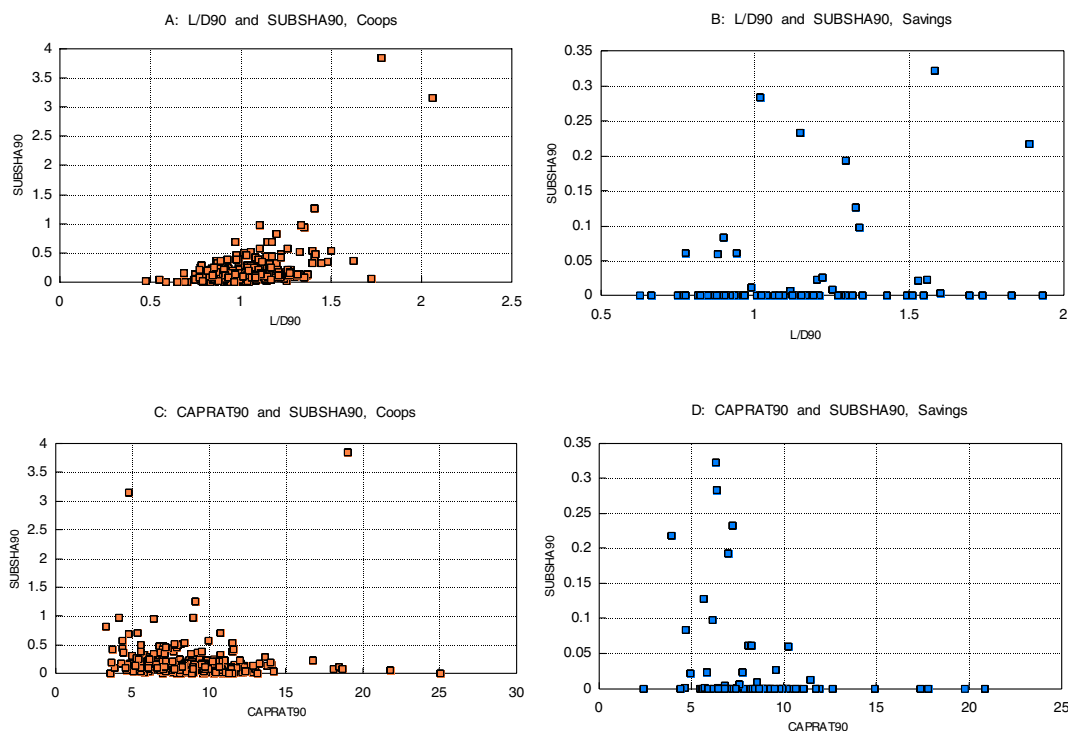
But to really be able to draw the conclusion that the patterns of subordinated debt are in line with the results of the loan equation, one needs to check that the issuance of subordinated debt by individual banks conforms with what the theory predicts. There are two important predictions in this regard. First, banks that issue the maximum amounts of subordinated debt are indeed banks that use nontrivial amounts of nondeposit funding (have high L/D's). Second, banks which issue most subordinated debt are also weakly capitalized, as the function of subordinated debt is to alleviate the problem of insufficient regulatory capital.

In Figure 2, we have plotted the ratio of subordinated debt to Tier-I capital (SUBSHA; per cent) against the L/D ratio and the total regulatory capital ratio (CAPRAT) at the end of 1990. The maximum amount of subordinated debt that is counted as regulatory capital is 50 per cent of Tier-I capital.

As can be seen no savings bank fully utilized the possibility to augment regulatory capital with subordinated debt. In contrast, several cooperative banks had subordinated debt outstanding well in excess of the regulatory maximum and many more were close to the maximum. Nonetheless, even most cooperative banks were below the maximum, suggesting that also within this group many banks perceived the problems of capital inadequacy as relatively small or that senior money market funding was attractively priced relative to subordinated debt.

Importantly, there is a clear positive relationship between SUBSHA and L/D, as required by the theory. This is particularly true for the cooperative banks but it may also hold among the savings banks.

Figure 2. **Share of subordinated debt in core capital against L/D and CAPRAT**



Plotting SUBSHA against regulatory capital concept (CORRAT) also indicates quite systematic behaviour.<sup>20</sup> The banks that issue significant amounts of subordinated debt are at the low end of the regulatory capital ratio. This is again clearly in line with the theoretical model, according to which the value of subordinated debt for the bank relates to capital adequacy.

Importantly, the negative relationship between capital adequacy and issuance of subordinated debt also suggests that issuance activity is governed by the supply side. Issuance by some banks is small because these banks prefer small amounts of such debt, not because buyers of subordinated debt had charged high lemons premia and, in the extreme, rationed such risky lending to the banks. If the latter factor had been dominant, one would expect to see the better capitalized banks having issuing relatively more than the weakly capitalized banks. Also the observation that some cooperative banks issued subordinated debt several

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<sup>20</sup> Essentially the same type of scatters would emerge if the plots were against the Tier-I capital ratio or K/A. The banks that utilized most subordinated debt thus did not manage to improve their regulatory capital ratios so as to make them rank very differently in an ordering of regulatory capital ratios. I.e. subordinated debt worked to alleviate insufficiency of regulatory capital, not to eliminate it.

times over the regulatory maximum suggests that pricing or availability of subordinated debt was no problem.

To ensure that the two partial relationships, which individually conform with the underlying theory, obtain also simultaneously, a Tobit model for end-of-1990 SUBSHA was estimated. The explanatory variables are the constant, L/D, K/A and bank size. Bank size is included to account for possible differences in access to the subordinated debt market of banks of different size; small banks presumably have higher unit costs of transaction and are likely to face higher lemons premia if such premia exist. The L/D ratio in the analysis is adjusted by deducting the amount of subordinated debt from the loan stock to make the ratio reflect more precisely the extent to which lending was financed with senior nondeposit funding. The results are reported in Table 9.

Table 9. **Tobit models for SUBSHA90**

A. The Cooperative Banks			B. The savings Banks		
Number of observations 332 <sup>(1)</sup> , of which 324 have positive values for SUBSHA90			Number of observations 128 <sup>(1)</sup> , of which 27 have positive values for SUBSHA90		
Explanatory variables	Coefficient	t-value	Explanatory variables	Coefficient	t-value
Constant	-10.4	-0.81	Constant	-7.29	-0.46
L/D <sup>(2)</sup>	37.7	4.16***	L/D <sup>(2)</sup>	-6.34	-0.68
K/A	-4.19	-3.72***	K/A	-3.55	-2.40**
Size	5.62	3.15***	Size	6.32	3.30***
Log of likelihood function = -1555.6			Log of likelihood function = -139.6		

(1) Data on some variables missing.

(2) In calculating the ratio, the amount of subordinated debt is subtracted from L.

The results confirm the bivariate negative relationship between bank capitalization and issuance of subordinated debt: weakly capitalized banks use more subordinated debt than others. It is important that the negative relationship obtains even after controlling for bank size, which as expected, exerts a positive effect on issuance of subordinated debt. However, the positive relationship between the issuance of subordinated debt and the L/D ratio is significant only for the cooperative banks.

In sum, local banks' issuance of subordinated debt has behaved broadly as predicted by the underlying theory. Its behaviour is moreover consistent with the results obtained with the loan regressions. Although banks used subordinated debt to improve their regulatory capital ratios in

the late 1980s, only a small fraction of them did so to the extent allowed by regulations. That they did not do so seems moreover to depend on their own choice rather than possible lemons premia or rationing in the market for subordinated debt.

As in the loan regressions, there is an important difference in the behaviour of subordinated debt as between the cooperative banks and the savings banks. The moral hazard incentives, which are suggested for both types of banks, seem to have been much stronger among the savings banks than the cooperative banks.

### 3.4.6 The quantitative significance of moral hazard

Even though the results suggest that moral hazard has affected banks' credit supply during the boom period, they do not precisely quantify its importance. One way of doing this is to make counterfactual calculations on what the expansion of aggregate credit would have been according to the model, had bank capital been sufficient to eliminate most, if not all, moral hazard.

The calculations utilize a decomposition of lending growth into the changes of the individual banks' loan deposit ratios and deposit growth:

$$\frac{\Delta L}{L} = \sum_{i=1}^N \frac{\Delta L_i}{L} \approx \sum_{i=1}^N \left( \Delta \left( \frac{L_i}{D_i} \right) \cdot \frac{D_i}{L} + \frac{L_i}{L} \cdot \frac{\Delta D_i}{D_i} \right), \quad (5)$$

where  $\Delta(L_i/D_i)$  is the change in the loan deposit ratio for bank  $i$  predicted by the model,  $D_i/L$  and  $L_i/L$  are ratios of bank  $i$ 's deposits and loans over the aggregate loans, respectively, and  $\Delta D_i/D_i$  is the rate of deposit growth for bank  $i$ . The decomposition thus combines the predictions for individual banks to arrive at a prediction of the growth of aggregate credit. In doing so it allows a big bank to affect the sectoral outcome according to its actual size, not just as a single observation in the total samples of 333 and 150 banks.

The hypothetical prediction of credit growth in the absence of moral hazard is computed by setting the capital asset ratio ( $K/A$ ) at the beginning of the period at 15 per cent for all banks in the nonlinear specification of the capital and cost effects (eq 4). This implies that the cross terms vanish from the equation. As roughly tripling the average capital asset ratio is a rather demanding requirement, the counterfactual prediction is also calculated with the capital/asset ratio at 10 per cent (approximately the maximum observed ratio in the sample). The

calculations are done for three specifications: The first is the specification e of Table 6, where the parameters are estimated with least squares and some important parameters are allowed to differ between the two banking groups. The second uses the same structure, but the estimation method is LAD. The third version is based on least squares estimation of a specification where the behaviour is imposed to be the same across the two banking groups, ie the savings bank dummies of the earlier versions are eliminated.

The results are reported in Table 10. Panel A provides point estimates for various factual and counterfactual growth rates. In panel B confidence intervals are reported for two counterfactual calculations. The first line in panel A provides an overall benchmark by showing what the growth rates were for the two banking groups separately and combined when using the decomposition (5) with the true  $\Delta(L/D)$  values. For every estimated specification, the first line reports the predicted sectoral growth rate using the true capital ratios  $K/A$ . Comparing these to the overall benchmark constitutes a sector level indicator of the goodness of fit. Comparing the counterfactual computations with the prediction using the true  $K/A$  ratios in turn provides measures of the quantitative importance of moral hazard.

The first observation of panel A is that the version allowing behaviour to differ between the two banking groups and using least squares as the estimation method produces almost precisely the same rates of growth as the decomposition with the true  $L/D$  ratios. In contrast, the prediction based on the LAD estimates underestimates growth in both sectors. Similarly, imposing the same behaviour on all banks leads to an overestimation of the cooperative banks' rate of growth and an underestimation of the savings banks' rate of growth. These observations suggest that the most reliable inference can be made on the basis of the first version, ie specification e of Table 6 (shaded area in Table 10).

The counterfactual calculations indicate that the estimated moral hazard effect is quantitatively very important. Had the capital ratios been at the assumed safe level of 15 per cent for all banks, the estimated rate of growth of lending by the two banking groups combined would have been 18 percentage points lower.

Table 10. **Predictions of aggregate growth of credit in 1986–1990, per cent**

**A. Point estimates**

	Cooperative banks	Savings banks	All banks in the sample
The total differential with the true $\Delta \frac{L}{D}$ values	79	99	89
Prediction on the basis of specification (e) in Table (6)			
with the actual K/A ratios	79	98	88
with K/A = 15%	73	68	70
with K/A = 10%	76	83	79
Prediction on the basis of LAD-estimates of the same model			
with the actual K/A ratios	77	95	86
with K/A = 15%	68	72	70
with K/A = 10%	73	84	78
Prediction on the basis of an equation imposing the same behaviour on the two banking groups			
with the actual K/A ratios	82	93	88
with K/A = 15%	67	72	69
with K/A = 10%	83	74	78

**B. The 90 per cent confidence intervals for counterfactual growth estimates based on eq e in Table 6**

		Cooperative banks	Savings banks	All banks in the sample
K/A = 15 %	lower 5 %	64	55	62
	mean	73	68	70
	upper 5 %	81	82	79
K/A = 10 %	lower 5 %	72	75	75
	mean	76	83	79
	upper 5 %	81	91	84



Even more striking are the results for the two banking groups separately. According to the point estimate the absence of moral hazard would have reduced the savings bank growth rate by almost a third from 98 per cent to 68 percent during the four-year period considered. Also lending by the cooperative banks would have been less without moral hazard incentives, but the difference is much less, less than a tenth of the actual growth rate. If the capital ratios for all banks had been at the maximum observed 10 per cent level, the reduction in moral hazard incentives would have been less but still 15 percentage points for the savings banks.

Furthermore, the confidence intervals calculated by Monte Carlo methods suggest that the conclusion as to the quantitative significance of moral hazard is quite well-founded in the case of the savings banks.<sup>21</sup> There is only a 5 per cent probability that the rate of growth of lending would have been over 82 per cent if all savings banks' capital ratios had been 15 per cent. Even this 82 per cent implies a 16 percentage point reduction in lending growth relative to actual growth. In contrast, for the cooperative banks the moral hazard effect is in the aggregate insignificant at the 5 per cent level.

Finally, the difference between the two banking groups stems mainly from different behaviour, although to some extent also the capital positions and cost positions of the savings banks were less favourable than those of the cooperative banks at the outset of the boom period.

### 3.5 Discussion

The estimation results on credit extension by the cooperative and savings banks support the hypothesis that low capital and high costs induced banks to expand lending in the boom years. The effect is particularly strong in the case of the savings banks. In the formal model that underlies the empirical analysis, the finding is consistent with moral hazard on the part of bank equity holders. The observed behaviour of banks' issuance of subordinated debt is broadly consistent with these conclusions.

The part of credit growth in 1986 through 1990 that, according to the estimated models, can be associated with moral hazard is also

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<sup>21</sup> Given the complicated nature of the aggregate loan growth predictions, confidence intervals can be best calculated by Monte Carlo methods. The intervals reported are based 1000 draws from the multivariate normal distribution estimated for the parameter vector of equation e in Table 6. For each draw a prediction of the aggregate loan growth was calculated. The intervals in panel B are the 5 per cent and 95 per cent fractiles, respectively, of the resulting distribution.

quantitatively very large. Counterfactual calculations suggest that almost a third of the lending growth of the savings banks as a group was due to moral hazard. For the cooperative banks the role of moral hazard seems quantitatively much smaller and, in the aggregate, insignificant. As there is a close association between lending growth and the magnitude of problem assets (Solttila and Vihriälä 1994), eliminating moral hazard from the savings bank behaviour would probably have changed the magnitude and nature of the Finnish banking crisis fundamentally.<sup>22</sup>

The results suggest that banks on average did not radically change their lending strategies during the boom period; in fact the overall change can be better accounted for than changes over shorter subperiods. To the extent there was change over time, the results suggest that the prime impulses from weak capital and high costs to expansion of credit took place in the early part of the boom period, immediately after the main deregulatory measures in the financial markets. Furthermore, the behaviour of the cooperative banks and savings banks was more uniform in this period than later. On the other hand, demand impulses seemed to be largely absent early on.

In the second half of the boom period (1989 and 1990), when restrictive monetary and regulatory policies had been introduced, the banks that had adopted an expansionary strategy in the early stage in response to weak capital and high costs, continued to expand lending rapidly. Relative to other banks their expansion in fact accelerated. In particular large savings banks continued rapid expansion of credit in this stage, as did the banks in which criminal activity was later suspected. Given the substantial upfront earnings associated with rapid growth, the profitability and capital/asset ratios of these expansionary banks had improved markedly by the end of 1988. Therefore, for a while these banks did not look particularly weak in terms of profitability or capital.

The observation that particularly those banks that had adopted a policy of rapid expansion in the beginning of the boom period continued to expand (in relative terms) in 1989 and 1990 is consistent with the idea that risk taking was to a large extent deliberate rather than based solely on overoptimistic expectations. So is the finding on the role of criminal activity. Thus moral hazard rather than misunderstanding of credit risks or bad luck is suggested. This conclusion is also supported by some internal documents of the two banking groups. In spring 1989 a circular

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<sup>22</sup> In fact the effect of eliminating the 'excessive' lending growth by the savings banks may be even stronger than just limiting the later losses of the savings banks. The aggressive behaviour of the savings banks in the loan market probably induced also other banks to expand in direct response to loss of market share and also through the impact on asset values.

sent by Skopbank to savings bank managers encouraged the banks to not to slow down credit growth in response to the special cash reserve requirement imposed by the Bank of Finland, but to use the opportunity to increase market share (Kuusterä 1995). In contrast, a similar circular sent by Okobank to cooperative banks already in late 1988 suggested that the cooperative banks should slow down credit growth and tighten credit criteria.<sup>23</sup>

Our findings on moral hazard as a cause of rapid growth of bank lending are consistent with the results of Keeley (1990) and others who have found evidence of moral hazard (see Chapter 1).

However, our results differ in an important respect from most of the analyses finding support for moral hazard. The fundamental reason for moral hazard in these studies is underpriced deposit insurance.<sup>24</sup> This is not the case in this analysis. The theoretical model underlying the empirical analysis points to two reasons for moral hazard: underpricing of nondeposit funding and perverse enforcement of capital regulations or, perhaps more appropriately, bank support policies that reward risk taking.

There is in fact some weak evidence suggesting that the proximate cause of moral hazard is underpricing of nondeposit funding rather than an anticipation that a failure to meet capital adequacy regulations would be rewarded by capital support with lenient terms.

Why then was nondeposit funding underpriced and particularly so for the savings banks? In principle two types of explanations exist. First, the lenders to the banks did not understand the risks involved, either because the shocks that made bank portfolios to a large extent nonperforming were wholly unpredictable or because the lenders simply were myopic. The shocks experienced by the Finnish economy very likely were to some extent unpredictable, and one cannot fully discount myopia either.<sup>25</sup>

However, it is very likely that a second factor, ie anticipation of creditor protection policies by the authorities, played a role as well. This receives support from the same argument used to show that risk taking by

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<sup>23</sup> According to the head of the Okobank finance department, Mr. Jaakko Eloranta, in an interview in 1995.

<sup>24</sup> Keeley's (1990) results do not necessarily require underpriced deposit insurance but could equally well be due to implicit creditor protection, ie 'too big to fail' policies. No distinction is made in his analysis between insured and uninsured institutions, as is done by Wheelock (1992). However, Keeley himself interprets the results to reflect the particular problem of deposit insurance.

<sup>25</sup> For example, Guttentag and Herring (1984) point out that 'disaster myopia' may strongly limit economic agents' capacity to take precautions against catastrophic low frequency events.

the expansionary banks was deliberate: No change in the behaviour of the most expansionary banks was observed even though external conditions turned for worse in 1989. Second, the holders of nondeposit liabilities are typically banks and other professional investors, who should know as much as there is to be known about bank risks. Third, particularly in the banking community there is a folk theorem saying that rapid expansion is risky. Finally, the events of the banking crisis of course proved all potential expectations about public creditor protection policies to be correct: no bank creditor was allowed to incur losses.

However, given the differences in behaviour between the savings bank group and the cooperative bank group, it is useful to take a look at the types of nondeposit funding used by individual savings and cooperative banks. As discussed in Section 2, the local banks had in principle two sources of nondeposit funding: directly from the market, for example, by issuing large denomination CDs or indirectly via their respective 'central banks', Okobank for the cooperative banks and Skopbank for the savings banks. Tables 1 and 2 reveal that relative to the total assets, the savings banks strongly increased borrowing from both sources in the boom period while the cooperative banks increased only borrowing from other banks (chiefly their central bank) and even that much less than the savings banks. On the assumption used in the underlying model, that the banks indeed maximized the value of equity, these patterns suggest that the pricing or availability of funding was different as between the two banking groups for both sources of refinancing.

It seems in fact quite plausible that the two central banks had different policies in the pricing of these funds. Although no numerical evidence is available, it has often been argued that Okobank charged a clear margin on short-term financing of cooperative banks on top of the CD rates. Although these rates may not have contained an explicit risk premium, funding of this type was subject to quantitative constraints even in the late 1980s, possibly resulting in steeply rising marginal cost schedules for individual cooperative banks, at least after some level of indebtedness.<sup>26</sup> By contrast, according to Kuusterä (1995), Skopbank provided the individual savings banks money market funding in unlimited amounts, effectively at going CD rates. Thus while the individual cooperative banks faced a relatively steeply rising marginal cost schedule for their 'central bank' financing, the savings banks may have been able to increase lending at an essentially constant posted marginal cost. The

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<sup>26</sup> Mr Jaakko Eloranta of Okobank confirmed this conjecture in telephone interviews in 1995.

potential for moral hazard type behaviour for individual savings banks seems to exist.

But if indeed Okobank followed a stricter policy in financing cooperative banks than Skopbank in financing savings banks, why did cooperative banks not substitute direct borrowing from the money market for borrowing from Okobank? One likely explanation is the very small average size of the cooperative banks; at the end of 1990 the average total assets of cooperative banks was FIM 310 million while that of the savings banks was FIM 812 million. Small banks have higher unit transaction costs and may be charged higher lemons premia than larger banks. But small bank size may not be the whole truth. In the regression analyses reported in this paper, bank size is accounted for – and has a positive impact on lending, as expected – but the behaviour still differs significantly between the two banking groups.

To fully account for these differences, one may need to resort to explanations that are outside the basic theoretical framework of this paper. More specifically, it may be that in some sense the legal structure and business traditions put less constraints on savings bank managers, who possibly sought to exploit underpriced funding, than on similar cooperative bank managers.<sup>27</sup>

Whatever are the reasons for differences between the savings bank group and the cooperative banks group and the differences between large and small banks, the question remains, how could Skopbank and some large savings banks and cooperative banks finance themselves in the money market without sufficient risk premium (or rationing)? We thus come back to the question of the role of implicit creditor protection policies. As long as one is unwilling to accept the idea that investors in these banks' uninsured liabilities did not understand the risks involved, at least not in 1989 and 1990, one is forced to conclude that the investors must have anticipated that their claims on the banks would be protected by the authorities.

Probably in most countries banks having a pivotal role in the payments system and wholesale market can be perceived as 'too big to fail'. In the Finnish system of the late 1980s such core banks presumably comprised, from the point of view of investors, at least the five 'HELIBOR' banks, including Skopbank and Okobank. The HELIBOR banks were the banks whose CDs were used to calculate indicative money market rates, the HELIBOR rates.

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<sup>27</sup> As discussed in Chapter 1, particularly Gorton and Rosen (1995) present arguments about management behaviour which may have some relevance in explaining why large savings banks were inclined to expand lending in the adverse conditions of 1989 and 1990.

Bank CDs were in the late 1980s in fact the main money market instrument. As there were not sufficient amounts of either short-term or long-term government paper in circulation, they also became the instrument of central bank market operations, when these operations started in early 1987. This role of CDs very likely contributed to uniform pricing of these instruments in the market, as the central bank treated all HELIBOR banks' CDs in the same way and actually priced them at par with its own CDs in conducting market operations. As particularly Skopbank used CD funding very aggressively in the boom period, pressures emerged in the market place in some instances to discount these papers relative to other CDs. However, price discrimination remained small, 20 basis points at the maximum, and was not applied by all major market players. Not only did the central bank continue to price Skopbank CDs at par with its own CDs but such uniform pricing was used also by some competing HELIBOR banks.

But quantitatively even more important than markka CDs was the funding Skopbank and some larger savings banks obtained from foreign banks and other foreign investors; at the end of 1990 the Skopbank group alone had outstanding CD liabilities on the order of FIM 13 billion (after peaking somewhat earlier at about FIM 20 billion), while the debts owed to foreign banks were FIM 29 billion and bond liabilities (excluding subordinated debt) FIM 15 billion. That also this funding (often much longer in maturity than CD funding in the markka market) was forthcoming at acceptable terms suggests that the crucial issue was a general trust that Finnish banks' debts would be very low risk rather than the role of bank CDs as a monetary policy instrument.

Finally, there is the question why the central organizations of the two respective local banking groups behaved differently. In a sense this is an issue of economic history rather than economics. Disaster myopia may have played a role here. Okobank experienced severe solvency problems in the early 1970s, as did later a relatively large cooperative bank, Iisalmen Osuuspankki. These experiences may have figured in the minds of the cooperative bank and Okobank managers in the late 1980s, while similar acute crises had not recently been faced in the savings bank group.

# 4 Credit Crunch or Collateral Squeeze?

## 4.1 Introduction

This chapter examines the role of banks' supply behaviour, as opposed to demand factors and borrower quality, in the contraction of bank credit in Finland in 1990–1992. The main issue is whether or not bank capital essentially constrained bank lending, ie whether a 'credit crunch' or 'capital crunch' was a significant cause of the decline of the credit stock.

As in the previous chapter, the empirical analysis will be conducted with the data on the savings banks and cooperative banks and is based on the theoretical model of Chapter 2. However, unlike in the analysis of Chapter 3, there is a large empirical literature on the issue of credit crunch which can be used as a point of departure.

The potential for credit crunches has long been recognized, and some economists have argued that such shifts in credit supply have also been quantitatively important (see eg Wojnilower 1980). However, prior to the 1990s, the shocks considered had to do primarily with the availability of deposit funding and direct regulations applied to lending. Changes in bank net worth or capital regulations as underlying shocks causing changes in lending have been considered only in the 1990s.

Starting with Bernanke and Lown (1991), a large number of empirical studies have examined the existence of a credit crunch in the United States in the period 1989 through 1991. As noted in Chapter 1, the American studies have produced rather mixed results and only a few studies exist on credit crunches in other economies.

With a couple of exceptions, these studies do not have any specific theoretical model as a point of departure. They are rather based loosely on the notion that bank capital may constrain banks' risky lending, either because unprotected bank creditors charge a premium on funds supplied or ration funding to weakly capitalized banks, or because regulators impose costs on banks that do not meet regulatory capital requirements.

The basic approach of the literature is then to use cross-section data to estimate a regression equation, where the dependent variable is lending growth and the explanatory variables include a measure of capital of the lending institution and some other variables that control for other factors (mainly credit demand). The empirical issue is the size of the effect of the capital variable or variables and their statistical significance. A

significant positive effect is interpreted as evidence of a credit crunch or more precisely a capital crunch.<sup>1</sup> Some studies have also investigated the reaction of securities holdings (eg Hancock and Wilcox 1994) or bank deposits (Peek and Rosengren 1995b) to changes in bank capital and other factors.

There are several potential problems in this methodology. An obvious purely empirical problem is that accounting for the factors that shift the demand for credit may be very difficult. One cannot assume that demand conditions are the same for all banks, as banks differ in their geographical location and specialization. This problem is likely to be less severe when aggregates of banks are used as observation units, but in this case the data loses information value due to aggregation. And, as noted by Sharpe (1995), there are severe conceptual difficulties as well.

First, the finding that better capitalized banks expand lending more (contract less) than weakly capitalized banks does not as such imply anything about aggregate credit supply. The better capitalized banks may supply all the credit that the weak banks fail to provide, if loan customers have access to the credit supply of at least some adequately capitalized banks. Thus while time series analysis may not tell much about the causes of a potential shift in the credit supply, cross-section analysis may not say much about the aggregate significance of such shifts in the credit supply of individual institutions.

Second, to the extent that bank capital is endogenous, banks opting for rapid growth (relative to other banks) may also select higher-than-average capital asset ratios as a precaution for the risks of rapid expansion. Thus a positive cross-sectional relationship can be observed between bank capital and credit expansion even though bank capital in no way constrains credit supply.

Third, there are serious difficulties in separating the effects of bank capital and borrower quality. Cross-sectional variation in bank capital is to a significant extent due to credit losses (or credit loss provisions, depending on accounting practices), and these losses are strongly associated with the creditworthiness of the potential borrowers that are likely to be – particularly in times of financial distress – more or less the same firms and households that form the existing borrower clientele. Thus unless one succeeds in controlling for borrower quality, observing that weakly capitalized banks expand lending less than other banks could

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<sup>1</sup> The natural approach of examining simultaneously the behaviour of prices and quantities is missing from the credit crunch studies, as information on the price of credit is very spotty. Interest rates do not tell very much about effective cost unless one can control for a number of usually missing factors, such as maturity of the contract, linkage of the rate to a reference rate, collateral etc. The analyses therefore focus without exception on quantities.



indicate simply that the potential customer base is of weaker creditworthiness than borrowers on average even though there were no difference in credit supply to borrowers of constant quality.

Finally, there are all the standard problems of econometrics relating to the specification of proxies for theoretical concepts. In particular, measuring the quality of lending opportunities is difficult. But also defining the appropriate capital concept may be problematic.

There are basically two ways of alleviating these problems of empirical credit crunch studies. One is to do the utmost to compile informative data. The other is to clarify the theoretical basis of the analysis, which, as noted, usually is very vague. We try to use both approaches: to construct the data set so as to be as informative as possible in the Finnish circumstances, and to base the analysis on an explicit – albeit simple – theoretical model developed for the particular banks in the particular regulatory environment of interest.

The analysis proceeds as follows. In section 4.2 we first discuss the basic selection of data, compare our theoretical point of departure with two theoretical models found in the literature, specify the loan equation to be estimated and take a preliminary look at the data. Section 4.3 reports the empirical results. The findings are summarized and discussed in section 4.4.

## 4.2 The framework for the empirical analysis

### 4.2.1 Basic selection of data

One way to alleviate the problems associated with cross-section analysis is to extend the data set to include observations on a cross-sectional unit at different points of time, ie to use panel data. For example, one might be able to separate the effect of capital from that of borrower quality much better if he could compare the response of lending to capital in the potential credit crunch period to that in more favourable macroeconomic conditions with generally high asset values, less uncertainty etc. Similarly the endogeneity of capital might be incorporated into the analysis by estimating an equation for the issuance of bank capital simultaneously with a credit equation. Also identifying the impact of a regulatory change could be facilitated by such an extension of the data. Panel data have in fact been used in several American credit crunch studies, most notably by Berger and Udell (1994) but also eg by Hancock and Wilcox (1993) and

Shrieves and Dahl (1995). And unsurprisingly, the results obtained tend to differ significantly from those obtained with pure cross-section data.

Unfortunately, the Finnish circumstances very much limit the possibilities for a panel analysis. A major problem is that the number of banks has declined sharply over the last ten years, and that this has taken place through mergers within the respective banking groups (Figure 1). This makes it difficult to construct an informative set of panel data. Also the changes in deposit pricing and capital regulation hamper panel analysis covering the whole period of the Finnish credit cycle. Finally, the availability of some highly interesting data from the point of view of separating a credit crunch from a 'collateral squeeze' are available only in the 1990s.

On the other hand, the fact that financial distress was widely spread in Finland in 1991 and 1992 may facilitate inference. In these conditions, finding a cross-sectional relationship between bank lending and bank capital (or other bank characteristics) could, with substantial confidence, be interpreted also as suggesting a similar aggregate relationship. Basically all major Finnish deposit banks had serious problems with capital adequacy in the early 1990s, so that borrowers were very unlikely to find major lenders with substantial slack in capital.<sup>2</sup> Furthermore, the very weak profitability prospects of most firms in the early 1990s, combined with high levels of indebtedness and plummeting asset values, very likely made adverse selection problems exceptionally acute, thus tying debtors to their existing lenders much more closely than in normal times.<sup>3</sup> Therefore, it would be very unlikely that borrowers turned down by their traditional lenders would find alternative sources of bank credit.

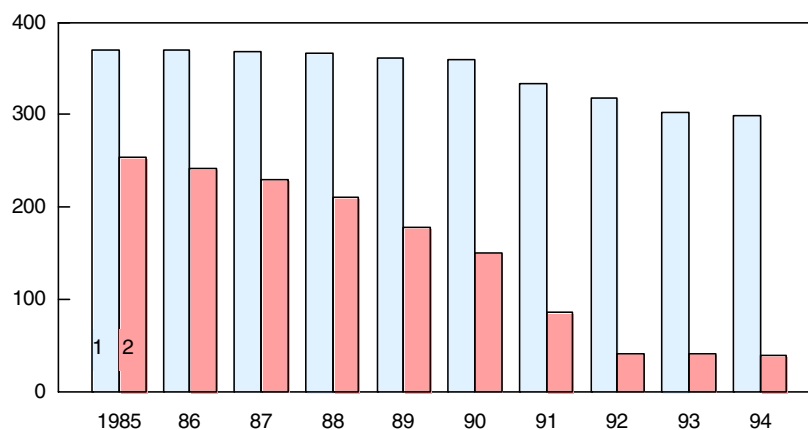
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<sup>2</sup> Not only did all the major banks incur significant losses in 1991 through 1993, but all of them utilized the offer by the government to invest in preferred capital certificates up to FIM 8 billion or some 15 per cent the total existing regulatory capital of the banking system in 1992, even though the terms of this investment were considered very stringent by the banking community and led some highly capitalized small banks to turn down the offer.

<sup>3</sup> The results of Vesala (1995b) suggest that competition in the bank loan market eased substantially in 1991 and 1992 relative to the two preceding years. A natural interpretation is that this was due to adverse selection problems and/or problems of bank capital, as regulatory changes and changes in taxation, if anything, worked only to increase competition.

Figure 1.

### Number of banks



- 1 Cooperative banks
- 2 Saving banks

Similarly, using the data on savings banks and cooperative banks, which supplied over 40 per cent of private sector bank loans in the beginning of the 1990s, provides several advantages in an analysis of a credit crunch.

First, bank capital can be regarded as essentially exogenous in the short run for the savings banks and cooperative banks. These banks have been able to issue equity-type instruments only to a very limited extent, and only since 1991. Given the nature of these 'basic fund shares' and 'investment shares', these instruments have not attracted investors and have remained relatively insignificant. In addition, these banks have been able to issue subordinated debt that counts as regulatory capital up to a maximum of a quarter of the total regulatory capital. Provided one can adequately incorporate the determination of subordinated debt into the analysis, the problem of capital endogeneity discussed above should be greatly alleviated.

Second, these banks operate for the most part in well-defined geographic locations. Therefore data on incomes, employment and population structure are available for the operating areas of each savings and cooperative bank. These data can be used to control for loan demand conditions faced by each observation unit much better than in many other studies that use data on individual banks.

Finally, the data on savings banks and cooperative banks should be statistically highly informative. These groups include banks with highly differing capital positions in the early 1990s, some having eg capital asset ratios of the order of 20 per cent, some posting ratios on the order of 2-4 per cent, and some loosing their capital several times over by the end of 1993. Also the number of observations is large, even though it declined

substantially over the period of interest, from 488 at the end of 1990 to 344 in 1993. This allows reliable statistical analysis.

These considerations lead us to use data on savings banks and cooperative banks to study the existence of a credit crunch. However, the restructuring of the banking sector in the course of the banking crisis effectively constrains the use of data after 1992. The relevant bank-level data are available only on an annual basis so that annual observations on savings and cooperative banks over a period of two years, 1991 and 1992, comprise the basic data of the analysis.<sup>4</sup>

#### 4.2.2 Theoretical background of the analysis

As noted, the tests for a credit crunch typically are not based on any explicit theoretical model. One exception is the analysis by Peek and Rosengren (1995b). They have a profit maximization model, in which the bank chooses the amount of loans ( $L$ ) supplied, subject to the conditions that these loans must be financed with exogenous capital ( $K$ ) and deposits ( $D$ ), the return on loans is decreasing, the cost of deposits is increasing, and there is a capital requirement ( $K \geq kL$ ). If the capital constraint is not binding, an increase in capital leads to an increase in lending but by less than the full change in capital, as capital in part substitutes for declining deposits. However, if the capital constraint binds, it also prevents the

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<sup>4</sup> The savings bank group went through a radical restructuring in 1990 through 1992. Mergers reduced the number of savings banks from 150 at the end of 1990 to 86 at the end of 1991. The larger savings banks merged to form Savings Bank of Finland (SBF) in autumn 1992, reducing the number of independent savings bank units to 41 at the end of the year. And in autumn 1993 SBF was effectively dismantled through a sale of loans and transfer of deposits to the four competing bank groups. This not only eliminated an interesting bank from the data but contaminated the loan data of other banks. The loans sold from the SBF loan books to the competing banks were transferred gradually to the balance sheets of the receiving banks. In part this took place already in 1993, in part later. This implies that the end-1993 loan books of the cooperative banks cannot be compared with those of the prior years.

In order to maximize the number of observations, the analysis is conducted for 1991 and 1992 with the data on cooperative banks that existed at end-1992, and for the savings banks that existed prior to the formation of SBF. The 1992 data on the 'SBF banks' refer as a consequence to the last-filed balance sheet, income statement and other information that existed prior to the merger, in practice August or September 1992. With regard to credit losses, an attempt was made to construct data even for the post-merger situation. For the other, non-SBF savings banks, the 1992 data are for the year as a whole or the yearend. To maximize the information on the potentially most interesting year 1992, all banks that existed in that year are included in the analysis, ie the observations prior to 1992 are aggregated for the banks that merged. As important data were missing on some banks, the analysis is conducted with observations 313 cooperative banks and 82 savings banks over the years 1990–1992.

issue of additional deposit liabilities. Therefore no substitution between capital and deposits exists and an increase in capital leads to an increase in deposits and loans. Thus the response of deposits changes sign while the response of loans only varies in degree when the capital constraint turns binding. Based on this observation Peek and Rosengren suggest that one should test for the existence of a binding capital constraint by estimating a deposit equation, where bank capital is one of the explanatory variables. Finding that capital has a significant positive effect on deposits would then be consistent with a capital crunch as an explanation for credit slowdown. Estimation of such a deposit equation (growth between first quarter 1990 and first quarter 1991) with cross-section data on 407 New England commercial and savings banks yields a result consistent with the capital crunch hypothesis.

The extremely simple framework of Peek and Rosengren abstracts from many important considerations. There are no substitution possibilities on the asset side, credit risk is not really modelled (a given exogenous fraction of loans is assumed to be booked as losses), the capital requirement is imposed as a technical constraint, which in no circumstances can be violated, the pricing of bank liabilities is assumed exogenous, etc.

The literature seems to contain only one other theoretical analysis directly connected with empirical credit crunch investigations. It is provided by Passmore and Sharpe (1994). They use a somewhat richer value maximization framework to derive rather different comparative static results, on the basis of which the findings of empirical studies can be assessed.

Passmore and Sharpe allow for safe securities (B) as an alternative asset (balance sheet:  $L+B = K+D$ ), assume that the return on loans, besides declining in volume, also is subject to stochastic variation and specify a capital requirement, the violation of which results in non-pecuniary penalties on the (owners of the) bank. Bank deposits may be withdrawn, which causes costs to the bank as raising replacement funds is assumed costly. Securities, on the other hand, can be sold without cost, so that securities holdings lower the liquidity costs associated with deposit liabilities. Capital is assumed to be either exogenous (short run) or available at the going securities market rate in infinite amounts (long run).

Specifying explicit forms for the contract loan rate (decreasing), deposit cost schedule (quadratic), the distributions of the stochastic element of the loan return (uniform) and deposit withdrawals (triangular), and making some auxiliary assumptions, Passmore and Sharpe derive comparative statics for both the short run and long run. In the short run, an exogenous increase in bank capital leads to an increase in bank loans

and a decline in bank deposits under all circumstances. The result is thus qualitatively the same as in the unconstrained case of the Peek and Rosengren model. Thus, should one consider the premises of the Passmore and Sharpe model more plausible than those of the Peek and Rosengren model, one could not base the capital crunch test on a deposit equation. Passmore and Sharpe also demonstrate how the effect of an exogenous capital shock can have qualitatively different effects on securities holdings, depending on the usefulness of securities in lowering liquidity costs. This casts doubt on analyses that are based on the notion that a negative response of a bank's securities holdings to an increase in capital would signal of capital crunch (eg Hancock and Wilcox 1994).

These two explicit models found in the literature suggest that one must be careful when setting up a test procedure for a credit or capital crunch. An explicit model of bank behaviour can clearly help to specify a valid test. A more specific suggestion of the Passmore and Sharpe model is that, after all, examining directly the relationship between bank lending and capital or other bank characteristics might be the most robust way of testing for credit crunch.

As noted above, the empirical work of this chapter will be based on a specific model of bank loan supply, analyzed in Chapter 2 and already used in Chapter 3. Our model is in many ways similar to that of Passmore and Sharp. In particular, the capital requirement is modelled in the same spirit: violating the required level of capital results in nonpecuniary penalties on the bank (owners). And just as in their model there are no true (pecuniary) bankruptcy costs in the sense that bankruptcy (inability to meet contractual commitments vis-à-vis creditors) would lower the value of bank assets, ie the value that is available to the creditors.<sup>5</sup> Similarly, the model assumes symmetric information. Bank creditors and regulators know just as much as the bank about the probability distribution of bank earnings.

But there are also several differences between this model and that of Passmore and Sharpe. From the point of view of testing for a credit crunch three differences are of importance. First, in our model there is an exogenous cost element associated with the collection of 'cheap' core deposits. Changes in these exogenous costs can be interpreted as changes in the bank's net worth in response to changes in competition, technology or, say, taxation of deposits. The bank's net worth is thus affected not only by the amount of capital that is in the bank to begin with but also by the costs of operation.

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<sup>5</sup> Passmore and Sharpe call the expected penalty imposed on the bank owners in the case of nonfulfilment of the capital requirement somewhat misleadingly 'bankruptcy costs', even though the 'bankruptcy event' has no effect on the value of bank assets as such.

Second, our model also considers subordinated debt, the behaviour of which can also be used to assess the stringency of capital constraints. If bank capital is a constraint on lending, banks should issue the maximum allowed amount of subordinated debt to alleviate the situation, provided they are not constrained in the market for subordinated debt as well.

Third, the consequences of capital insufficiency are allowed to vary in our model. In addition to the situation of positive nonpecuniary penalties analysed by Passmore and Sharp, we analyse the cases where insufficient capital has no effect on bank owners and where capital insufficiency is in fact rewarded by perverse enforcement of capital regulations (ill-conceived bank support policies).

As in Chapter 3, the behaviour of risky bank lending under these assumptions is summarized by eq 1:

$$L=L( K, R^D, D, k, c, x, z) \quad (1)$$

+	-	+	-	-	+	+	fair pricing+normal capital regulation
-	+	?	-	-	+	+	underpricing+normal capital regulation
-	+	+	+	-	+	+	fair pricing+perverse capital regulation

Thus under certain circumstances a credit crunch can emerge if bank equity diminishes or charter value decreases, say due to an increase in the costs of core deposits. Similarly, a credit crunch can emerge as a result of a decline in core deposits. But the model also predicts quite the opposite responses of lending to capital and costs under different circumstances.

Apart from the effects of capital and costs and the standard responses to demand shocks, the model also implies an effect of borrower quality. A negative shift in borrower quality takes place when low yields become more likely at the expense of yields close to the contractual maximum. This type of change is also called increasing credit risk, ie increasing likelihood of credit losses. Negative shifts in borrower quality always reduce lending, assuming fair pricing and positive capital insufficiency penalties, but with the most likely parameter values also in the case of fixed pricing; and the effect can remain positive even with negative

penalties. Thus, the model predicts in most circumstances a 'collateral squeeze' if borrower quality weakens.<sup>6</sup>

### 4.2.3 Specification of the loan equation

The starting point of the specification of the empirical loan equation is the same as in Chapter 3. However, we will end up with a somewhat different structure for the following reasons.

First, the empirical content of the core deposit concept very likely became much narrower in the 1990s relative to what it had been in the 1980s. As of the beginning of 1991, taxation of capital income was radically reformed. As a rule, all capital income became subject to a withholding tax. Low-yielding bank deposits fulfilling certain conditions remained tax free, but other deposits became taxable at the low uniform rate. This unleashed strong competition for such deposits, heightened by banks' heavy reliance on money market debt and the high short-term rates of the time.<sup>7</sup> Thus not all deposits remained exogenous as assumed in the underlying model and as seemed to be case still in the late 1980s. The same applies to deposit rates. A similar informal test of endogeneity as performed in the previous chapter indeed suggests that growth of total deposits and level of deposit rates appeared to depend on bank characteristics in the 1990s unlike in the 1980s (see Appendix 5). Unfortunately our data on individual banks' deposits does not allow for isolating the more narrow core deposit concept. Therefore, we must leave deposits and deposit rates out of the loan equation.<sup>8</sup> Note, however, that there is no need to exclude the variable depicting 'operational costs'. Excluding the deposit and deposit rate variables means that the empirical model is somewhat less strictly linked to the underlying theoretical model

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<sup>6</sup> Considering the typical financial crisis situation, in which borrower quality weakens, bank capital is depleted by credit losses, and perhaps regulation is tightened to contain excessive risk taking, the model can produce several alternative responses for lending. Although weaker borrower quality and tighter regulation induce a cutback in lending, a reduction in capital may either increase or decrease lending or fail to have any effect. The net result then depends on the relative strengths of these effects and other factors such as credit demand.

<sup>7</sup> Similar developments have been observed also more generally in the aftermath of deregulation (see eg Neven and Röller 1996).

<sup>8</sup> The problem cannot be solved with instrumental variables either, as in practice the proper instruments would be the same exogenous variables that influence loans directly: multicollinearity would result. Leaving the deposit volumes out of the loan equation also corresponds with other credit crunch studies using cross-section data.



than in the specification of Chapter 3. It also means that we cannot test directly for a credit crunch caused by declining core deposits.

Second, as credit risk and borrower quality became highly important in 1991 and 1992, they must be incorporated into the analysis. This will be done by including in the loan equation variables that can be considered to reflect the quality of each bank's borrowers. We use materialized credit losses, stock of nonperforming assets and share of business loans as proxies for borrower quality.

Third, with the introduction of new capital regulation at the beginning of 1991 the relevant capital adequacy concept may have changed. This needs to be explored by experimenting with different operationalizations of capital adequacy. Another issue is that during this period anticipated losses strongly affected banks' equity capital in the relevant horizon for lending decisions. Credit losses also had a technical effect in reducing the loan stock. The exact operationalizations of borrower quality, capital adequacy and other variables are discussed in more detail in Appendix 6.

As in Chapter 3, there are again good reasons to focus on the change in lending over the period of interest rather than the level of lending at certain points of time. Almost all other credit crunch studies have used the growth of lending as the dependent variable, including the only cross-sectional Finnish study (Solttila and Vihriälä 1992). Comparability of results thus supports using the same formulation. In addition, it may be argued that particularly in times of financial distress adjustment of loan stocks is slow, as finding new creditworthy customers is likely to be costly and severing ties with existing customers may result in substantial credit losses. Thus the loan equation to be estimated takes the following form:<sup>9</sup>

$$\begin{aligned} \frac{\Delta L}{L} = & a + b \cdot \text{CAP} + c \cdot \text{COST} + d \cdot \text{CGLOSS} + e \cdot \text{NPA} \\ & + f \cdot \text{BUSSHA} + \sum g_i \cdot X_i + h \cdot \text{CP0} + k \cdot \text{SIZE} \\ & + l \cdot \text{CLOSSG} + \sum m_i \cdot \text{SBDUM:i} + \varepsilon, \end{aligned} \quad (2)$$

where L refers to the loan stock, CAP is a capital adequacy variable, COST a variable reflecting the bank's operational costs, CGLOSS

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<sup>9</sup> Resembling the partial adjustment formulation of Chapter 3, a dynamic form of eq (1) could be specified as  $\Delta L/L = \mu(x,z)(L^*/L_{-1} - 1)$ , where  $\mu(x,z)$  is an adjustment speed factor, depending on the demand for loans and borrower quality and  $L^*$  is the optimal loan stock as determined by eq (1). Linearizing the whole right-hand side of this equation would then give the linear function (2).

measures credit and guarantee losses and NPA nonperforming assets, BUSSHA is the share of business loans, the  $X_i$ 's are variables that shift the demand for loans, CPO is a measure of the competitive situation in the local market, SIZE describes the bank's size, CLOSSG reflects gross credit losses, SBDUM: $i$ 's are dummy variables (intercept as well as slope dummies) that obtain a nonzero value for savings bank observations, and  $a$  through  $m_i$ 's are parameters to be estimated and  $\varepsilon$  an error term.<sup>10</sup> In some versions the capital adequacy variable is split into the capital ratio excluding the government capital injection in 1992 and the contribution of that injection (GOVK).

The dependent variable is the rate of growth of bank loans between the beginning of the period and the end of the period. In the reported versions the loan concept is total loans at the end of the year. Three alternative periods are considered: (i) end-1990 – end-1992, (ii) end-1990 – end-1991, (iii) end-1991 – end-1992.

Based on eq 2 the tests we want to perform can be summed up as follows. The credit crunch, or more specifically capital crunch, hypothesis implies that the coefficient of CAP should be significant and positive. In addition, for the behaviour to be consistent, the COST variable should obtain a significant negative coefficient. Thus finding no capital and cost effects or negative capital effects and positive cost effects would be inconsistent with the credit crunch hypothesis.

The borrower quality or collateral squeeze hypothesis implies that the risk variables obtain significant negative coefficients. Thus finding no effect would contradict the hypothesis.

The hypothesis that changes in the loan stock are due to demand forces implies that the demand variables obtain significant coefficients, the coefficient of income being positive and that of the unemployment rate negative, or at least that their combined effect be significant. Finding no significant individual or combined effects suggests a weak role for the demand factors.

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<sup>10</sup> Just as in the analysis of the boom period, there are good reasons to believe that bank behaviour has differed between the two banking groups considered. Therefore the coefficients of all 'bank related' variables, ie variables other than those associated with demand for loans or competitive situation, are in principle allowed to differ across the two groups.

#### 4.2.4 Some preliminary observations about the data

The data set contains banks with highly different characteristics. Lending growth between end-1990 and end-1992 varies from -30 per cent to +40 per cent, the regulatory capital ratio DBARAT at end-1990 from 4 per cent to 35 per cent, nonperforming assets at end-1991 from 0 to 36 per cent of the risk-weighted assets etc (Table 1).

There are also major differences between the two banking groups. While lending on average grew somewhat in the cooperative banks in both 1991 and 1992, it declined on average in both years in the savings banks. In terms of capital adequacy the cooperative banks were on average throughout the period somewhat stronger than the savings banks by most measures reported. The posted capital ratios for 1992 furthermore substantially overestimate the true capital position of many savings banks. The reported ratios for member banks of the Savings Bank of Finland – registered in August 1992 – do not take into account the pending credit losses to be booked at the end of the year, which in many cases exceeded the total regulatory capital manyfold. These were revealed in the audit of SBF in December 1992. These additional credit losses, over FIM 4 billion in all for the SBF banks of the sample, cannot be precisely allocated to the original SBF banks.<sup>11</sup>

Despite mounting credit and guarantee losses, the average capital ratios remained relatively stable in the data set 1990–1992. This is due to several factors. First, as noted, a substantial part of the losses incurred ultimately by the savings banks did not materialize prior to the autumn 1992. Second, the risk-weighted assets of many banks declined substantially over the period. Third, the government capital injection bolstered many banks' capital ratios substantially.

A very rough way of examining the existence of a relationship between lending growth and bank capital is to plot them against each other. Such a plot for the 1990–1992 growth rate and the beginning-of-period core capital ratio (CORRAT) does not indicate any association at all between the two variables among the cooperative banks. Among the savings banks one may detect a positive association, but it would seem to be due to a couple of observations (Panels A and B of Figure 2). The same holds also for other capital concepts and the cost variable. Thus, should there be a relationship of the credit crunch type, establishing that

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<sup>11</sup> An attempt to do so is nevertheless made to check to what extent the results obtained are sensitive to the extra loss of capital implied. This is based on the data of SBF losses by the 32 internal 'SBF districts'.

relationship would require an analysis of all the relevant factors simultaneously.

In contrast, there seems to be a somewhat clearer negative relationship for the savings banks between lending growth and riskiness of bank lending as measured by the ratio of nonperforming assets to risk-weighted assets (incl. off-balance sheet commitments).

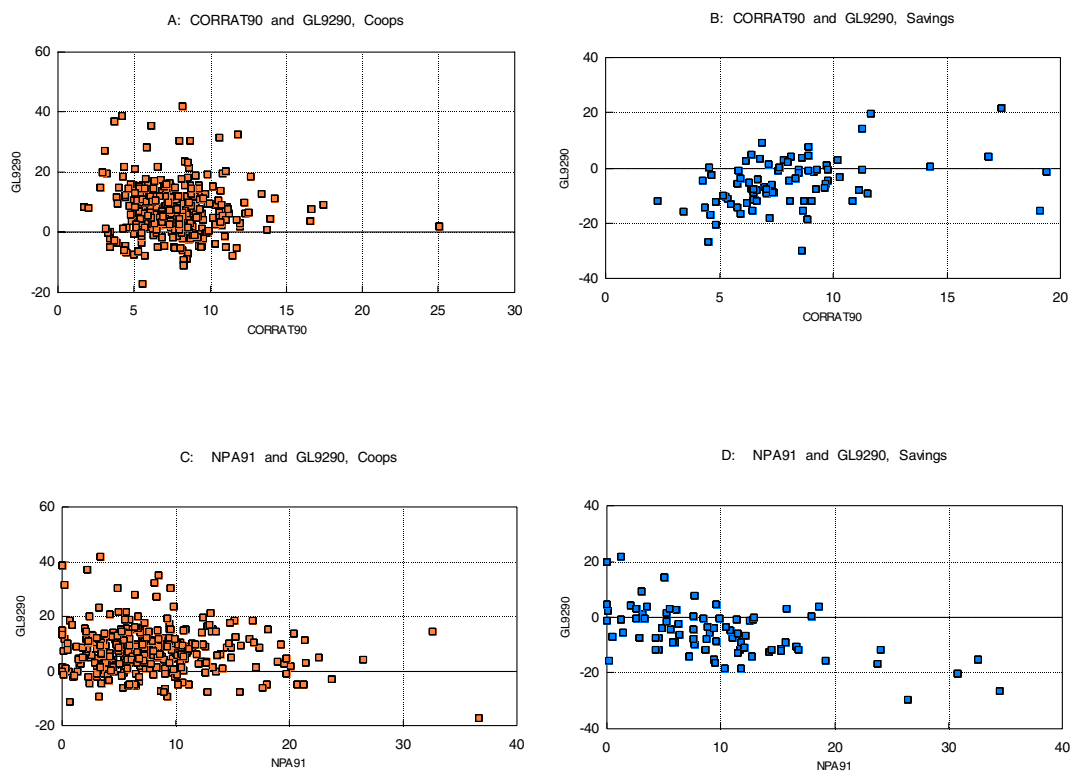
Table 1. **Some univariate statistics**

	Coops			Savings		
	mean	min	max	mean	min	max
GL9290*	7.42	-17.22	41.72	-5.51	-29.70	21.64
GL9190	5.41	-12.68	26.49	-1.32	-14.77	16.14
GL9291	1.84	-17.64	22.52	-4.37	-17.51	13.87
DBARAT90	13.37	4.85	35.71	11.49	4.00	23.60
DBARAT91	14.64	5.91	29.69	12.08	1.97	21.86
DBARAT92	16.05	4.68	30.58	12.46	3.14	27.18
BISRAT90	8.59	3.28	25.05	8.54	2.42	20.88
BISRAT91	9.38	3.73	17.19	8.97	1.86	20.83
BISRAT92	10.29	2.86	20.10	9.27	2.96	23.23
CORRAT90	7.53	1.73	25.05	8.03	2.25	19.37
CORRAT91	7.77	2.10	15.72	7.98	1.76	18.90
CORRAT92	8.31	2.06	17.40	8.03	2.45	20.27
GOVK	0.36	-0.00	2.75	0.37	-0.00	2.12
C90	0.04	0.02	0.11	0.03	0.02	0.07
C91	0.04	0.02	0.06	0.04	0.02	0.06
C92	0.04	0.03	0.06	0.04	0.03	0.06
CGLOSS91	0.42	-0.29	20.44	0.93	0.00	10.49
CGLOSS92	0.63	-1.27	10.45	9.66	0.00	34.56
NPA91	7.84	0.00	26.65	13.22	0.12	61.67
NPA92	10.15	0.00	48.45	43.82	17.64	73.90
BUSSHA90	51.39	16.08	85.71	42.91	19.06	72.44
DIN9290	0.10	-0.23	1.31	0.10	-0.14	0.48
DUNR9290	9.96	1.48	21.30	9.48	2.50	13.38
CONSER	0.55	0.13	0.95	0.60	0.32	0.85
URPOP	0.51	0.00	0.98	0.60	0.00	0.98
CP0	0.36	0.00	1.00	0.20	0.00	1.00
L90D	1.02	0.48	2.07	1.12	0.63	1.93
L91D	0.99	0.50	1.69	1.03	0.57	1.66
L92D	0.94	0.48	1.73	0.99	0.49	2.25
SIZE	2.84	0.69	6.33	3.95	1.79	6.86
CLOSSG92	0.44	0.00	6.62	0.25	0.00	2.21
CLOSSG91	0.22	0.00	5.01	0.59	0.00	3.40

\* Reading guide: GL9290 is the growth rate of lending (per cent) between end-1990 and end-1992

Figure 2.

## Lending growth against capital ratio and nonperforming assets



### 4.3 The empirical results

In what follows the empirical experiments are reported starting with the estimation of the loan equation (2). First, in section 4.3.1, we report the results concerning the whole period between the end of 1990 and the end of 1992. Particular attention is paid here to the statistical properties of the model. Section 4.3.2 examines the stability of the estimated loan relationship over time and the robustness of the results in other respects. Section 4.3.3 summarizes the results for the loan equation. This is followed by an examination of the behaviour of subordinated debt in section 4.3.4.

### 4.3.1 The main results for 1991–1992

The basic OLS results with three alternative capital variables dated at the beginning at the period are reported in Table 2. To reduce the number of parameters to be estimated, the savings bank dummies that are insignificant at the 10 per cent significance level are dropped. In all equations the government capital injection variable (GOVK) is included. In addition to the coefficient estimates and t-values, also the F-tests for the joint significance of four sets of coefficients are reported: (i) the capital and cost variables, (ii) the credit loss and nonperforming asset variables, (iii) the credit loss, nonperforming assets and business share variable, and (iv) the four demand variables. Given the allowed difference in behaviour between the cooperative banks and the savings banks, the tests (ii) and (iii) are calculated separately for the two groups. Due to missing data on BUSSHA, 7 observations are omitted, resulting in a sample size of 388 observations.

The equations explain over 40 per cent of the variation of lending growth. The fit is thus better than that obtained by Vihriälä and Solttila (1992) for Finnish saving banks in 1991, where the highest  $\bar{R}^2$  was 33 per cent. The fit also compares well with those of other credit crunch studies with cross-section data; Bernanke and Lown for example report equations with  $R^2$ s on the order of 10 per cent for their equations, again using the rate of growth of lending as the dependent variable.

None of the capital variables are significant, nor is the cost variable. In fact, apart from the constant (for coops), only nonperforming assets (savings banks), share of business loans (coops), bank size and the technical correction due to writeoffs appear to be significant. The equation may nevertheless be seriously misspecified. Although no heteroscedasticity is suggested by the White test, the Jarque-Bera test indicates that the error term cannot be considered normally distributed.<sup>12</sup>

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<sup>12</sup> For these diagnostic tests, see White (1980) and Jarque and Bera (1980).

Table 2.

**OLS equation with the beginning-of-period  
capital dependent variable GL9290**

Variable		BISRAT90		DBARAT90		CORRAT90 (BIS)	
		coef- ficient	t-value	coef- ficient	t-value	coef- ficient	t-value
CONSTANT,	coops	30.9	5.77***	30.2	5.58***	31.5	5.91***
	savings	11.9	1.86*	11.1	1.75*	12.8	1.99**
CAP:		0.01	0.08	0.06	0.56	-0.06	-0.33
GOVK		0.94	1.51	0.97	1.56	0.93	1.49
COST		-1.20	-0.02	-1.17	-0.02	-2.32	-0.04
CGLOSS91		-0.23	-0.69	-0.22	-0.67	-0.23	-0.68
NPA91	coops	-0.08	-0.91	-0.08	-0.90	-0.08	-0.92
	savings	-0.46	-3.58***	-0.46	-3.50***	-0.47	-3.63***
BUSSHA,	coops	-0.23	-5.52***	-0.23	-5.53***	-0.23	-5.51***
	savings	0.01	0.09	0.00	0.09	0.00	0.06
DINC		-4.31	-0.97	-4.21	-0.95	-4.37	-0.99
DUNR		-0.33	-1.59	-0.32	-1.58	-0.33	-1.60
CONSER		1.07	0.23	1.01	0.21	1.08	0.23
URPOP		-0.52	-0.19	-0.44	-0.16	-0.58	-0.21
CP0		-1.66	-1.62	-1.68	-1.64	-1.64	-1.60
SIZE		-2.32	-4.90***	-2.28	-4.81***	2.34	-4.94***
CLOSSG		-1.12	-1.99**	-1.14	-2.03**	-1.10	-1.97*
ADJ.R <sup>2</sup>		0.42		0.42		0.42	
WHITE, (sign. level)		0.946		0.933		0.921	
JARQUE-BERA, (sign.level)		0.00		0.00		0.00	
F-TESTS for joint significance: Significance levels							
CAP & GOVK & COST		0.52		0.47		0.49	
CGL&NPA	coops	0.49		0.51		0.49	
	savings	0.00		0.00		0.00	
CGL&NPA &BUS	coops	0.00		0.00		0.00	
	savings	0.00		0.00		0.00	
DEMAND		0.52		0.53		0.51	

\*, \*\*, \*\*\* significant at the 10, 5 and 1 per cent level respectively.

A source of problems might be that measuring capital at the beginning of the period may not be appropriate. As discussed in Appendix 6 an obvious alternative is the end of the two-year period. The main results of these regressions are reported in Table 3. Now the effect of bank capital (excl. government supplied capital) on lending appears to be significantly negative, irrespective of the exact capital variable used. The effect is particularly strong when core capital is used as the capital variable. But this effect may be due to the simultaneity problem noted above. To overcome that, one must use the instrumental variables (IV) approach in the estimation.

Table 3. **OLS equation with end-of-period capital, capital and cost effects**

Variable	BISRAT92		DBARAT92		CORRAT92	
	coef-ficient	t-value	coef-ficient	t-value	coef-ficient	t-value
CAP <sup>(a)</sup>	-0.29	-2.08**	-0.18	-1.76*	-0.54	-3.72***
GOVK	0.77	1.24	0.68	1.08	0.66	1.07
COST	-12.7	-0.22	-5.31	-0.09	-19.5	-0.37
ADJ.R <sup>2</sup>	0.43		0.43		0.45	
WHITE, (sign. level)	0.494		0.006		0.813	
J-B, (sign. level)	0.00		0.00		0.00	

<sup>(a)</sup> The government capital injection excluded.

\*, \*\*, \*\*\* significant at the 10, 5 and 1 per cent level, respectively.

However, before turning to the instrumental variables estimation, the problem of non-normality of the error terms must be tackled. Just as the coefficients of the variables other than capital are not affected by the change in the dating of the capital variables, the Jarque–Bera test suggests non-normality of the error term also in the case of the Table 3 equation. A closer look reveals that the residual series displays both nonzero skewness and kurtosis. There are outliers, the behaviour of which cannot be well described by the equation with a normally distributed error term. Furthermore, the specification with DBARAT fails to meet the homoscedasticity assumption which also is required for the OLS to be efficient.

As noted in Chapter 3, there are in principle two ways of handling the outlier problem. One is to simply discard a selected group of observations. The other is to use a robust estimation technique, such as the least absolute deviations estimator (LAD) which gives much less weight to far-away observations but does not fully discount them as constraining the sample does. However, using such a technique poses a problem, as combining it with instrumental variables estimation is difficult. A two-stage strategy is therefore chosen. We first estimate the equations of Table 3 with LAD, and eliminate from the sample enough observations with high absolute residual value to make the residual series pass the Jarque-Bera test. We then apply least squares instrumenting for the end-of-period capital variable. The instruments used are all the exogenous variables plus the beginning-of-period capital variable. Setting the highest allowed absolute residual value at 2.5 times the standard deviation of the LAD-residual eliminates 10 observations and makes the residual from the regression with the remaining 378 observations pass the



normality test.<sup>13</sup> The excluded observations are typically small cooperative banks. The LAD results and some characteristics of the excluded outliers are reported in Appendix 7. The instrumental variables estimates are reported in Table 4.

The IV results for the nonoutlier sample resemble remarkably the OLS results of Table 2. In particular, the capital variables and the cost variable again turn out to be insignificant irrespective the operationalization of capital. The government capital injection again obtains a positive coefficient but fails to be significant for any capital concept examined. The only qualitative difference is that, unlike in Table 2, now the competitive situation matters; CPO obtains a significant negative coefficient.

As discussed earlier, the capital ratios of the SBF banks as recorded in August or September 1992 do not incorporate the substantial losses booked by the SBF in December. However, if the estimated additional bank level losses are deducted from the recorded 1992 core capital and the equations are re-estimated with the adjusted capital ratios as explanatory variables, no qualitative changes obtain. The capital variables still remain insignificant, and the risk variables retain their significance. Given the insensitivity of the results, these experiments are not reported in detail.

Thus the growth in local banks' loan stock appears to have been the smaller in 1991–1992, the more the nonperforming assets at the end of 1991 (savings banks), the more the business loans in the portfolio (cooperative bank) and the larger the bank. In addition, if there was no commercial bank presence in the local bank's operating area, the contraction of credit was more pronounced. And even after accounting for these factors, the savings banks contracted lending in 1991–1992 by more than the cooperative banks.

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<sup>13</sup> The exact procedure used was to discard observations for which the absolute value of the LAD residual was more than 3, 2.5 and 2 times the standard deviation of the residual series and to run an OLS regression to check the Jarque-Bera statistic. A cutoff limit of 2.5 times the standard deviation was sufficient for all equations (with different capital variables).

Table 4.

**Instrumental variables estimation with  
end-of-period capital, 10 outliers excluded,  
dependent variable GL9290**

Variable		BISRAT92		DBARAT92		CORRAT92	
		coef- ficient	t-value	coef- ficient	t-value	coef- ficient	t-value
CONSTANT,	coops	27.7	5.38***	25.9	4.81***	27.1	5.56***
	savings	10.1	1.69*	8.65	1.43	10.2	1.74*
CAP: <sup>(a)</sup>		-0.08	-0.52	0.00	0.02	-0.10	-0.59
GOVK		0.81	1.47	0.86	1.49	0.80	1.46
COST		-20.3	-0.58	-25.3	-0.52	-28.9	-0.59
CGLOSS91		-0.15	-0.52	-0.16	-0.55	-0.15	-0.52
NPA91	coops	-0.01	-0.09	-0.00	-0.01	-0.01	-0.09
	savings	-0.49	-4.31***	-0.48	-4.07***	-0.49	-4.37***
BUSSHA,	coops	-0.19	-5.12***	-0.19	-5.08***	-0.19	-5.12***
	savings	0.03	0.40	0.03	0.47	0.03	0.38
DINC		-1.69	-0.43	-1.94	-0.49	-1.66	-0.43
DUNR		-0.20	-1.09	-0.19	-1.08	-0.20	-1.10
CONSER		1.47	0.35	1.50	0.35	1.50	0.36
URPOP		-2.93	-1.20	-2.83	-1.15	-2.91	-1.20
CPO		-2.06	-2.31**	-2.08	-2.32**	-2.05	-2.30**
SIZE		-1.68	-4.01***	-1.65	-3.81***	-1.69	-4.03***
CLOSSG		-1.20	-2.45**	-1.21	-2.46**	-1.20	-2.48***
ADJ.R <sup>2</sup>		0.47		0.46		0.47	
F-TESTS for joint significance: Significance levels							
CAP & GOVK & COST		0.38		0.43		0.37	
CGL&NPA	coops	0.86		0.86		0.86	
	savings	0.00		0.00		0.00	
CGL&NPA &BUS	coops	0.00		0.00		0.00	
	savings	0.00		0.00		0.00	
DEMAND		0.55		0.57		0.55	

<sup>(a)</sup> Excludes government capital injection

\*, \*\*, \*\*\* significant at the 10, 5 and 1 per cent level respectively.

### 4.3.2 Stability over time and other checks of robustness

With the severe deepening of the economic crisis through 1991 and 1992, the banks' situation evolved rapidly. It is quite possible that bank behaviour as a result changed within the two-year period in response to mounting nonperforming assets and credit losses and the general economic decline. To examine this possibility the equation with anticipated core capital (excl. government capital injection) as the capital variable was estimated separately for 1991 and 1992. For the reasons

discussed in Appendix 6, the credit and guarantee loss variable (CGLOSS) and the nonperforming asset variable (NPA) were dated in both regressions in 1991 and at the end of 1991 respectively. The estimation technique is IV and the same 10 outliers are excluded as in the previous equations. The results are reported in the first two columns of Table 5.

The results indeed display significant behavioural differences over time. The equation fits better for 1992 than for 1991. As 1992 was much worse in terms of credit losses, nonperforming assets etc, this suggests that credit risk indeed was very important in the determination of loan volumes in the early 1990s.

The most striking difference concerns the effect of bank capital. While the coefficient of CAP remains insignificant in the first subperiod, it obtains a significantly negative coefficient in the 1992 regression. Similarly, capital growth via government capital injection exerts a positive effect on lending in 1992. The cost variable remains insignificant in all versions. Credit growth reacts more negatively to nonperforming assets and share of business loans in 1992 than in 1991. Interestingly, the reaction of the savings banks changes sign. In 1991 savings banks' lending was lower, the higher the share of business loans at end-1990, whereas in 1992 (as for the cooperative banks) their lending was lower the higher the share of business loans at end-1991. Demand factors also become more significant in 1992 in contrast to 1991: unemployment exerted a negative impact on bank lending in 1992.<sup>14</sup>

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<sup>14</sup> The finding that bank capital had a statistically significant impact on bank lending in 1992 but not in 1991 or over the period as a whole prevents a useful analysis of the response of different loan categories to capital. The 1992 data on the breakdown of loans into lending to different sectors are missing on an important subset of the banks under investigation. An (unreported) examination of the determinants of the 1991 growth rates of business loans and household loans indicates no impact of capital on lending, just as there is no impact on aggregate loan stock. A noteworthy finding is that unemployment seemed to affect only lending to households, not to firms. The unemployment rate is thus likely to proxy the willingness to borrow by households rather than the general condition of the local economy. The rather bad fits furthermore indicates that the behaviour of the aggregate can be much better explained by bank characteristics than can the individual lending components. This gives us some confidence that the aggregate loan variable focused on in other empirical exercises is indeed the relevant loan concept.

Table 5. **IV estimates for 1991 and 1992 separately**

Variable	Period	Dependent variable GL9190		Dependent variable GL9291					
		CAP= CORRAT91		CAP= CORRAT92 <sup>(a)</sup>		CAP= CORRAT92 <sup>(a)</sup>		CAP= CORRAT92 <sup>(a)</sup>	
		coef- ficient	t-value	coef- ficient	t-value	coef- ficient	t-value	coef- ficient	t-value
CONSTANT	coops	10.6	3.15***	15.3	5.97***	17.7	5.99***	16.9	6.58***
	savings	-1.42	-0.34	11.9	3.80***	12.6	3.51***	13.3	4.17***
CAP:		0.14	1.15	-0.20	-2.38**	-0.26	-2.77***	-0.23	-2.75***
GOVK		-	-	0.65	2.08*	0.48	1.33	0.64	2.01**
COST		-30.9	-0.90	-8.28	-0.32	-4.21	-0.13	-16.1	-0.57
CGLOSS91		-0.22	-1.04	-0.00	-0.00	-0.01	-0.04	-0.03	-0.22
NPA	coops	-0.01	-0.22	-0.06	-1.42	-0.03	-0.67	-0.04	-0.93
	savings	-0.19	-2.43***	-0.35	-5.47***	-0.35	-4.70***	-0.35	-5.40***
BUSSHA,	coops	-0.08	-3.12***	-0.10	-4.71***	-0.13	-5.35***	-0.11	-5.37***
	savings	0.09	1.82*	-0.10	-2.24**	-0.08	-1.70*	-0.10	-2.32**
DINC		0.85	0.17	2.15	0.92	1.84	0.67	2.85	1.19
DUNR		0.03	0.16	-0.28	-1.99**	-0.27	-1.65*	-0.29	-1.99**
CONSER		-0.69	-0.23	0.81	0.35	0.58	0.21	0.42	0.17
URPOP		0.46	0.27	-1.90	-1.39**	-2.61	-1.64	-2.59	-1.86*
CP0		-0.67	-1.08	-1.29	-2.54**	-1.26	-2.12**	-1.32	-2.55**
SIZE		-0.64	-2.29**	-1.19	-5.04***	-1.31	-4.81***	-1.13	-4.68***
CLOSSG		-0.64	-0.99	-0.95	-2.65***	-1.24	-3.04***	-1.21	-3.39***
ADJ. R <sup>2</sup>		0.30		0.45		0.39		0.45	
SAMPLE		excl. 10 outliers		excl. 10 outliers		incl. outliers		excl. 7 outliers	
N=		378		378		388		381	

F-TESTS for joint significance: Significance levels

CAP & COST		0.34	0.00	0.01	0.00
CGL & NPA	coops	0.54	0.35	0.79	0.65
	savings	0.02	0.00	0.00	0.00
CGL & NPA	coops	0.01	0.00	0.00	0.00
& BUS	savings	0.01	0.00	0.00	0.00
DEMAND		0.99	0.13	0.16	0.04

(a) = end-1992 Tier-I capital (BIS) excl. government capital injection.

\*, \*\*, \*\*\* significant at the 10, 5 and 1 per cent level respectively.

The capital effect in 1992 requires further examination to ascertain whether it is simply an artefact associated with the particular sample. It is also interesting to know whether it obtains only with the anticipated core capital or also with other specifications. We therefore estimated the equation with both all observations and excluding observations that have been outliers under the 2.5 standard error criterion in a LAD regression on the 1992 data. These results are reported in the last two columns of Table 5. They show that the negative effect of capital on lending is not the result inclusion or exclusion of a small number of outliers but is rather robust to small changes in the data set. In contrast, the effect of

government-supplied capital is sensitive to these changes in the data set. One should therefore not draw strong conclusions about this variable.

The results of a negative effect of bank capital on lending in 1992 does not depend on the timing of the CORRAT variable either. If CORRAT dated at the beginning of the period is used instead of end-of-period CORRAT, qualitatively the same result obtains. On the other hand, the relevant capital variable indeed seems to be core capital. Unlike in the whole-period estimation, CORRAT now is superior to both BISRAT and particularly to DBARAT (Table A8.1, Appendix 8).

Given the perverse effect of bank capital on lending in 1992, the question naturally arises as to whether this phenomenon can be associated with particular types of banks. To investigate this we split the sample in three ways to separate a priori 'weak' banks from a priori 'strong' banks: (1) 'bislow' banks (whose BISRAT at end-1991 was below 8 per cent) vs. 'bishigh' banks (the rest), (2) 'npahigh' banks (whose NPA ratio at the end of 1991 was above the medium value) vs. 'npalow' banks (the rest), and (3) savings banks vs. cooperative banks. The gist of the regression results are presented in Table 6.

Two observations stand out from the subsample regressions. First, the equation explains much better the behaviour of the weak banks, both in the capital ratio sense and in the nonperforming asset sense; the  $\bar{R}^2$ 's are at least twice as high for the weak banks as for the strong banks. This suggests that bank capitalization and credit risks were indeed important for banks' loan supply: For banks whose capital position was strong or the share of problem assets low, changes in loan stock are not very well explained by the examined factors, while these factors exerted a strong influence on weak banks' behaviour. Similarly the lending behaviour of a priori weak savings banks can be much better accounted for than that of a priori strong cooperative banks.

The second observation is that the perverse response of lending to capital is *not* a feature of weak banks, either in terms of the capital ratio or share of nonperforming assets, but if anything obtains among the strong banks. Similarly, the perverse effect obtains among the cooperative banks rather than among the savings banks, which were on average plagued with much more serious asset quality and capital problems. This is in sharp contrast to the results of Chapter 3, which suggested that particularly savings banks' behaviour was characterized by moral hazard. The estimation results for the cooperative banks are nevertheless somewhat problematic, as the cost variable also obtains a significant *negative* coefficient at the 5 per cent level. This is difficult to reconcile with the negative capital effect, as the theoretical model does not allow both coefficients to be negative.

In any case, these findings suggest that to the extent there was a 'gamble for resurrection' in 1992, and some of that is indeed indicated, it took place among the 'better' banks. How is this possible? A reasonable explanation might be that the weaker banks were prevented from additional risk taking by regulatory action. However, it is very difficult to verify this conjecture. There has been no Finnish equivalent to the formal regulatory enforcement actions that were implemented in the US, and which in the analysis of Peek and Rosengren (1995a) turn out to be highly significant explanatory factors for credit contraction. Classifying banks according to some criteria which a priori might have to do with regulatory stringency did not result in any clear distinction in behaviour between the supposedly strictly regulated and less strictly regulated banks, and these results are not reported.

Table 6. **Comparison of capital and cost effects in subsets of banks**

Variable	BISLOW		BISHIGH		NPAHIGH	
	coef-ficient	t-value	coef-ficient	t-value	coef-ficient	t-value
CAP: CORRAT92*	-0.01	-0.04	-0.42	-3.32***	-0.11	-1.00
GOVK	1.07	1.95*	0.46	1.11	0.40	1.03
COST	-85.6	-1.35	-0.72	-1.68*	-25.9	-0.56
ADJ. R <sup>2</sup>	0.65		0.30		0.54	
N	124		257		195	

Variable	NPALOW		SAVINGS BANKS		COOPERATIVE BANKS	
	coef-ficient	t-value	coef-ficient	t-value	coef-ficient	t-value
CAP: CORRAT92*	-0.37	-2.74***	-0.01	-0.06	-0.41	-4.38***
GOVK	0.94	1.67*	1.83	1.99*	0.03	0.08
COST	-0.62	-1.06	-22.3	-0.32	-86.0	-2.22**
ADJ. R <sup>2</sup>	0.26		0.52		0.22	
N	186		79		302	

\*, \*\*, \*\*\* significant at the 10, 5 and 1 per cent level respectively.

### 4.3.3 Conclusions on the loan equation estimation

The estimation results do not contain any evidence of a credit crunch in the sense that bank capital would have constrained lending in 1991 or 1992. No significant positive effect of bank capital on bank lending can be detected once we control for riskiness of the bank portfolio and conditions in the local market. Although in certain subsets of the observations a negative cost effect is found, this is not a robust result. The results do not depend on the exact definition of bank capital; all examined alternatives yield the same conclusion in this regard.

The finding that there was an inverse relationship between bank size and lending growth further supports this conclusion. One would namely expect that the capital constraints would, *ceteris paribus*, be more restrictive for small banks than for large banks, as the latter presumably have the advantage of lower transactions costs in the capital market and may also benefit from potential 'too-big-to-fail' policies. The negative effect of bank size on lending growth may have to do in part with differences in the composition of lending unaccounted for by business share and demand variables. But it may also reflect the weak deposit growth for the larger banks as reported in Appendix 5. To the extent this is true, it suggests a 'credit crunch' due to financing difficulties for some reason other than weak capital.

As far as capital is concerned, the results suggest that, if anything, a strong capital position (as measured by core or Tier-I capital) implied less lending in 1992. Thus the perverse incentive effects found in the analysis of the boom period appear to have held also for at least some banks in 1992. However, the results are somewhat difficult to interpret on this score, particularly in comparison with the results for the 1980s. First, the perverse effects obtain only in 1992, not in 1991. Second, the types of banks that appear to be plagued with moral hazard are somewhat surprising. The perverse effect can be observed among the better capitalized banks or banks with less-than-average credit risks in the portfolio, and among the cooperative banks rather than the savings banks. Furthermore, only the capital variable (not the cost variable) indicates perverse reactions. In the 1980s it was the savings banks that displayed bad behaviour rather than the cooperative banks, and the same type of effect obtained both for the capital variable and the cost variable.

These findings suggest that a change in bank behaviour took place in the early 1990s. The savings banks and weak banks in general adopted a more conservative attitude towards lending, while among stronger banks, typically cooperative banks, there emerged an attempt to overcome the difficulties of capital adequacy and delinquent assets through further

extension of credit. The theoretical model suggests two reasons for these discrepancies. One is that the pricing of the weak/savings banks' marginal funds became more responsive to risk, while no change or a change in the opposite direction took place for the strong/cooperative banks. The other possibility is that regulatory pressures on the weak banks became much more stringent in the 1990s than they had been in the 1980s, while no such change took place for the stronger banks. Naturally both factors may have worked simultaneously.

Some broad observations support both of these hypotheses. The savings banks as a group started to receive more regulatory attention in 1991 with the mounting problems and the eventual failure of their central bank (Skopbank) in autumn 1991. The takeover by the authorities of Skopbank, including immediate dismissal of top management, not only signalled what could happen to failing banks but it also made the savings banks very directly dependent on the authorities. For example, the solvency of many savings banks was greatly affected by the valuation of the so-called K-shares issued by Skopbank and held by the savings banks. In 1992 about half of the savings bank units merged to form the Savings Bank Finland, the member banks of which undoubtedly were closely scrutinized by the authorities already prior to the merger. In these circumstances the possibilities to continue to increase risk by expansionary lending, eg to customers already in financial distress, presumably declined radically.<sup>15</sup> There is also some evidence of market pressures on savings banks' financing; the savings banks appeared to have lost deposits, despite higher pricing in 1991 and 1992.

There was no equivalent to the Skopbank crisis in the cooperative bank group, and it seems that the cooperative banks did not have problems with their deposit funding either. On the other hand, the cooperative banks benefited, as did other banks, from repeated signals from the authorities of their willingness to support banking systems liquidity and solvency.<sup>16</sup> Thus the lending decisions of the banks, which (due to their weak state) were not directly subject to stringent regulatory control, may not have been very much constrained in 1991 or 1992.

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<sup>15</sup> In terms of the theoretical model one would say that the expected penalty for a failure to meet the regulatory requirement was increasing as probably both the frequency and thoroughness of examination increased, so that the banks for example could not get away with excessively small writeoffs.

<sup>16</sup> Examples of the readiness for bank support are the rescue of Skopbank in September 1991, the government offer of capital injection and the establishment of the Government Guarantee Fund in spring 1992 and the government's statement about the support of the banking system in august 1992.



In contrast to the failure of the capital crunch hypothesis, the collateral squeeze hypothesis receives rather strong support in the data. The riskiness of bank lending, as proxied by the ratio of nonperforming assets to risk-weighted assets and the share of business loans in total loans, exerts a clear negative effect on lending. Furthermore, the finding that the capital variable as such in no case had a positive effect on lending suggests that the risk variables do not primarily proxy for anticipated losses in capital but for riskiness of lending opportunities.

However, unlike in the analysis for the 1980s, the variables that were constructed to reflect demand did not turn out to be particularly important, although eg unemployment had a negative effect on lending growth in 1992. An interpretation could be that the customers who were not forced to borrow in 1991 or 1992 did not want to raise much additional credit but rather were happy to let their credit stocks decline with the amortization payments. Thus most genuine demand-side impulses came from financially distressed borrowers and, the extent to which this demand was satisfied by the banks, depended on the bank characteristics. In addition, the competitive situation seems to have mattered: In the absence of commercial bank presence in the local market, the local banks were more likely than otherwise to cut lending.

#### 4.3.4 Subordinated debt

According to the analysis of Chapter 3, the volumes of subordinated debt issued by the cooperative banks and savings banks were consistent with the hypothesis that in the 1980s either money market debt was underpriced or the banks did not expect positive penalties for capital insufficiency or both. This conclusion was particularly clear in the case of the savings banks. Importantly, the findings on subordinated debt were in line with the premise of the model that demand for subordinated debt is highly elastic: banks willing to issue such debt were able to do so without significant lemons premia.

In the early 1990s both the cooperative banks and the savings banks increased the issuance of subordinated debt. But still at the end of 1992 both types of banks had on average far less subordinated debt outstanding than could have been counted toward the regulatory maximum (50 per cent of Tier-I capital). And although the average share rose more among the savings banks, most savings banks still had zero subordinated debt in 1992 (Table 7).

Table 7. **Use of subordinated debt**

	Cooperative banks, N = 313		Savings banks, N = 82	
	1990	1992	1990	1992
Number of banks with zero subordinated debt	5	40	58	55
Number of banks with the share of subordinated debt in TIER-I capital, SUBSHA, greater than the regulatory maximum = 0.5	16	38	0	3
Average SUBSHA	.19	.22	.02	.08

However, one cannot exclude the possibility that in the period of general financial distress in 1991 and 1992, the market for subordinated debt was no longer willing to absorb additional issues without significant lemons premia. Thus although the banks would then have liked to issue subordinated debt, buyers may not have been around to the same extent as before. Should the potential lemons premia have been significant, one would expect that the change in the ratio of subordinated debt to Tier-I capital would be negatively associated with bank credit risk. More specifically in terms of the variables used in this analysis, the change should be positively associated with equity capital (the capital adequacy ratio excluding subordinated debt) and negatively associated with the share of nonperforming assets.

Table 8 reports equations for the change in the ratio of subordinated debt to Tier-I capital ( $\Delta$ SUBSHA) in the period end 1990 – end-1992. The behaviour of cooperative banks' subordinated debt is essentially random; only 3 per cent of variation can be explained by beginning-of-period SUBSHA, L/D and CORRAT90 and NPA91 and size. Of these, only CORRAT90 obtains a significant (negative) coefficient, suggesting a continued – and at least to some extent successful – attempt by the weakly capitalized banks to add to capital through the issuance of subordinated debt. Thus availability of subordinated debt does not appear to have been an overwhelming problem for the cooperative banks even in 1991 and 1992.

Table 8.

**Simple models of subordinated debt**OLS equation for change in SUBSHA, 1990–1992<sup>a)</sup>

	COOPS	SAVINGS
Constant	.03 (.42)	-.29 (-3.19***)
SUBSHA90	-.01 (-.16)	.25 (.44)
L/D90	.00 (.03)	.22 (2.55)
CORRAT90	-.006 (-2.01**)	.002 (.76)
NPA91	.001 (.38)	-.006 (-2.32**)
SIZE	.016 (1.58)	.034 (3.30***)
R <sup>2</sup>	.03	.28

<sup>a)</sup> From the cooperative banks' data set 10 outliers are excluded. The savings bank data are used as such. Correction for heteroscedasticity is applied to both equations.

\*, \*\*, \*\*\* significant at the 10, 5 and 1 per cent level respectively.

A much larger fraction of the change in the savings banks' SUBSHA can be explained by the explanatory variables. In this case, no significant relationship exists between the capital ratio and the change in SUBSHA. However, nonperforming assets have a significant negative effect and bank size a significant positive effect on the issuance of subordinated debt. This suggests that the weak savings banks could not issue subordinated debt as the cooperative banks could and as also the savings banks had been able to do up to 1990.

One way to shed additional light to the determination of subordinated debt would be to look directly at the yields of subordinated debt relative to the senior bank liabilities of the same maturity. Unfortunately, the data on such yields are very scanty. Some rough calculations based on a relatively small number of subordinated debt at-issue yields suggest no subordinated debt premium relative to senior debt in the yields. However, that does not constitute strong evidence against difficulties in the issuance of subordinated debt in the crisis period, as quantitative rationing may have been the main vehicle of limiting investor risk.

To sum up, the observations on the issuance of subordinated debt suggest that the local banks in general and the savings banks in particular perceived very small or no penalties at all from a failure to fulfil the capital requirements by 1990. During the crisis period the banks increased their use of subordinated debt, although only a handful of banks reached the regulatory maximum. Savings banks were then relatively somewhat more active in the issuance of net debt. This change also seems to be consistent with the observed differences in lending behaviour between the two banking groups. In this period the savings banks appeared to be more conservative. That the savings banks nevertheless did not in general reach the regulatory maximum may have been due to constraints imposed at this stage by investors on the issuers of subordinated debt in an environment of general financial distress and increased uncertainty. In the case of the cooperative banks, there is no evidence of such constraints, suggesting that the failure to use such debt up to the regulatory maximum in 1991 and 1992 reflected unwillingness on the part of the cooperative banks to do so.

## 4.4 Discussion

The estimation results of a reduced form loan growth equation on cooperative and savings bank data do not support the hypothesis of a credit crunch or capital crunch in the sense that bank capital constrained lending on the margin in 1991 or 1992. After controlling for the riskiness of lending, demand for loans, the competitive situation, and the change in the credit stock due to credit losses, no significant positive effect of bank capital on lending is found. Consistent with this, bank costs generally failed to have a negative impact on bank lending. In addition, the issuance of subordinated debt is broadly in line with the results with the loan equation.

The results thus overturn the findings by Solttila and Vihriälä (1992), which suggested a statistically significant (albeit quantitatively weak) capital crunch in 1991. Their analysis was however based solely on savings banks data, controlled only roughly for demand factors and not at all for competitive conditions. Furthermore, in the statistically best formulation of their analysis, the capital concept incorporated the anticipated effect of nonperforming assets on bank capital. Thus, in part the estimated effect of bank capital reflected (in the light of this analysis, wrongly) the riskiness of lending opportunities.

The lack of evidence of a credit crunch due to capital insufficiency is somewhat surprising given the findings of many American cross-

sectional studies, which support the credit crunch in much less severe circumstances. Three factors may well explain the paradox. First, for reasons discussed in section 4.2, our analysis probably does not suffer from the capital endogeneity problem to the same extent as do the typical American cross-section studies. Second, in the Finnish case studied here the overall weakness of loan demand and problems of borrower quality were so overwhelming that bank capital did not in fact become a true constraining factor. In other words, weak borrower quality or 'collateral squeeze' combined with the unwillingness of creditworthy borrowers to borrow to dominate the overall behaviour of credit. Finally, bank support helped substantially in preventing the collapse of bank capital.

To the extent significant effects of bank capital on lending were found, they were – just as in the analysis of the late 1980s – of the opposite type: A weak capital position induced banks to increase lending. But this effect of bank capital on lending appears to hold only in 1992, of the two years, and only for some subsets of the banks examined. The perverse effect can be found to a greater extent among the strong banks (in terms of capital asset ratios and amount of problem assets) than among the weak ones, and among the cooperative banks rather than the savings banks. This is in contrast to the findings for the 1980s, when perverse effects were characteristic of savings banks and weak banks in general.

A reasonable explanation is that in the early 1990s pressures from both creditors and regulators started to limit the weak banks' and particularly the savings banks' possibilities and willingness vis-à-vis risk taking while such pressures were small or nonexistent for stronger banks, ie typically cooperative banks.

Although in general creditors continued to believe in banks' creditworthiness, probably not least due to strong public sector support of the banking system, the savings banks experienced some loss of deposits in 1991 and 1992. In contrast, the cooperative banks apparently did not face such problems. Similarly, risky savings banks (banks with high shares of nonperforming assets) failed to increase their use of subordinated debt to improve regulatory capital ratios in the same period, in contrast to the corresponding cooperative banks and in contrast to the late 1980s. This is another indication of market pressures on the weak savings banks.

On the regulatory side, increasing attention began to be focused on the savings banks through 1991 and in 1992. Particularly the close scrutiny and the ultimate takeover of Skopbank in 1991 by the authorities made the savings banks not only aware of the consequences of a failure but also made them in several ways highly dependent on the authorities.

The perceived penalties for failure to satisfy supervisory requirements presumably increased as a consequence. No such direct regulatory pressures existed on the cooperative bank side, and these banks presumably only benefited from the clearly articulated commitment of the authorities to support the banking system.

These arguments lead to the following characterization of bank behaviour in the early 1990s: The weakest banks, in terms of capital adequacy and credit risks, contracted their lending due to regulatory and market pressures. Among these banks the exact levels of capital ratios were not very important. The regulatory and market pressures were not as strong in respect of the better capitalized banks or banks with lesser credit risks on the balance sheet. Among these banks, typically cooperative banks, an element of 'gamble for resurrection' can be detected in 1992: the lower the capitalization, the more expansive the credit supply. The best banks presumably had no need to continue financing customers in financial distress but could take the losses without endangering their reported capital adequacy ratios. In contrast, banks that were not so weak as to be closely constrained by either regulators or creditors, but which nevertheless could not take the pending losses without violating the capital adequacy constraint, played for time by financing customers with debt servicing problems.

## 5 Concluding Remarks

This study has focused on the role of financial intermediation in the Finnish credit cycle of 1985–1995. More precisely the question is about the role of Finnish deposit banks – the predominant vehicle of financial intermediation in Finland – in the rapid growth of credit in the late 1980s and its subsequent steep contraction. Did banks' lending policies contribute to the rapid credit growth? If they did, was the reason simply better refinancing possibilities created by financial liberalization or did distorted incentives play a role as well? Similarly, was there a credit crunch caused by insufficient bank capital in the early 1990s, or do weak demand and weak borrower quality explain the entire contraction of credit?

The first chapter briefly reviewed the theoretical arguments of recent literature on the role of financial intermediation and provided a description and preliminary interpretation of the Finnish credit cycle.

The time patterns of private credit and bank interest margins and some differences in behaviour between bank groups were found to be consistent with the following tentative conclusions. First, changes in the balance sheets of firms and households very likely contributed to both the rapid growth of credit in the late 1980s and its subsequent steep contraction. Second, the supply of bank credit also increased in the late 1980s and contracted in the early 1990 relative to other sources of credit to the private sector. Third, distorted incentives may have contributed to the expansion of risky lending by at least some weak banks in the boom period, and problems with capital adequacy may have constrained the lending of at least some banks in the early 1990s.

The theoretical analysis of Chapter 2 used a model designed to fit the conditions of the Finnish cooperative and savings banks to show how lending can vary depending, on the one hand, on bank characteristics and, on the other, on the pricing principles for bank's marginal financing and the stringency of capital regulation. If marginal funds are fairly priced or contain a lemons premium and banks are penalized for insufficient capital, bank lending depends positively on the amount of capital and negatively on costs. As a consequence a 'credit crunch' due to a reduction in capital or an increase in costs can result. Zero penalty (no costs of bankruptcy) under fair pricing implies independence of bank lending from bank characteristics. On the other hand, underpricing of marginal funds or a situation in which bank owners are rewarded for capital insufficiency (by ill-conceived bank support) can lead banks to expand lending 'excessively' and in particular make lending depend negatively

on bank capital and positively on costs. Bank behaviour is characterized by moral hazard, which induces banks to transfer a part of credit risk to their providers of funds (or their insurers). Similarly, the model implies quite different behaviour for subordinated debt under different assumptions about the pricing of bank liabilities and capital regulation.

The empirical analysis, which used data on savings and cooperative banks, was split into examinations of the boom period of 1986–1990 and the contraction period of 1990–1992.

The analysis of the boom period focused on the issue of moral hazard. The results strongly support the hypothesis. Growth of lending was, *ceteris paribus*, negatively associated with bank capital and positively associated with bank costs. That this was not just a matter of underestimating the risks is suggested by the fact that banks that had opted for a growth strategy initially did not change behaviour even though external conditions turned for worse in the middle of the boom period. Also the behaviour with respect to the use of subordinated debt is consistent with the moral hazard hypothesis. Some findings suggest that the cause of this behaviour was more likely underpricing of liabilities than perceptions concerning bank support policies which would directly reward banks' equity owners. In particular, the main issue seems to be underpriced nondeposit funding rather than underpriced deposit insurance. The perverse behaviour was much stronger among the savings banks than among the cooperative banks. According to calculations based on the estimation results, the rate of growth of savings bank lending would have been 1/3 smaller than the actual growth rate in 1986–1990 in the absence of moral hazard. In the case of the cooperative banks the estimated moral hazard effect was much smaller and in the aggregate not statistically significant. Given the clear positive association of the rate of growth of lending during the boom period and the amount of nonperforming assets later during the banking crisis, the disproportionate losses of the savings bank group are – in the light of this analysis – largely due to moral hazard.

The empirical analysis of the determination of bank lending in 1991 and 1992 attempted to establish in particular how bank capital and costs, on the one hand, and borrower quality, on the other, affected lending. The findings do not support the hypothesis of a general credit crunch caused by weak capital. Some findings however suggest that regulatory pressures and perhaps distractions caused by restructuring may have had a negative effect on lending by the savings banks and some cooperative banks. In line with the analysis of the 1980s, some evidence is found in support of moral hazard. Weak capital contributed positively to credit growth for a subset of banks in 1992. This moral hazard behaviour differs however



from that observed for the late 1980s. This time the banks resorting to a 'gamble for resurrection' were not the weakest banks in terms of capitalization or credit risks but more in the middle of the spectrum: not so strong that they could take the full losses associated with nonperforming assets and not so weak that regulatory pressures would have markedly constrained additional lending to ailing customers. These banks were typically cooperative banks whereas in the 1980s they were the savings banks. On the other hand, weak borrower quality – measured mainly by share of nonperforming assets – seems to have contributed significantly to slow growth and contraction of bank lending in 1991 and 1992. Thus the issue of the early 1990s seemed to be more a 'collateral squeeze' than credit crunch.

Although our empirical analysis provides support for the hypothesis that banks' lending policies contributed to the rapid growth of risky lending in the boom period, it is obviously not the whole story of lending growth and subsequent banking problems. Clearly there were macroeconomic shocks that were virtually impossible to predict. The clearest example of course is the collapse of the Soviet Union and with it the Finnish eastern export business. Neither can one wholly discount the claim – often made but difficult to test – that most economic agents were plagued by myopia and herd behaviour, which contributed to unsustainable increases in asset prices and ex post faulty borrowing and lending decisions. Therefore even if the whole banking system had been functioning with the correct incentives, rapid growth of credit and substantial losses could not have been avoided and very likely also some public expenditure would have been needed to keep the banking system functioning.

In contrast to the discovered importance of bank behaviour in the boom period, the findings provide almost no support for the credit or capital crunch hypothesis for the contraction period. This claim may appear somewhat strange. After all, the banking system lost in the aggregate more than its total capital. Much smaller capital problems have been found to exert a significant negative effect on bank lending in American studies. However, three factors make the result understandable. The first is bank support. It helped to keep all banks' regulatory capital ratios above the level required by law. Furthermore, the Government as well as Parliament very clearly stated that the State would guarantee banks' capacity to fulfil their contractual commitments.

Second, demand for credit very likely collapsed and borrower quality weakened very strongly with the outset of the general economic crisis in 1991. Creditworthy firms were probably unwilling to take on additional debt when the demand for their products and profitability plummeted and

real rates of interest were close to or in excess of 10 per cent. The same applies to creditworthy households. Thus additional credit was presumably sought primarily by firms and households in financial distress, ie relatively less creditworthy customers. Even though there was pressure on bank capital (even with bank support), creditworthy demand for credit declined so sharply that capital did not become a significant constraining factor.

Third, our analysis is less vulnerable to the problems of capital endogeneity, which may have biased the results of many American studies. Likewise, demand conditions are more carefully accounted for than in the typical studies with US data.

In addition, our results do not imply that eg increased risk aversion on the part of management did not constrain lending. Such an effect is quite possible, but it was not considered in our empirical tests, as it was not possible to measure risk attitudes with our data set.

Given the (in many important respects) partial nature of the analysis, strong policy implications are not warranted. Nevertheless, some points can be made.

First, the conclusion that bank capital did not essentially constrain banks' lending even in the worst years of the general economic crisis suggests that additional bank support would not have helped much to buoy up lending and economic activity. But this does not imply that less support would have been better or even feasible. Undoubtedly, a policy of no bank support at all would have led to a collapse of the banking system. The issue thus is what amount, allocation, and conditions of bank support would have been sufficient to maintain confidence among bank creditors. These types of questions cannot be adequately answered on the basis of this study.<sup>1</sup> On the other hand, the results support the idea that policies that would have buoyed up borrower quality relative to what happened would have boosted bank lending and by implication economic activity. But the question as to what policies might have been is again beyond the scope of this study.

Second, the distorted incentives for which evidence is found seem to be associated with the underpricing of banks' nondeposit liabilities. This implies that the problem is not, at least not solely, one of subsidized deposit insurance. The problem is rather an anticipation of implicit creditor protection policies. And the experience of bank support policies of the early 1990s proved these beliefs about a comprehensive de facto

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<sup>1</sup> It is however noteworthy that the FIM 8 billion government capital injection had a small positive impact on bank lending in 1992. Thus, to a degree at least, capital support worked as intended even though, on the whole, bank capital was not an important constraining factor.

safety net to be well-founded. Therefore eradicating such expectations in the future is going to be difficult. The authorities can of course argue that comprehensive protection of bank creditors was necessary given the highly exceptional macroeconomic circumstances, and that in more isolated problems of confidence such all-embracing support will not be forthcoming. But this claim may not be wholly credible. Given the high concentration of banking, a failure of any major Finnish bank is likely to have significant macroeconomic repercussions. The markets may therefore consider most, if not all, current Finnish banks 'too big to fail' anyway. To change this, major changes in the banking structures may be needed. Greater penetration of foreign banks into the Finnish market and wider international diversification of the assets of the Finnish banks are likely to be essential ingredients of such structural changes. Limiting the coverage of deposit insurance and making its price risk-dependent may help to reduce moral hazard, but it is unlikely to solve the problem, as it does not address the central issue of implicit creditor protection.

Third, the theoretical analysis clearly points to the detrimental effects of lax enforcement of capital regulations. The precise form of capital regulation or level of required capital are not the most important issues. What is important is that any failure to meet the requirement is sufficiently penalized. And of course bank owners should not be rewarded for risk taking by ill-conceived bank support policies. An important point is the timing of regulatory actions. Limiting additional risk taking when the banking system is already in trouble is useful, but it probably also exacerbates the deflationary tendencies. There is a trade-off here. In contrast, in times of buoyant macroeconomic conditions, a reduction in risky lending caused by strict regulatory policies is unlikely to be harmful from a short-term macroeconomic point of view but, if anything, contributes to longer-term economic stability. Moreover, it is in such good times that opportunities for risk taking are the greatest.

It is obvious that many aspects of the Finnish credit cycle need further analysis. One such area is the role of macroeconomic policies, both in the makings of the credit boom and in the contraction phase. Although there are already several relevant studies available,<sup>2</sup> the banking system has not been very well integrated in these analyses. Given the important role found for the banks in the expansion phase and the central role of asset prices as determinants of borrower quality, such exercises would seem to be potentially fruitful. Also the effects of changes in competition in the financial markets are worth further study.

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<sup>2</sup> See eg Bordes, Currie and Söderström (1993), Jonung, Söderström and Stymne (1996), Honkapohja, Koskela and Paunio (1996) and Kiander and Vartia (1996).

The suggestion of the analysis of the contraction phase that 'collateral squeeze' rather than 'credit crunch' was – in addition to the standard demand factors – a cause of credit contraction clearly requires further analysis. A full-fledged panel analysis of borrower behaviour with enterprise data would be useful in confirming or to rejecting this conclusion. Such an analysis over this period would be especially interesting from the point of view of the balance sheet mechanism, as firm balance sheets and income statements of 1991 and 1992 were affected by the depreciation of the markka, which probably had only marginal direct implications for the business opportunities of the firms producing for the domestic markets.<sup>3</sup>

There is also much scope for studies that might shed light on the questions of what helped to create the indicated expectations concerning comprehensive creditor protection policies and what made certain individual banks to behave as they did. These types of questions may require approaches that differ from those typically used in economics.<sup>4</sup>

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<sup>3</sup> Brunila (1994) provides such an analysis. She however concentrates solely on the largest enterprises, which a priori have the least problems with external financing. Moreover, the period of the analysis ends in 1992, thus leaving out the year of lowest economic activity and the recovery phase, both of which are highly interesting from the point of view of balance sheet effects.

<sup>4</sup> Kuusterä provides a highly interesting exposition of the modes of behaviour and some of the incentives which were very probably behind the observed behaviour in the savings bank group. Comparative studies of this nature could add to our knowledge of why many of the savings banks chose a risky lending strategy while some others did not and why Skopbank appeared to behave so differently from Okobank and other commercial banks.

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# Appendix 1

## Capital regulation in the 1980s and early 1990s

Capital regulations in force throughout the 1980s and up until the end of 1990 required cooperative banks and savings banks to hold minimum capital amounting to 2 per cent of liabilities. The required ratio for the commercial banks, which had a somewhat wider scope of authorized banking activities, was 4 per cent.

Capital here included equity capital (commercial banks), cooperative capital (cooperative banks), primary capital (savings banks), reserve fund, equalization fund and other funds. The regulatory capital concept could also include half of the reserves for loan losses (up to 0.5 per cent of total liabilities), and subordinated debt (up to 50 per cent of capital proper).

The denominator in the regulatory capital ratio consisted of all liabilities on the balance sheet less subordinated debt and the equivalent of cash, receivables from the state, municipalities, church, Bank of Finland and other banks. Also receivables guaranteed by the state, municipalities and the church and certain bonds could be deducted. The savings banks and the cooperative banks could furthermore deduct up to 50 per cent of the loans that were guaranteed by a supervised insurance company. On the other hand, half of the off-balance sheet commitments were included in the bank liabilities concept.

The details of the regulations were set out in instructions issued by the Banking Supervision Office. Thus, for example, the value adjustments for fixed property that could be used to add to the equalization fund were regulated by the Banking Supervision Office.

In 1990 the banks were allowed to transfer 90 per cent of their reserves for loan losses to the reserve fund. This implied an increase in the regulatory capital, as only half of the loan loss reserves could be counted towards capital.

As of the beginning of 1991 a new Deposit Bank Act entered in force setting on all types of deposit banks a uniform requirement of 8 per cent of regulatory capital in relation to risk-weighted assets and off-balance sheet commitments. The regulations followed relatively closely the BIS recommendations of the time. A notable exception was that the assets of savings banks and cooperative banks that were insured by a supervised insurance company continued to have preferred treatment: they were

included in the 50 per cent risk category instead of the normal 100 per cent category. The regulatory reform implied tighter capital regulation for essentially all banks, although the difference was not as much as the percentages alone would suggest. The main lines of the prospective reform became known in the banking community at the latest by mid-1988.

At the beginning of 1994 the Deposit Bank Act was replaced by the Credit Institution Act, which fully harmonized Finnish capital regulations with EC banking directives, thus for example abolishing favourable treatment of insured assets.

# Appendix 2

The second order conditions and the comparative statics

## A. Liability-side capital requirement, fair pricing, $M > 0$

First order condition (FOC):

$$H \equiv MR^* - R^B \cdot \lambda_3 = 0, \quad \lambda_3 = 1 + \frac{c(1+k)F(a^k)}{1 - F(a^M)}$$

Second order condition (SOC):

$$\frac{\partial H}{\partial M} = MR^{*'} - MC^{M'}$$

where

$$MC^{*'} \equiv \frac{\partial MR^*}{\partial M} = MR' \cdot (1 - F(RL)) - MR^2 \cdot f(RL) < 0,$$

if MR is decreasing, ie  $MR' < 0$ , and

$$MC^{M'} \equiv R^B \cdot R^M \left( \frac{c \cdot (1+k)^2 \cdot f(a^M)}{1 - F(a^M)} + \frac{c(1+k) \cdot F(a^k) \cdot f(a^M)}{(1 - F(a^M))^2} \right)$$

$$= \begin{cases} > 0, & \text{if } c > 0 \\ = 0, & \text{if } c = 0 \\ < 0, & \text{if } c < 0 \end{cases}$$

$$\Rightarrow \frac{\partial H}{\partial M} < 0$$

always if  $MR' < 0$  and  $c \geq 0$ .

Comparative statics:

$$R^B: \quad \frac{\partial H}{\partial R^B} = -\lambda_3 + R^B \frac{\partial \lambda_3}{\partial R^B} = -\lambda_3 < 0 \Rightarrow \frac{dM}{dR^B} = \frac{dL}{dR^B} < 0$$

$$c: \quad \frac{\partial H}{\partial c} = -R^B \cdot \frac{(1+k)F(a^k)}{1-F(a^M)} < 0 \Rightarrow \frac{dM}{dc} = \frac{dL}{dc} < 0$$

$$k: \quad \frac{\partial H}{\partial k} = -R^B \cdot \frac{cF(a^k) + c(1+k) \cdot (R^M M + R^D D) \cdot f(a^k)}{1-F(a^M)} = \begin{cases} < 0, & c > 0 \\ = 0, & c = 0 \\ > 0, & c < 0 \end{cases}$$

$$\Rightarrow \frac{dM}{dk} = \frac{dL}{dk} = \begin{cases} < 0, & c > 0 \\ = 0, & c = 0 \\ > 0, & c < 0 \end{cases}$$

$$K: \quad \frac{\partial H}{\partial K} = MR^{*'} \Rightarrow \frac{dM}{dK} = -\frac{MR^{*'}}{MR^{*'} - MC^{M'}} < 0$$

$$\frac{dL}{dK} = 1 + \frac{dM}{dK} = \frac{-MC^{M'}}{MR^{*'} - MC^{M'}} = \begin{cases} > 0, & c > 0 \\ = 0, & c = 0 \\ < 0, & c < 0 \end{cases}$$

$$R^D: \frac{\partial H}{\partial R^D} = -R^B \cdot \left( \frac{c(1+k)^2 \cdot D \cdot f(a^k)}{1-F(a^M)} + \frac{c(1+k)F(a^k) \cdot D \cdot f(a^M)}{(1-F(a^M))^2} \right) < 0$$

$$\Rightarrow \frac{dM}{dR^D} = \frac{dL}{dR^D} = \begin{cases} < 0, & c > 0 \\ = 0, & c = 0 \\ > 0, & c < 0 \end{cases}$$

$$D: \frac{\partial H}{\partial D} = MR^{*'} - R^B \cdot R^D \cdot \underbrace{\left( \frac{c(1+k)^2 f(a^k)}{1-F(a^M)} + \frac{c(1+k)F(a^k)f(a^M)}{(1-F(a^M))^2} \right)}_{=A}$$

$$\Rightarrow \frac{dM}{dD} < 0, \text{ if SOC 's hold } \Rightarrow$$

$$\frac{dL}{dD} = \frac{R^B \cdot (R^M - R^D) \cdot A}{MR^{*'} - R^B R^M \cdot A} = \begin{cases} > 0, & \text{if } c > 0 \\ = 0, & \text{if } c = 0 \\ < 0, & \text{if } c < 0 \end{cases}$$

$$x: \frac{\partial H}{\partial x} = MR_x^* \equiv MR_x(1-F(RL)) - MR \cdot R_x \cdot L \cdot f(RL) > 0$$

unless  $f(RL)$  very large

$$z: \frac{\partial H}{\partial z} = -MR \cdot F_z(RL) - R^B \left( \frac{c(1+k)F_z(a^k)}{1-F(a^M)} + \frac{c(1+k)F(a^k)F_z(a^M)}{(1-F(a^M))^2} \right)$$

$> 0,$

if  $F_z(\cdot) < 0$  and  $c \geq 0$



## B. Liability-side capital regulation, fixed pricing, $M > 0$

$$\text{FOC: } H \equiv MR^* - MC^{\text{Mf}} = 0,$$

where

$$MC^{\text{Mf}} = MC \cdot (1 - F(a^{\text{M}}) + c \cdot (1+k) \cdot F(a^{\text{k}}))$$

$$\text{SOC: } \frac{\partial H}{\partial M} = MR^{*'} - MC^{\text{Mf}'},$$

where

$$MR^{*'} = MR' (1 - F(\text{RL})) - MR^2 \cdot f(\text{RL})$$

and

$$MC^{\text{Mf}'} = MC' (1 - F(a^{\text{M}}) + c(1+k)F(a^{\text{k}})) - MC^2 (f(a^{\text{M}}) - c(1+k)^2 f(a^{\text{k}}))$$

$$\Rightarrow \frac{\partial H}{\partial M} < 0$$

if  $MC'$  is large enough or  $f(\text{RL})$  is not too much smaller than  $f(a^{\text{M}})$ .

### Comparative statics

$$R^{\text{B}}: \quad \frac{\partial H}{\partial R^{\text{B}}} = 0 \Rightarrow \frac{dM}{dR^{\text{B}}} = \frac{dL}{dR^{\text{B}}} = 0$$

$$\begin{aligned} \text{m: } \frac{\partial H}{\partial m} &= -MC_m(1 - F(a^M) + c(1+k)F(a^k)) + MC(R_m^M \cdot M \cdot f(a^M) \\ &\quad - c(1+k)^2 R_m^M M f(a^k)) < 0 \end{aligned}$$

on the assumption  $MC_m^M > 0$ ,  $R_m^M > 0$  and  $f(a^k)$  is not too large

$$\Rightarrow \frac{dM}{dm} = \frac{dL}{dm} < 0$$

unless  $c < 0$  and  $f(a^M)$  is very large

$$\text{c: } \frac{\partial H}{\partial c} = -MC(1+k)F(a^k) < 0 \Rightarrow \frac{dM}{dc} = \frac{dL}{dc} < 0$$

$$\text{k: } \frac{\partial H}{\partial k} = -MC(cF(a^k) + c(1+k)(R^D D + R^M M) \cdot f(a^k)) < 0$$

$$\Rightarrow \frac{dM}{dk} = \frac{dL}{dk} = \begin{cases} < 0, & c > 0 \\ = 0, & c = 0 \\ > 0, & c < 0 \end{cases}$$

$$\text{K: } \frac{\partial H}{\partial K} = MR^{*'} < 0 \Rightarrow \frac{dM}{dK} < 0$$

$$\frac{dL}{dK} = 1 + \frac{dM}{dK} = \frac{-MC^{Mf'}}{MR^{*'} - MC^{Mf'}} = \begin{cases} > 0, & MC^{Mf'} > 0 \\ = 0, & MC^{Mf'} = 0 \\ < 0, & MC^{Mf'} < 0 \end{cases}$$

$$R^D: \frac{\partial H}{\partial R^D} = MC \cdot D \cdot (F(a^M) - c(1+k)^2 f(a^k)) > 0$$

$$\Rightarrow \frac{dM}{dR^D} = \frac{dL}{dR^D} > 0$$

unless  $c$  is large (close to unity)

$$D: \frac{\partial H}{\partial D} = MR^{*'} + MC \cdot R^D \cdot (f(a^M) - c(1+k)^2 f(a^k)) \lesssim 0 \Rightarrow \frac{dM}{dD} \lesssim 0$$

$$\frac{dL}{dD} = 1 + \frac{dM}{dD} = \frac{-MC^{Mf'} - MC \cdot R^D \cdot (f(a^M) - c(1+k)^2 f(a^k))}{MR^{*'} - MC^{Mf'}}$$

$$= \begin{cases} > 0, \text{ if } MC^{Mf'} > -MC \cdot (R^D \cdot f(a^M) - c(1+k)^2 f(a^k)) < 0 \\ < 0, \text{ if } MC^{Mf'} < -MC \cdot (R^D \cdot f(a^M) - c(1+k)^2 f(a^k)) < 0 \end{cases}$$

$$x: \frac{dM}{dx} = \frac{dL}{dx} = -\frac{MR_x^*}{MR^{*'} - MC^{Mf'}} > 0$$

unless  $f(RL)$  is very large

$$z: \frac{\partial H}{\partial Z} = -MR F_z(RL) + MC[F_z(a^M) - c(1+k)F_z(a^k)] > 0$$

unless  $|F_z(a^M)|$  is much greater than  $|F_z(RL)|$

$$\Rightarrow \frac{dM}{dz} = \frac{dL}{dz} > 0$$

unless  $|F_z(a^M)|$  is much greater than  $|F_z(RL)|$

# Appendix 3

## Alternative solutions with weak loan demand

The expected marginal revenue on bonds,  $MR^B$ , can in general be greater than, equal to or smaller than  $R^B$ . This is so because one must deduct from the posted rate  $R^B$  the expected part to be paid to depositors in case of bank default and add the benefit from a smaller expected penalty from not meeting the capital requirement when the amount  $R^B$  of sure value is created.

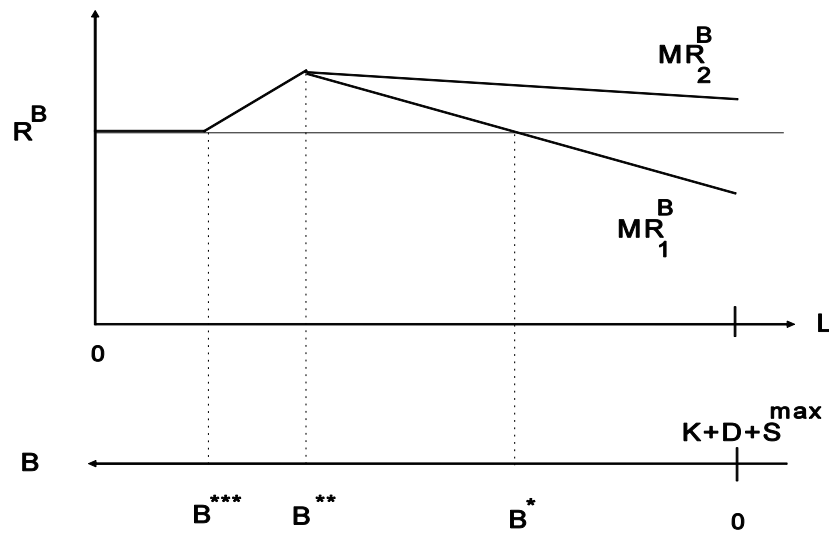
$MR^B$  is increasing in  $B$  with small  $B$  as long as the density function is not too exotic and  $c$  is not close to unity: increasing bonds increases the expected marginal return, as additional bond revenues decrease the probability of defaulting by  $R^B f(a^D)$  but increase the expected penalty only by the fraction  $c$  times  $R^B f(a^k)$ .

At  $B=0$ ,  $MR^B < R^B$  if  $c < c^* \equiv F(a^D)/F(a^k) < 1$ . At high enough  $B$ , say  $B^*$ ,  $MR^B$  reaches  $R^B$ . At a still higher  $B^{**} \equiv (R^D D - a^{\min})/R^B < D$ , the deposits become fully safe ( $F(a^D)=0$ ), and only the declining capital requirement effect remains:  $MR^B$  is decreasing in  $B$  in this range. This ceases at  $B = B^{***} \equiv ((1+k)R^D D - a^{\min})/R^B$ , when the bank is sure to meet the capital requirement. For  $B > B^{***}$ ,  $MR^B = R^B$ .

With  $c > c^*$   $MR^B$  starts right away above the bond rate, and in the special case of  $c=1$  with the distribution uniform,  $MR^B$  is flat in the range  $[0, B^*]$ . This thus represents a very stiff enforcement of the capital adequacy regulation with such a penalty imposed in the case of inadequate capital that the bank owner/manager would in fact be fully liable. This is of course unlikely to be a feature of any real world capital regulation (Figure A3.1).

Figure A3.1

**Expected marginal return on bonds**



The kinky shape of the expected marginal return on bonds  $MR^B$  and the a priori rather unrestricted shape and position of the expected marginal return on loans schedule  $MR$  imply that many types of optima can exist, even if the portfolio is always assumed to contain loans. Thus there may be either  $S$  or  $B$  in the portfolio, depending on the precise shapes and positions of  $MR^*$  and  $MR^B$ .

When the portfolio is a corner solution,  $L=K+D$  or  $L=K+D+S^{\max}$ , loans are determined 1-to-1 by the exogenous funding  $K+D$  (and the maximum allowed amount of subordinate debt), and no other factors influence the optimum on the margin.

But the portfolio may also be defined by the marginal conditions  $MR^*=MR^B$  or  $MR^*=R^B$ . When the portfolio is defined by the marginal condition  $MR^*=MR^B$ , yet two alternatives are possible:  $MR^*$  can intersect  $MR^B$  either in the downward sloping section (in  $L$ ), where the bank is risky ( $F(a^D)>0$ ), or in the upward sloping section, where the bank is safe ( $F(a^D)=0$ ). If the intersection of the two schedules happens to take place in the upward sloping range, the relevant bond return function collapses to  $MR^B=R^B(1+cF(a^k))$ . If the intersection takes place in the downward sloping range of  $MR^B$  the  $F(a^D)$  term is also included. When the marginal condition is  $MR^*=R^B$ , yet different comparative statics are implied. The characteristics of the comparative statistics in the three types of interior solutions are shown in Table A3.1.

Table A3.1. **Comparative statics of L in interior solutions with  $c > 0$**

L determined by:	Exogenous variables							
	$R^B$	c	k	K	$R^D$	D	x	z
(a) $MR^* = R^B(1-F(a^D)+cF(a^k))$	-	-	-	-	+	-	+(-)	+(-)
(b) $MR^* = R^B(1+cF(a^k))$	-	-	-	+	-	+	+(-)	+
(c) $MR^* = R^B$	-	0	0	0	0	0	+(-)	+

+(-): both possible but + more likely

The fundamental reason for the very varied outcomes is the capital requirement. Should  $k=0$ , the  $MR^B$  schedule would never exceed  $R^B$  and only corner solutions or the solution with  $MR^*=R^B$  would be possible.

# Appendix 4

## The endogeneity of deposits

The endogeneity of a variable  $x$  can often be tested by the Hausman specification test (see eg Pindyck and Rubinfeld 1991). The test is done by estimating a reduced form equation for  $x$ , including the prediction of this equation in the equation for the endogenous variable, and testing for the significance of the prediction. This approach cannot however be used in our case, as it is very difficult to find instruments for  $x$  which would not be among the explanatory variables of the endogenous variable. Namely, if deposit growth is endogenous for a bank, it is likely to depend on exactly the same bank characteristics as loan growth. Only the demand side could provide useful instruments. However, in our cross-sectional data set one cannot find variables which would shift the demand for deposits but not the demand for loans.

We therefore examine the issue of deposit endogeneity by simply estimating for deposit growth an equation with the same explanatory variables as in the loan equation. If deposit growth can be explained as well by bank characteristics as loan growth, we conclude that deposits are endogenous. The results of such an exercise are reported in the A4.1. It turns out that the deposit growth cannot really be accounted for by bank characteristics to the same degree as loan growth.  $R^2$  is much lower for deposits than for loans. Furthermore,  $\chi^2$ -tests (F-tests cannot be used because of the heteroscedasticity correction) confirm this impression. Bank characteristics do not even as a group exert a significant effect on deposit growth, whereas they do so clearly for loan growth. To the extent the explanatory variables affect deposit growth, the effect stems from demand factors. The results suggest that deposit growth indeed can be considered exogenous in our analysis.

It is noteworthy that the same demand variables are significant in both equations. Interestingly, however, the coefficients in the loan equation are larger. This suggests that also the change in loan/deposit ratio is likely to depend on these demand variables.

Table A4.1

**Equation for loan growth and deposit growth**

Explanatory variables	Endogenous variable			
	gD9086 <sup>1)</sup>		gL9086 <sup>2)</sup>	
	coefficient	t-value	coefficient	t-value
Constant	61.5	3.74**	-2.61	-.11
K/A	-1.14	-1.43	-2.49	-1.97**
C/A	-3.18	-0.67	0.82	0.14
CPØ	-0.93	-0.41	5.95	1.69*
SIZE	0.78	0.48	3.35	1.26
ΔINC	0.31	3.17**	0.77	3.73***
ΔUNR	0.35	0.72	0.93	1.02
CONSTR	6.24	0.85	22.1	1.30
URPOP	14.2	1.97**	57.6	4.43***
CRIMPRO	9.27	0.69	93.8	2.64***
SBDUM:CONSTANT	-21.1	-1.06	-84.4	-2.65***
SBDUM:K/A	0.68	0.52	-1.93	-0.82
SBDUM:C/A	7.25	1.24	24.7	2.36**
SBDUM:CPØ	0.29	0.06	3.83	0.49
SBDUM:SIZE	-3.94	-1.51	1.45	0.30
Adj. R <sup>2</sup>	0.07		0.42	

	test statistic	significance level	test statistic	significance level
(a) $\chi^2$ -test for the significance of all slope coefficients	26.9	.020	158.4	.0000
(b) bank characteristics (excl. demand variables)	5.9	.822	71.7	.0000

a) Rate of growth of bank deposits between end-1986 and end-1990.

b) Rate of growth of bank lending between end-1986 and end-1990.



## Appendix 5

### The endogeneity of deposit rates and deposit volumes in the 1990s

The exogeneity of bank deposit rates and the deposit growth rates are tested by estimating equations for average deposit rate and average deposit growth rate for the period 1990–1992 that are analogous to the loan equation. The results are reported in Table A5:1. Both the deposit rate and the deposit growth rate depend significantly on bank characteristics. Thus treating these variables as exogenous would not seem justified in the 1990s.

A couple of interesting observations can be made about the equations. Deposit growth was, *ceteris paribus*, significantly weaker among the savings banks than the cooperative banks, even though the savings banks paid, if anything, higher rates on deposits than the cooperative banks. There is also a significant negative effect of nonperforming assets on deposit growth, particularly in the case of the savings banks. This suggests that bank risk affected banks' possibilities of obtaining deposit funding, while banks did not pay any risk premium on deposit funding. It is also noteworthy that large banks, *ceteris paribus* lost deposits in 1991 and 1992. Finally bank operating costs lowered the average deposit rate suggesting that investment in and usage of an extensive branch network indeed allowed banks to collect deposits that were 'cheap' in terms of interest costs.

Table A5.1 **Equations for the deposit rate ( $R^D$ ) and growth of deposits (GD)**

Dependent variable		$R^D$ (aver. 91-92)		GD9290 <sup>a)</sup>	
explanatory variable		coefficient	t-value	coefficient	t-value
CONSTANT	coops	7.60	17.5***	40.4	6.68***
	savings	7.84	15.1***	27.7	3.36***
CORRAT90		-0.02	-1.39	-0.05	-0.34
COST		-20.5	-4.43	-136.2	-2.26**
CGLOSS91		0.02	0.98	-0.29	-1.13
NPA91	coops	0.01	1.58	-0.12	-1.15
	savings	0.02	1.38	-0.47	-1.94*
BUSSHA	coops	-0.01	-1.87*	-0.12	-2.65***
	savings	-0.01	-0.73	0.07	0.63
DINC		-0.13	-0.66	6.10	1.30
DUNR		0.02	1.15	-0.61	-3.23***
CONSER		-0.15	-0.50	1.06	0.24
URPOP		0.27	1.57	-0.69	-0.25
CP0		0.01	0.02	0.58	0.54
SIZE		-0.05	-1.68*	-2.10	-4.06***
ADJ. $R^2$		0.26		0.30	
		test statistic	significance level	test statistic	significance level
$\chi^2$ -test for the significance of all slope coefficients		56.0	0.0000	104.5	0.0000
$\chi^2$ -test for the significance of bank characteristics		34.1	0.0000	61.4	0.0000

a) The rate of growth of bank deposits between the end of 1986 and the end of 1990.

# Appendix 6

## The operationalization of the exogenous variables in the loan equation

There are several possible operationalizations for the capital adequacy variable. In the theoretical model the exogenous capital concept is the ex ante equity capital invested by the owner-manager. The closest empirical counterpart of such a concept might be core capital or the Tier-I capital of the Deposit Bank Act or Credit Institution Act. Core capital scaled by risk-weighted assets is denoted by CORCAP. The capital concept is almost the same in the Deposit Bank Act and Credit Institution Act but the denominators differ a great deal from one another. In the analyses reported, the core capital concept is the estimated Tier-I capital required by the Credit Institution Act. CORCAP is rather close to the ratio of equity capital and reserves (provisions) to total assets, which was used in the examination of the boom period.

But also wider capital concepts may be relevant. The information banks produce to creditors and regulators typically emphasizes the total capital adequacy ratio required by the legislation, ie the ratio including in the numerator subordinated debt and other items which are classified as Tier-II capital. In Finland in the early 1990s, banks' capital adequacy was almost exclusively discussed in terms of the banks' total regulatory capital ratio.

Two alternative total capital adequacy ratios are examined. The first one (DBARAT) is specifically the capital adequacy ratio as defined by the Deposit Bank Act, in force from 1 January 1991 through 31 December 1993. The act required that banks hold a ratio at least 8 per cent. But as many banks did not fulfil the requirement at the time of enactment, a transition period through 1 January 1996 was allowed for such capital-deficient banks. Therefore many banks had DBARATs below 8 per cent in the period of the analysis. The second alternative, denoted BISRAT, is the ratio defined in the Credit Institution Act (CIA), in force since 1 January 1994. The new requirement abolished the favoured treatment in riskweighting of assets guaranteed by insurance companies and implied a significant tightening of the requirement compared to the DBA, particularly for the cooperative banks, which had widely used insurance company guarantees. The new ratio – denoted BISRAT – is fully compatible with EU regulations and close to the recommendations of the Bank for International Settlements (BIS). Banks

may have considered BISRAT more relevant already in 1991 and 1992 for two reasons. First, the banks which were authorized by the Bank of Finland (BOF) to conduct foreign exchange transactions were regulated also by the BOF, which required the banks to report their BIS capital ratios. Second, banks may have already prepared for the prospective regulatory change, which had been under discussion and preparation ever since enactment of the DBA.

The valuation and time of measurement of capital are not quite obvious either. The theoretical concept refers to the ex ante equity capital invested. The appropriate empirical counterpart would be the market value of bank equity at the beginning of the period of interest. Such a market value would take into account anticipated capital losses due to outstanding nonperforming assets. Given the conditions of the early 1990s, this would be highly desirable. However, no such market value data are available.

An alternative would be to use the ratio of some future observed capital to beginning-of-period (risk-weighted) assets. Such a measure, as used by Hancock and Wilcox, would incorporate anticipated changes in capital due to retained profits or losses (and anticipated issues of equity capital). But such a procedure would not incorporate anticipated changes in assets, which can be equally important, as banks certainly are aware of the amortization schedules of loans and can make projections about the use of loan commitments. To incorporate these, one would need to use the capital ratio as at some future date as such. But this in turn creates a potentially very serious simultaneity bias in the estimated relationship. Unexpected changes in the loan stock, due to delinquencies, unexpected use of loan commitments etc, increase loan stock while they at the same time lower the capital ratio: the simultaneity creates a spurious negative correlation between loan growth and end-of-period capital ratio. To eliminate this, one must use the instrumental variables approach.

Finally, in the period of interest there is a special factor that affected several banks' end-of-period capital stock. It is the capital injection by the Finnish government, FIM 8 billion in all in 1992. This measure certainly was not known in 1991, as it was decided in March 1992, and the terms were defined in June 1992. But it may nevertheless have affected loan supply in the second half of 1992. Furthermore, the banks that accepted the offer – 56 cooperative banks and 22 savings banks in the data set – may have expected tighter supervision than the banks in which no such government money was invested. Thus the behaviour of these banks may have differed from that of others. Therefore, when using capital dated at the end of 1992 one needs to deduct government-supplied capital and

examine its effects separately; the change in the appropriate capital concept due to the government capital injection is denoted by GOVK.

The cost variable (COST) is operationalized by the ratio of all costs other than interest expenses to the balance sheet total (average of beginning and end-of-year), just as in the previous chapter. It is dated at the beginning of the period of interest.

Three types of variables are used to depict the riskiness of bank lending. They all relate to a bank's existing portfolio. It is assumed that the riskiness of a bank's lending business is positively related to the amount of net credit and guarantee losses incurred (CGLOSS), outstanding nonperforming assets, NPA, and the share of business loans in all loans (BUSSHA). While CGLOSS and NPA can be assumed to reflect quite directly the riskiness of a bank's loan portfolio, the share of business loans does so only in so far as business loans indeed are riskier than other loans. Given the much higher default rates on business loans than other loans in the early 1990s, this seems well justified. However, the share of business loans may also proxy for the demand for loans independently of risk, provided the demand for business loans depends in a different manner than do other loans on the proper demand variables. CGLOSS and NPA are scaled in the estimations reported according to total risk-weighted assets and off-balance sheet commitments.

As the idea is to use CGLOSS and NPA variables to depict the perceived riskiness of bank lending, they should be dated at near the beginning of the period of interest. However, the data problems discussed prevent us from using any NPA data prior to the end of 1991 and any really meaningful CGLOSS data prior to 1991. Therefore the earliest possible dates are used. As the banks probably were aware of the writeoff needs for 1991 already some time during the year and probably followed the evolution of delinquent loans through 1991, the variable dating in this way probably reflects quite well the perceived risks of the existing loan stocks at the beginning of 1991.

The ratio of gross credit losses to loan stock (CLOSSG) is included in the regression to account for the 'technical' change in the loan stock due to the elimination from loan books of those loans that were written off during the period of interest. The typical procedure is that when a loan writeoff is effected, the loan as a whole is removed from the loan stock and the residual value (collateral value) is booked under some other item (cash, real estate, other receivables). CLOSSG differs from the earlier CGLOSS in that in CLOSSG only credit losses are included and no deduction is made for recoveries of previously booked losses and for credit insurance indemnities. The latter is a priori important, as many

credits by the local banks have been partially insured by mutual credit insurance companies.

Finally, demand and competitive conditions are proxied as in Chapter 3.

# Appendix 7

## The LAD regression and excluded observations

Table A7.1 **Lad results**

Capital concept		CORRAT92*		BISRAT92*		DBARAT92*	
Variable		coefficient	t-value	coefficient	t-value	coefficient	t-value
CONSTANT	coops	29.5	6.88***	28.3	6.46***	30.8	7.04***
	savings	15.1	2.93***	12.2	2.33**	15.8	3.09***
CAP		-0.48	-4.08***	-0.22	-2.09***	-0.27	-3.27***
GOVK		0.85	1.96*	0.99	2.25**	0.56	1.26
COST		-0.50	-1.43	-0.59	-1.65	-35.3	-1.04
CGLOSS91		-0.06	-0.28	-0.10	-0.46	-0.16	-0.73
NPA91	coops	-0.01	-0.21	-0.09	-1.31	-0.16	-0.24
	savings	-0.56	-6.13***	-0.56	-6.08***	-0.58	-6.33***
BUSSHA	coops	-0.17	-5.56***	-0.19	-6.04***	-0.18	-5.87***
	savings	-0.01	-0.08	-0.00	-0.08	-0.02	-0.31
DINC		0.91	0.26	-0.46	-0.13	-0.93	-0.27
DUNR		-0.16	-1.11	-0.20	-1.32	-0.21	-1.41
CONSER		3.09	1.81*	3.05	1.76*	2.74	1.59
URPOP		0.15	0.07	1.05	0.47	1.06	0.48
CP0		-1.81	-2.38**	-0.81	-1.06	-1.88	-2.46**
SIZE		-2.27	-6.60***	-1.97	-5.71***	-2.39	-7.01***
CLOSSG		-0.96	-2.34**	-0.67	-1.63	-0.75	-1.83*
ADJ. R <sup>2</sup>		0.43		0.43		0.44	
N		388		388		3.88	

Table A7.2 **Characteristics of the outliers**

Average	Outliers N = 10	Total sample N = 395
GL9290	32.7	4.7
BISRAT90	9.9	8.6
CGLOSS91	0.09	0.53
NPA91	4.4	8.2
L/D90	.86	1.04
ASSETS, millions of FIM	106.5	567.4

# Appendix 8

## Further regression results

Table A8.1 **Different capital concepts for 1992**

Variable	CAP = CORRAT91		CAP = BISRAT92*		CAP = DBARAT92*	
	coefficient	t-value	coefficient	t-value	coefficient	t-value
CONSTANT	coops 18.0	6.49***	17.8	6.10***	18.5	5.88***
	savings 14.5	4.31***	13.8	4.01***	14.0	3.99***
CAP	-0.22	-2.75***	-0.15	-1.83*	-0.14	-1.78*
GOVK	0.70	2.18**	0.70	2.14**	0.59	1.73*
COST	-38.9	-1.11	-42.6	-1.21	-40.5	-1.16
CGLOSS91	-0.02	-0.11	-0.01	-0.07	-0.00	-0.02
NPA91	coops -0.03	-0.70	-0.04	-0.87	-0.05	-1.10
	savings -0.35	-5.26***	-0.35	-5.14***	-0.35	-5.18***
BUSSHA	coops -0.12	-5.47***	-0.12	-5.47***	-0.12	-5.44***
	savings -0.11	-2.44**	-0.10	-2.35***	-0.10	-2.23**
DINC	2.34	0.97	2.59	1.06	2.77	1.13
DUNR	-0.33	-2.24**	-0.32	-2.13**	-0.30	-2.01**
CONSER	0.48	0.20	0.59	0.24	0.74	0.30
URPOP	-2.55	-1.80*	-2.56	-1.82*	-2.68	-1.88*
CP0	-1.34	-2.54**	-1.33	-2.53**	-1.33	-2.51**
SIZE	-1.10	-4.58***	-1.10	-4.50***	-1.14	-4.54***
CLOSSG	-1.22	-3.37***	-1.22	-3.37***	-1.17	-3.17***
ADJ. R <sup>2</sup>		0.43		0.43		0.43
N		381		381		381
Est. method		OLS		IV		IV
TESTS: Significance levels						
CAP & GOVK & COST						
		0.00		0.02		0.02
CGL & NPA	CB'S	0.76		0.68		0.53
	SB'S	0.00		0.00		0.00
CGL & NPA & BUS	CB'S	0.00		0.00		0.00
	SB'S	0.00		0.00		0.00
DEMAND		0.04		0.04		0.04

\*, \*\*, \*\*\* significant at the 10, 5 and 1 per cent level, respectively.



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