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Credit Crunch or Collateral Squeeze?

An Empirical Analysis of Credit Supply of the Finnish Local Banks in 1990–1992

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Abstract

The paper examines the determination of bank lending in the early 1990s with the data on 393 savings and cooperative banks. Particular attention is paid to the respective roles of bank capital and costs on the one hand and borrower quality on the other hand. The findings do not support the hypothesis of a general credit crunch caused by capital insufficiency. Some findings suggest, nevertheless, 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 addition there is some evidence that weak capital contributed positively to credit growth of some subset of banks in 1992. This moral hazard behaviour differs, however, from that observed in a companion paper 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 non-performing assets and not so weak that regulatory pressures had strongly constrained additional lending to ailing customers. These banks were typically cooperative banks rather than savings banks as in the 1980s. On the other hand, weak borrower quality - measured mainly by the share of non-performing assets - contributed significantly to the low growth and contraction of bank lending in 1991 and 1992. In sum, bank capital was not a major factor in the contraction of lending in the early 1990s but lending was significantly reduced by weak borrower quality.

Keywords: credit crunch, capital crunch, borrower quality, collateral squeeze, bank lending

Tiivistelmä

Paperissa tutkitaan pankkien luotonantoa 1990-luvun alussa 393 säästö- ja osuuspankin aineistolla. Erityisesti pyritään selvittämään pankin oman pääoman ja luotonottajien laadun vaikutusta. Tulokset eivät tue käsitystä pankkien pääomapulan aiheuttamasta yleisestä luottolamasta. Osin havainnot viittaavat kuitenkin siihen, että viranomaissääntely ja mahdollisesti toimintojen uudelleen organisoinnin aiheuttamat ongelmat ovat saattaneet rajoittaa säästöpankkien ja joidenkin osuuspankkien luotonantoa. Lisäksi löytyy hieman viitteitä siitä, että huono pääomatilanne lisäsi eräiden pankkien luotonantoa 1992. Tämä moral hazard -käyttäytyminen poikkeaa kuitenkin vastaavanlaisessa analyysissä 1980-luvun lopun osalta havaitusta moral hazard -il-

miöstä. Tällä kertaa "jälleensyntymispeliin" turvautuneet pankit eivät olleet oman pääoman ja luottoriskien suhteen huonoimpia pankkeja vaan pikemminkin "keskivälin pankkeja": liian heikkoja, jotta ne olisivat voineet kirjata järjestämättömiin saamisiin liittyvät tappiot täysimääräisesti mutta tarpeeksi vahvoja jotta viranomaisten puuttuminen ei pystynyt rajoittamaan lisäluotonantoa maksuvaikeuksissa oleville asiakkaille. Tällaiset pankit olivat tyypillisesti osuuspankkeja, ei 1980-luvun tapaan säästöpankkeja. Toisaalta luottoasiakaskunnan huono laatu, jota mitattiin lähinnä järjestämättömien luottojen osuudella, myötävaikutti merkittävästi luotonannon hitaaseen kasvuun ja supistumiseen 1991 ja 1992. Kaiken kaikkiaan pankkien omat varat eivät olleet merkittävä rajoittava tekijä luotoannon supistumisessa 1990-luvun alussa, mutta luottokohteiden huono laatu oli tällainen rajoittava seikka.

Avainsanat: luottolama, pääomalama, luottokelpoisuus, vakuusongelma, luotontarjonta

Contents

1 Introduction

Bank lending contracted in Finland by a quarter between the end of 1990 and the end of 1995. Many factors associated with the deep recession of the Finnish economy of this time have very likely contributed to this decline. But a preliminary aggregative analysis suggests that one factor may have been a shift banks' credit supply. Contraction of bank credit has been much more pronounced than contraction of other types of external finance of the private sector. Aggregate level interest margins applied to bank lending were on the increase in 1990 through 1993. Survey data indicate clear tightening of availability of credit in the private sector in the same period, and ancedotal evidence suggests that banks experienced difficulties in their refinancing in 1992 and early 1993 (Vihriälä 1995a).

Several potential reasons exist for a shift in banks' credit supply. The aggregate losses of the Finnish deposit banks in 1991 through 1995 were FIM 66 billion, which falls exceeds the total regulatory capital of these banks at the end of 1990. This put pressure on the sufficiency of bank capital with regard to both "market requirements" potentially imposed by unprotected creditors and "regulatory requirements" imposed by law. The latter constraint was in fact tightened with the introduction of the "BIS" type capital requirements in 1991 and their subsequent modification in the beginning of 1994. Even though banks in fact generally met the regulatory capital requirements thanks to a massive government intervention, the pressures on bank capital or net worth had a potential of reducing the supply of risky bank credit. A "credit crunch" or perhaps better "capital crunch" cannot be excluded a priori. The wholy new experience of mounting losses due to non-performing assets and outright write-offs may also have changed bankers' attitudes towards credit risk. Bankers very likely became much more aware of the existence of credit risk in a deregulated environment than they had been in the mid-1980s. Given the consequences of massive credit losses, bankers may also have become much more risk averse. A credit crunch may thus have resulted also due to a smaller willingness to allocate funds to risky lending, independently of banks' capital position.

But as already noted, changes in banks' supply behaviour is only one explanation for the contraction of bank credit. Two obvious alternatives exist. Given the high level of real rates of interest, substantial overcapacity in many production sectors, and weak short-term income prospects ia. associated with rapidly increasing unemployment, demand for credit by both firms and households can be assumed very weak in the beginning of the decade. Decline in credit may thus have been essentially a reflection of weak demand.

Another factor is borrower quality or creditworthiness. The erosion of asset values since the peak of the credit cycle in 1990 reduced firms' and households' net worth substantially. Simultaneously the high levels of real rates of interest on the existing stock of debt increased the debt service burden. For many firms having borrowed in foreign currency the depreciation of markka due to the devaluation of November 1991 and following the floating of the currency since September 1992 compounded these difficulties. As a result, the creditworthniness of many potential borrowers declined substantially in the first years of the 1990s.

Depending on the point of view, borrower quality can be regarded as both a supply phenomenon and a demand phenomenon. Lenders are likely to consider weakening of borrower quality a decline in effective demand, while potential

borrowers are likely to view the resulting higher prices and tighter terms as a decline of credit supply, see for example Akhtar (1994). In the modern literature on financial intermediation, the impact of borrowers' balance sheets on financial intermediation imply a deviation from the efficient situation. Projects requiring external finance cannot be realized in full as supply of external funds fails to be as elastic as it would be in complete markets with symmetric information, see eg. Bernanke (1993). Supply of credit may in these theories be disturbed equally by weak borrower balance sheets and by weak supply of intermediary credit due, say, to weak intermediary capital. Tirole and Holmström (1994) call the first type of intermediation problem "collateral squeeze" to be separated from "credit crunch" potentially associated with intermediary behaviour.

Even though conceptually different, changes in borrower quality and intermediary behaviour are likely to work simultaneously and reinforce one another. Thus a decline in asset values not only weakens the quality of the potential future borrowers but also induces credit losses which weaken lender capital and may change lenders' risk attitudes as noted above. Reduced supply of intermediary funds in turn is likely to worsen financial distress, and put pressure on asset values and thus on borrower quality. As a consequence, identifying the two forces separately is likely to be very difficult in any given historical episode.

Nevertheless, from a policy point of view separating these two mechanisms would be highly desirable. If the main issue is intermediary behaviour, regulatory policies and public bank support might be efficiently used to alleviate the adverse aggregate effects. On the other hand, if the dominant factors are associated with borrower balance sheets, selective measures to bolster banks' capacity and willingess to lend would probably not be very effective. More important would be to improve borrowers' balance sheets. To the extent influencing this is feasible at all in the short run, the effective measures are likely to be in the realm of macroeconomic policies rather than selective banking policies.

Given that there has been a massive government intervention through bank support, tightening of capital standards, some selective measures to alleviate borrowers' financial distress, and major reorientations in macroeconomic policies in Finland in the early 1990s, identifying the causes of the contraction of credit during this period could help assess the appropriateness of the adopted policy measures. On the other hand, given the exceptional depth of the financial crisis in Finland, the episode should provide a very informative test case for any theory about the role of financial factors in severe recessions.

The aim of this paper is to analyze the relative roles of credit crunch, borrower quality, and pure demand factors in the contraction of bank credit in 1991 and 1992 Finland. Although by credit crunch is meant a negative shift in the banks' credit supply for whatever reason other than change in the general level of interest, the focus is on the effect of bank capital on lending. What is being tested is thus the existence of a negative shift in lending due to weak bank capital - capital crunch - rather than a negative shift in general. However, also other potential reasons for a credit crunch than insufficient capital are discussed in the course of the analysis. The paper utilizes data on 313 cooperative banks and 82 savings.

The paper is organized as follows. In section two we discuss very briefly the basic approach of the existing credit crunch literature, the data that may be used to examine credit crunch in Finland, and the theoretical underpinnings of the analysis. In section three the specification of the test procedure is discussed including the exact

period of analysis and choice of variables and functional forms. Section four reports the empirical results on the loan equation, and examines the behaviour of subordinated debt. Conclusions of the analysis are summarized in section 5.

2 The framework of the empirical analysis

2.1 The approach of the credit crunch literature and its main shortcomings

The potential for changes in the intermediaries' supply of credit has been recognized long, and some economists have argued that such shifts in credit supply - credit crunches - have been also quantitatively important, see eg. Wojnilower (1980). However, prior to the 1990s, the shocks considered had primarily to do 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. Only a few studies exist about credit crunches in other economies.[1]

The American literature, recently been surveyd by Passmore and Sharpe (1994) and Sharpe (1995), has given rather mixed results. A rather widely accepted view on the basis of aggregate data seems to be that bank lending indeed contracted in the beginning of the decade more than demand conditions and the stance of monetary policy would have warranted, see Akhtar (1994), Lown and Wenninger (1994). However, time series analyses are fundamentally ill-suited to examine the precise reasons for such a "credit slowdown", as the main argument is that lending behaviour depends on bank and borrower characteristics. As a result, most studies have used data on individual intermediaries or some narrower aggregates of them (eg. different states of the U.S.). Many of these studies have discovered bank capital as an important constraining factor, ie. that the issue indeed is "capital crunch" (eg. Bernanke and Lown). Some studies have furthermore implicated capital regulation or rather its tightening through higher requirements or through stiffer enforcement as the reason for capital insufficiency (eg. Peek and Rosengren 1995a). However, the results tend to depend a great deal on how extensively the analyses control for other factors: the more explanatory variables are added the less important bank capital turns out to be in the regressions, see Berger and Udell (1994).

With a couple of exceptions, the 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,

[1] O'Brian and Browne (1992) include several Eurepan counties in their aggregate level analysis, Llevellyn and Drake (1994) examine credit slowdown in the UK, and Solttila and Vihriälä (1992) and Saarenheimo (1995) do so for Finland.

or because regulators impose costs on the banks, which do not meet regulatory capital requirements.

The basic approach of the literature is then to estimate with cross-section data a regression equation, where the dependent variable is growth of lending and the explanatory variables include a measure of capital of the lending institution and some other variables to control for other factors (mainly demand for credit). 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 capital crunch.[2] 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.

However, there are several potential problems in this methodology. An obvious purely empirical problem is that accounting for the factors which shift 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 looses informativeness due to aggregation. But, 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 the 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 credit supply, cross-section analysis may not tell much about the aggregate significance of such shifts in the credit supply of individual institutions.

Second, to the extent bank capital is endogenous, banks that opt for a rapid growth (relative to other banks) also may 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, as alluded to in the introduction, 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 the book-keeping practices), and these losses are strongly associated with the creditworthiness of the potential borrowers, which 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 just indicate that the potential customer base is of weaker creditworthiness than borrowers on avegare even though there were no difference in credit supply to borrowers of constant quality.

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[2] The natural approach of examining simultaneously the behaviour of prices and quantities is in the credit crunch studies excluded, as information about price of credit is very partial. Interest rates do not tell too much about the effective cost unless one can control for a number of usually missing factors, such as the maturity of the contract, the linkage of the rate to a reference rate, collateral etc.. The analyses therefore focus without exception on quantities.

Fourth, separating the role of regulatory actions from that of market pressures is all but straightforward. In particular, stiffer enforcement of capital requirements is likely to take place simultaneously with mounting creditor worries about bank solvency.

Finally, there are all the standard problems of econometric work relating to the specification of proxies for the 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 one is to clarify the theoretical basis of the analysis, which, as noted, usually is very vague. This paper aims at using both these avenues: to construct the data set 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.

2.2 The basic selection of data

One way to help the problems associated with cross-section analysis is to expand the data set to contain observations of cross-sectional unit at different points of time, ie. use panel data. For example, one might be able to identify the effect of capital from that of borrower quality much better if one 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 helped by such an expansion of data. Panel data have in fact been used in several American credit crunch studies, most notably by Berger and Udell (1994) but also eg. Hancock and Wilcox (1993) and Shrieves and Dahl (1995). And unsurprisingly, the results so obtained tend to differ significantly from those obtained with pure cross-section data.

Unfortunately, the Finnish circumstances limit very much the possibilites for a panel analysis. A major problem is the uniqueness of the experience with significant credit losses and depletion of bank capital. Significant materialization of credit risk is a wholy new phenomenon in Finland. Prior to 1991 banks typically booked very small credit losses. Apart from relatively stable macroeconomic conditions, this was presumably mainly due to tight regulation. On the one hand interest rate regulation encouraged the banks to use creditworthiness as the main criterion to ration credit. The regulation focusing on the average lending rate also allowed the banks to compensate for the unreceived interest earnings on non-performings loans with higher rate on other loans. More important probably was, nevertheless, the fact that interest rate and foreign exchange regulation allowed the real rates of interest become significantly negative at times of potential financial distress: borrowers vulnerable to financial distress were bailed out by transferring the burden to bank depositors, which did not have highly yielding alternatives for their savings.

A consequence of the small credit losses of the earlier times is that one cannot truly compare the response of banks to depletion of capital in the early 1990s to that

in different macroeconomic and regulatory conditions. The problem with the Finnish data is not simply that credit loss data are uninformative (variation in credit losses over time and across bank is mainly due to taxation), but compilation of some important data has started only in the 1990s. In particular, bank level data on non-performing (delinquent) assets exist only since the end of 1991. In addition, a couple other factors, discussed below, hamper using genuine panel analysis.

But the uniqueness, or rather the exceptional depth of the economic and financial crisis of the early 1990s may also help 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 suggesting about 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.[3] 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 high thus tying debtors to their existing lenders much more closely than in normal times.[4] Therefore, it would be very unlikely that borrowers turned down by their traditional lender would find alternative sources of bank credit.

Apart from expanding data in the time dimension, another natural way of helping the identification of the effects of intermediary characteristics from other factors, particularly those relating to the borrower quality, would be to combine data on banks with data on individual borrowers. However, problems of data avalability prevent such an exercise in the analysis of the Finnish episode.

But even though one may be limited to use essentially cross-section data on financial intermediaries, an appropriate choice of the intermediary units to be examined may help many of the aforementioned problems of inference. In the Finnish case, the so-called local banks ie. savings banks and cooperative banks, which supplied over 40 per cent of the bank loans of the private sector in the beginning of the 1990s, have several attractive features for an examination of the existence of credit crunch.

First, these banks specialize in lending to the domestic public, much more so than the commercial banks that also are active in the interbank market, securities market and - in some cases - foreign markets. Decisions related to lending are likely to be the main preoccupation of these banks. Consequently, should bank characteristics be important for bank lending at all, they should affect the lending decisions of these institutions particularly strongly.

Second, these banks operate for the most part in well-defined geographical locations. Therefore data on incomes, employment, and population structure are

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[3] Not only did all major banks incur sigificant 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 stiff by the banking community leading some highly capitalized small banks to turn down the offer.

[4] The results by Vesala (1995) 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.

available for the operation area of each savings and cooperative bank.These data can be utilized to control for conditions of loan demand faced by every observation unit much better than in many other studies using data on individual banks.

Third, bank capital can be regarded as essentially exogeneous in the short run for the savings banks and cooperative banks. These banks have been able to issue equity type of instruments only to a very limited extent, and even that only since 1991. Given the nature of these "basic fund shares" and "investment shares", these instruments have been of little interest to investors, and their significance has remained small. 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 incorporate the determination of subordinated debt into the analysis adequately, the problem of capital endogeneity discussed above should be greatly alleviated.

Finally, the data on the savings banks and cooparative banks should be statistically highly informative. These groups contain banks with highly different capital positions in the early 1990, some having eg. capital asset ratios of the order of 20 per cent, some posting such ratios of the order of 2 to 4 per cent, and some banks 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 the savings banks and cooperative banks to study the existence of credit crunch. However, restructuring of the banking sectors in the course of the banking crisis constrains effectively the use of data after 1992, as will be discussed in more detail below. The relevant bank level data are available only annually so that annual observations on the savings and cooperative banks over a period of two years, 1991 and 1992, form the basic data of the analysis.

2.3 The theoretical backgroud of the analysis

As noted, the tests of credit crunch typically are not based on any explicit theoretical model. One exception is the analysis by Peek and Rosengren (1995). They have a profit maximization model, where 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 deposits which decline. However, if the capital constraint binds, it also prevents issuing 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

betwwn the first quarter 1990 and the first quater 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 away from many important aspects. 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 safe securities B as an alternative asset (the balance sheet: $L + B = K + D$), assume that the return on loans apart from 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 in all circumstances. The result is thus qualitatively the same as in the unconstrained case of the Peek and Rosengren model. Thus, would 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 demonstate 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 the 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).

These two explicit models found in the literature suggest that one needs to be careful when setting up a test procedure for credit or capital crunch. An explicit model of bank behaviour clearly can help specifying 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.

The empirical work of this paper will be based on a specific model of bank loan supply, developed for the Finnish savings and cooperative banks in Vihriälä (1995b). It is a static model of value maximization where the bank faces a declining demand schedule for risky loans, based on the formulation of Dermine (1984). The model incorporates the main institutional features that have been relevant for the savings

and cooperative banks in the recent years. In particular capital regulation and the liability structure (including subordinated debt) are modelled so as to resemble as much as possible the relevant circumstances; the balance sheet is L + B = K + D + S + M, where S stands for subordinated debt, and M for money market debt.

The capital requirement is modelled in the same spirit as in Passmore and Sharpe: violating the required level of capital results in non-pecuniary 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 the contractual commitments vis-à-vis creditors) would lower the value of the bank assets ie. what would be available to the creditors.[5] Similarily, the model assumes symmetric information. Bank creditors and regulators know just as much as the bank about the probability distribution of bank earnings.

There are several differences between this model and that of Passmore and Sharpe. 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.[6] The bank's net worth is thus affected not only by the amount of capital there is in the bank to begin with but also by the costs of operation.

Secondly, the pricing of other senior bank liabilities than core deposits (money market debt M) is analyzed under two regimes. The first assumes fair pricing under risk neutrality ie. that the creditor always receives an expected return equivalent to the safe rate of interest. This does not allow any part of credit risk to be transferred to the holders of money market debt. The second pricing regime assumes a fixed increasing interest schedule of such bank liabilities.

Third, the consequences of capital insufficiency are allowed to vary. We analyze in addition to the situation of positive non-pecuniary penalties (as Passmore and Sharp do) also 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).The behaviour of bank lending under these assumptions is summarized in Table 1.

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[5] Passmore and Sharpe call the expected penalty imposed on the bank owners in the case of non-fulfilment of the capital requirement somewhat misleadingly "bankruptcy costs", even though the "bankruptcy event" has no effect on the value of bank assets as such.

[6] The negative of these costs could also represent the earnings from other banking business than lending, let us say securities trading, real estate speculation etc. Such earnings are likely to decline in times of weak economic activity and declining asset prices putting thus additional pressure on bank profitability.

Table 1. **Comparative statics of lending**

Penalty for capital insuffi-ciency	Pricing of non-deposit funding	Penalty	Required capital ratio	Equity capital	Deposit rate	Amount of deposits	Demand	Borrower quality
Positive	fair	-	-	+	-	+	+(-)	+
	fixed	-	-	+/-	+(-)	+/-	+(-)	+(-)
Zero	fair	..	0	0	0	0	+(-)	+
	fixed	..	0	+/-	+	+/-	+(-)	+(-)
Negative	fair	-	+	-	+	-	+(-)	+(-)
	fixed	-	+	+/-	-	+/-	+(-)	+(-)

+/-: both possible depending on circumstances
+(-): both possible, but + more likely

Given the central role of capital requirement, many results depend crucially on whether there indeed is a positive expected penalty for the violation of the requirement or not. If there is, the model implies a credit crunch due to a tightening of capital regulation. Both increasing the required amount of capital and increasing the expected penalty for the violation of the capital requirement reduce bank lending.

With given regulation and a positive penalty, the effect of a decline of the beginning-of-the-period bank capital, say due to credit losses experienced, and the effect of an increase in exogenous bank costs (decline in charter value), may also lead to a reduction in bank lending, but only in certain circumstances. More precisely, the begining-of-the-period capital has a positive impact on lending if the cost of the marginal liabilities increases steeply enough, and the exogenous costs have a negative impact on lending only if the pricing is fair. The difference of the effects of the two exogeneous components of bank net worth stems from the fact that an increase in bank costs unambiguously increases the likelihood that the bank defaults on its money market debt and thereby lowers the expected cost of money market debt with a given loan portfolio, while a reduction of the beginning-of-the-period capital leads to a need to increase money market funding to finance a given loan portfolio implying that the expected marginal benefit from changing the loan stock depends on the slopes of the loan return schedule and the money market debt cost schedule. Thus, a credit crunch can emerge in this constellation if bank equity diminishes or charter value decreases say due to an increase in the costs of core deposits. Similarily, a credit crunch can also emerge as a result of a decline in core deposits.

If the capital requirement penalty is zero, none of the three factors- the level of capital requirement, capital and costs - have any effect on lending, as long as the bank's marginal funding is fairly priced. Bank characteristics in fact do not matter at all, but lending is determined solely on the basis of loan demand and the going rate of interest. This corresponds to the Modigliani-Miller irrelevance theorem about the role of a firm's financial structure.

But the model also predicts quite the opposite responses of lending to capital and costs pricing of marginal liabilities does not respond adequately to bank risk or if perverse bank support policies reward capital insufficiency.

Apart from the effects of capital and costs also the standard responses to demand shocks and shocks to borrower quality fall out of the model. Borrower quality is here equivalent to the shape of the probability distribution of lending returns. A negative shift in borrower quality takes place, when the 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 reduce lending always with 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 the borrower quality weakens.[7]

The model's implication for the issuance of subordinated debt, the pricing of which is always assumed to be fair, is simple. If the bank's perception is that failure to meet the capital requirement will result in punishment, the bank that uses money market funding will always issue (at least) the maximum amount of subordinated debt counted as regulatory capital. As this maximum is determined by the amount of equity capital, also the total regulatory capital is effectively exogenous. However, if no penalty is perceived, subordinated debt does not differ in any way from senior debt and no specific amount of subordinated debt is predicted. With a negative penalty and fair pricing, the optimal subordinated debt is zero. Also with fixed pricing zero, some intermediate amount or the maximum amount of subordnated debt may result depending on the shape of the marginal cost curve and the loan demand schedule.

Under the assumptions of the model, the amount of subordinated debt the banks issue can thus be used as an independent test of the pricing of marginal liabilities and the stiffness of regulation. Finding that the banks using non-deposit credit instruments have used at least the maximum amount of subordinated debt that counts as regulatory capital suggests of fair or sufficiently steep pricing of money market debt and appropriately working capital regulation. By the same token, low shares of subordinated debt suggest of either too low pricing of money market debt or non-positive perceived penalties for violations of the capital requirement, or both.

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[7] Thinking of the typical financial crisis situation, in which borrower quality weakens, bank capital is depleted by credit losses, and perhaps regulation is tighteted to contain excessive risk taking, the model can produce several alternative responses of lending. Although weaker borrower quality and tighter regulation induce cut back of lending, 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 demand for credit.

3 Specification of the test procedure

3.1 Constraining factors

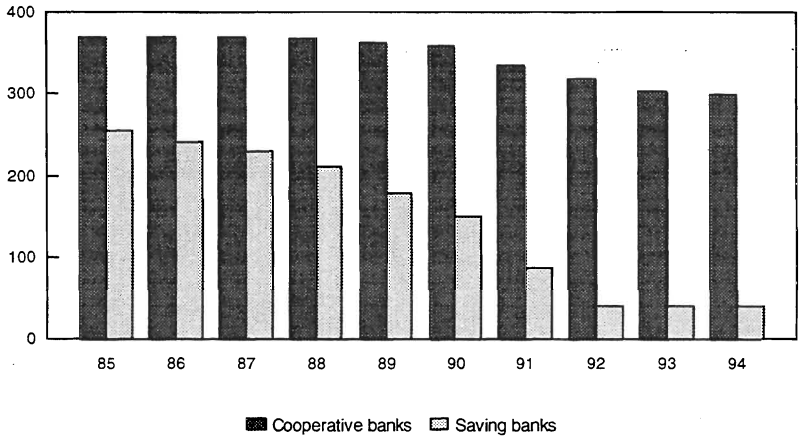
The theory discussed above suggests estimating an equation for bank loans, and using the estimated effects of bank capital and costs as a means of testing for the existence of a "credit crunch" due to capital or net worth problems. The companion paper (Vihriälä, 1996c) focusing on the effect of a potential mispricing of bank liabilities and the associated moral hazard on the growth of bank lending in the 1980s is based on the same theoretical model. It would therefore be natural to use the same formulation also in the analysis of the current problem, ie. conduct a uniform analysis of local bank credit supply since the mid-1980s. However, this is not possible.

As was discussed above, credit risk is a new phenomenenon in the Finnish banking market. Relevant data do not exist for the 1980s, and partly not even before the end of 1991. In addition, three factors importantly affect the period of analysis, the number of observations, and the choice of variables and functional forms. They effectively prevent a uniform analysis of banks' loan supply in the period of the mid-1980s through the early 1990s.

First, the number of the banks has declined substantially over the years. The number of cooperative banks declined from 338 at the end of 1990 to 303 at the end of 1993 due to mergers within the group. A much more radical change took place in the savings bank group. Mergers reduced the number of savings banks from 150 at the end of 1990 to 86 at the end of 1991. Furthermore, most of the larger savings banks merged to form Savings Bank of Finland (SBF) in the Autumn of 1992 reducing the number of independent savings bank units to 41 at the end of the year (Figure 1). And in the Autumn of 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-of-1993 loan books of the cooperative banks cannot be compared with those a year before.[8]

[8] Also some of the remaining savings banks were affected indirectly, as some savings bank customers rather trasferred their loans to another savings bank than to the designated buyer. As precice data on the loan transfers are not available, no useful analysis can be done with the 1993 data.

Figure 1. **Number of banks**



In order to maximize the number of observations, the analysis is conducted for 1991 and 1992 with the data on the cooperative banks that existed at the end of 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 even data about the post-merger situation. For the other, non-SBF savings banks, the 1992 data are for the year as a whole or the year end. To maximize the information about 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 have merged. As important data were missing on some banks, the analysis is conducted with the observations of 313 cooperative banks and 82 savings banks of the years 1990-1992.

Second, the empirical counterpart of the exogenous core deposits has very likely become much smaller in coverage in the early 1990s than it was in the 1980s. The changes in capital income taxation have allowed banks to price competitively a large fraction of their deposits. This part of the deposit stock has therefore become endogenous. Unfortunately, bank level data by types of deposits are not readily available. Therefore one can neither regard all deposits or their interest costs as exogeneous (as one could in the 1980s data) nor explicitely model their determination, see Appendix 1. As a consequence, it is not appropriate to use deposit growth or the average deposit rate as explanatory variables or use the loan deposit ratio as the dependent credit variable as was done in the companion paper.

Third, as will be discussed below, capital regulation was significantly modified in 1991 (and 1994). This makes difficult to use a uniform capital concept for a period extending from the mid 1980s to, say, 1992.

3.2 The loan equation and the main variables

As with most economic relationships, the theoretical model discussed above posits relationships between abstract concepts in a simple stylized world. To be able to investigate the hypotheses about credit crunch, collateral squeeze and demand factors, operationalizations for the theoretical concepts are needed and the functional form has to be specified. One also needs to control for factors that may affect the observed behaviour of lending but which have been abstracted away in the theoretical discussion.

The basic form of the equation for bank loans to be examined in this paper is

$$\frac{\Delta L}{L} = a + b \cdot CAP + c \cdot COST + d \cdot CGLOSS + e \cdot NPA + f \cdot BUSSHA + \Sigma g_i \cdot X_i + h \cdot CP0 + k \cdot L/D + l \cdot SIZE + m \cdot CLOSSG + \Sigma n_i \cdot DUMMY_i + \varepsilon,$$

where L refers to the loan stock, CAP is a capital adequacy variable, COST a variable reflecting the bank's operational costs, CGLOSSNET measures credit and guarantee losses and NPA non-performings assets, BUSSHA is the the share of business loans, X_i's are variables that shift demand for loans, CP0 is a measure of the competitive situation in the local market, SIZE describes the bank's size, CLOSSG reflects gross credit losses, $DUMMY_i$'s are dummy variables (intercept as well as slope dummies) that obtain a non-zero value for savings bank observations, a through n_i's are parameters to be estimated and ε an error term.

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 the 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.

The inclusion of the capital and cost variables falls directly out of the theoretical model. The capital adequacy variable has several possible operationalizations. 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-weigted assets is denoted by CORCAP.[9] CORCAP is rather close to the ratio of equity capital and reserves (provisions) to total assets, which often times is the capital concept used in empirical studies. This alternative was used in the companion study on the boom period.

But also wider capital concepts may be relevant. The information banks produce for 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, bank capital adequacy was almost exclusively discussed in terms of the banks' total

[9] The capital concept is almost the same in the Depent 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 an estimated Tier-I capital of the Credit Institution Act.

regulatory capital ratio: whether or not the banks met the 8 per cent minimum and how large the margins vis-à-vis this minimum were.

From the point of view of the buyers of senior bank debt such a wider concept may in fact be more relevant than the narrow core capital, even if no such role is given for it in the theoretical model. In the fair pricing version of the model, the buyers of money market debt require the same expected rate of return independently of how much subordinated debt the bank has. In the version with a fixed pricing schedule, no dependence between the pricing schedule and the amount of subordinated debt is specified. But in reality, with lemons premia, the cost and availability of senior funds are likely depend also on the amount of junior debt.

Two alternative total capital adequacy ratios are examined. The first one (DBARAT) is directly the capital adequacy ratio of the Deposit Bank Act in force 1 January 1991 through 31 December 1993.[10] 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 risk weighting of the assets guaranteed by insurance companies, and implied a significant tightening of the requirement with respect to the DBA, particularly for the cooperative banks, which had widely used insurance company guarantees. The new ratio - denoted BISRAT - is fully compatible with the 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 Bank of Finland (BoF) to conduct foreign exchange transactions, were regulated also by BoF, which required the banks to report the BIS capital ratio. Second, banks may have already prepared for the prospective change in the regulation, which was being discussed and prepared ever since the 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 were the market value of bank equity in the beginning of the period of interest. However, no such market value data are available.

An alternative would be to use the ratio of some future observed capital to the beginning-of-the period (risk-weighted) assets. Such a measure, as used by Hancock and Wilcox, would incorporate the 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 (whether explicit or implicit). To incorporate these, one would need to use capital ratio of 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 the end-of-the-period capital ratio. To eliminate this one needs to use an instrumental variables approach.

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[10] The act required the banks to hold the ratio at at least 8 per cent. But as many banks did not fulfil the requirement at the time of its enactment, a transition period through 1 January 1996 was allowed for such capital deficient banks. Therefore many banks had DBATATs below 8 per cent in the period of the analysis.

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 of FIM 8 billion in all in 1992. This measure certainly was not known in 1991, as it was decided upon in March 1992, and the terms of it 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 such banks may have differed from that of others. Therefore, when using a capital dated at the end of 1992 one needs to deduct the 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 other costs than interest expenses to the balance sheet total (the average of the beginning and the end of the year), just as in the companion paper. 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 the existing portfolio of the bank. It is assumed that the riskiness of a bank's lending business is positivelty related to the amount of net credit and guarantee losses incurred, CGLOSSN, the outstanding non-performing assets, NPA, and the share of business loans in all loans, BUSSHA.While CGLOSSN and NPA can be assumed to reflect rather directly the riskiness of the bank's loan portfolio, the share of business loans does so only in so far 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 differently than other loans on the used proper demand variables. CGLOSSN and NPA are scaled in the estimatations reported by the total risk-weigted assets and off-balance sheet commitments.[11]

As the idea is to use CGLOSSN and NPA variables to depict the perceived riskiness of bank lending, they should be dated at around the beginning of the period of interest. However, the data problems discussed prevent from using any NPA data prior to the end of 1991 and any really meaningful CGLOSSN data prior to 1991. These first possible dates are therefore used. As the banks probably were aware of the write-off needs for 1991 already some time during the year, and probably followed the evolution of delinquent loans through 1991, the variables dates this way probably reflect quite well the perceived risks of the existing loan stocks in the beginning of 1991.

Demand conditions are proxied with the same variables as in the companion paper ie. the rate of growth of income dINC, change in the unemployment rate dUNR, the share of construction and services employment in total employment CONSER , the share of urban population in total population URPOP. One may assume that this type of variables are more related to the potential borrowers' willingness to borror than the riskiness of such loans. But of course these variables also may signal of the riskiness of lending opportunities: low income, high

[11] Also scaling with bank capital is experimented with but the results of such analyses are not reported as the results do not differ qualitatively from those reported and give in general a marginally inferior fit.

unemployment, and say high share of the depressed services and constuction activity are likely to be associated with not only weak willingness to borrow but also with inability to service debt.

Also as in the earlier paper, the market conditions are characterized, in addition to the demand variables, by a variable that seeks to depict the competitive situation in every operation area. The variable CP0 obtains value 1, if none of the two main commercial banks of the time (KOP, SYP) has an office in the operation area of the bank considered, and 0 otherwise.

L/D depicts the loan deposit ratio in the beginning of the period. This variable is intended to capture possible adjustment effects of the loan deposit ratio to a common steady state value, if such a value exists.

A variable measuring bank size is also included. As in the companion paper, the variable used, SIZE, is the logarithm of the number of employees of the bank.

The ratio of gross credit losses to the loan stock, CLOSSG, is included in the regression to account for the "technical" change in the loan stock due to the elimination from the loan books of the loans, which have been subject to write-offs during the period of interest. The typical procedure is that when a write-off on a loan is made, 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 CGLOSSN in that in CLOSSG only credit losses are included and no deduction is made for recoveries of losses booked earlier and for compensations from the credit insurance. The latter is a priori important as many credits by the local banks have been partially insured by mutual credit insurance companies.

Finally, the dummy variables $DUMMY_i$'s are used to allow the constant term and the slope coefficient to differ between the savings banks and the cooperative banks, should that turn out to be important. The results of the earlier paper suggest that behaviour indeed may differ between the two banking groups.

Let us restate the tests. The credit crunch or more specifically capital crunch hypothesis implies that the coefficient of CAP should significant and positive. In addition, for the behaviour to be consistent, the COST variable should obtain a significant negative coefficient. Thus finding of no capital and cost effects or negative capital efects 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 the finding of no effect contradicts the hypothesis.

The demand-for-credit hypothesis implies that the demand variables obtain significant coefficients, the coefficient of income being positive and that of unemployment rate negative, or that at least combined their effect is significant. The signs of CONSER and URPOP are indeterminate. Finding no significant individual or combined effects suggests of weak role of the demand factors.

3.3 Some preliminary observations about the data

The data set contains banks with highly different characteristics. Lending growth between the end of 1990 and the end of 1992 varies from -30 per cent to +40 per cent, the regulatory capital ratio DBARAT at the end of 1990 from 4 per cent to 35 per cent, non-performing assets at the end of 1991 from 0 to 36 per cent of the risk-weighted assets etc. (Table 2).

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 all the time 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 the 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 by several times over. 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.[12]

Despite mounting credit and guarantee losses the average capital ratios remained relatively stable in the data set 1990 through 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 of 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 one another. Such a plot for the 1990–1992 rate of growth and the beginning-of-the-period 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 such a relationship requires analysis of all the relevant factors simultaneously.

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

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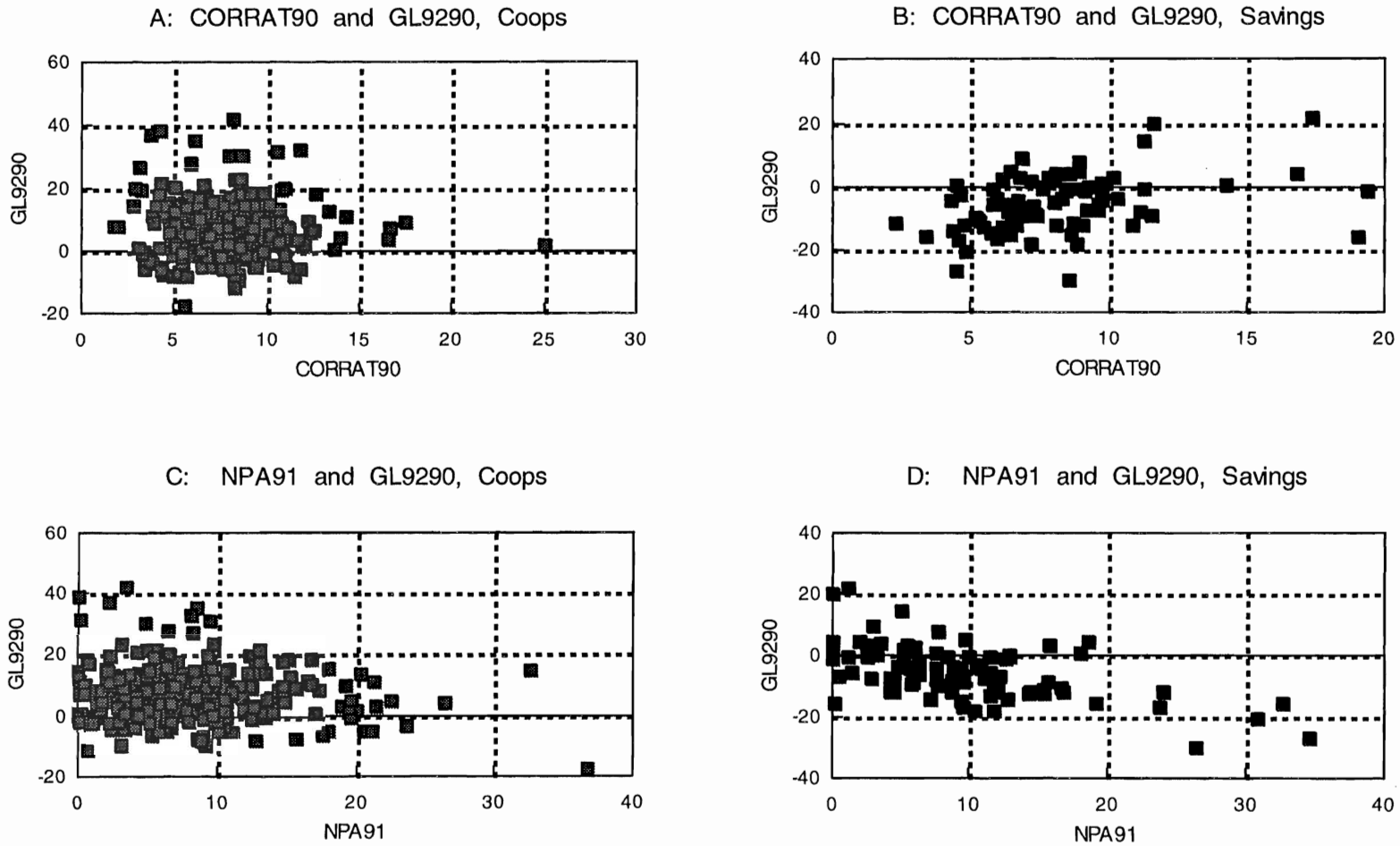
[12] An attempt to do so is nevertheless made to check to what extent the results obtained are sensitive to the extra loss of capital implied. This is based on the data of SBF losses by the 32 internal "SBF districts".

Table 2. **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
CGLOSSN91	0.42	-0.29	20.44	0.93	0.00	10.49
CGLOSSN92	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 of 1990 and end of 1992

Figure 2. **Lending growth against capital ratio and non-performing assets**



4 The empirical results

In what follows the empirical experiments are reported starting with the estimation of the loan equation (1). First, in section 4.1, we report the results concerning the whole period between the end of 1990 and the end of 1992. In this particular attention is paid to the statistical properties of the model. Section 4.2 examines the stability of the estimated loan relationship over time and the robustness of the results in some other ways as well. Section 4.3 summarizes the results on the loan equation. This is followed by a brief examination of the behaviour of subordinated debt in section 4.4.

4.1 The basic results for 1991-1992

As there are good reasons to believe that bank behaviour has differed between the two banking groups considered, the coefficients of all "bank related" variables ie. other variables than those associated with demand for loans or competitive situation are in principle allowed to differ across the two groups. This is done by including savings bank dummies for both the intercept and slope coefficients in a preliminary OLS regression.[13] To reduce the number of parameters to be estimated, the dummy variables which are insignificant at the 10 per cent significance level are then dropped. The OLS estimates of the parameters of the resulting equation with three savings bank dummy variables and three alternative capital variables dated at the beginning of the period are reported in Table 3. In all equations the government capital injection variable GOVK is included. In addition to the coefficient estimates and t-values, also the tests for the joint significance of four sets of coefficients are reported: (i) the capital and cost variables, (ii) the credit loss and non-performing asset variables, (iii) the credit loss, non-performing assets and business share variable, and (iv) the four demand variables. Given the difference allowed 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 have to be skipped resulting in the sample size of 388 observations.

The equations explain over 40 per cent of the variation of lending growth. This is less than what was obtained for lending growth over 4 years in the analysis of the boom period but of the same order of magnitude obtained for the subperiod 1988-1990. It also compares well with most credit crunch studies with cross-section data; Bernanke and Lown for example report equations with R^2 's of the order of 10 per cent.

None of the capital variables is significant. Neither is the cost variable. In fact, apart from constant (for the coops), only non-performing assets (savings banks), the share of business loans (coops) , bank size and the technical correction due to write-offs appear significant. The equation may nevertheless be seriously misspecified.

[13] Essentially the same result would have obtained if all parameters had been allowed to differ in the preliminary regression. The only exception is the coefficient of CLOSSN which in that case do not differ significantly between the two groups.

Although no heteroscedasticity is suggested by the White test, the Jarque-Bera test suggests that the error term cannot be considered normally distributed.[14]

Table 3. **OLS equation with the beginning-of-the-period capital Dependent variable GL9290**

		BISRAT90		DBARAT90		CORRAT90 (BIS)	
Variable		coef-ficient	t-value	coef-ficient	t-value	coef-ficient	t-value
CONSTANT,	CB'S	31.0	5.42***	29.9	5.16***	32.0	5.74***
	SB'S	12.1	1.89*	11.0	1.74*	13.3	2.05**
CAP:		.01	.08	.06	.54	-.06	-.34
GOV. CAP		.94	1.51	.97	1.56	.93	1.48
COST		-.45	-.01	2.00	.03	-4.26	-.07
CGLOSS91		-.23	-.68	-.23	-.67	-.22	-.67
NPA91	CB'S	-.08	-.89	-.08	-.90	-.08	-.87
	SB'S	-.46	-3.40***	-.46	-3.37***	-.46	-3.40***
BUSSHA,	CB'S	-.23	-5.54***	-.23	-5.56***	-.23	-5.52***
	SB'S	.01	.06	.00	.04	.00	.04
DINC		-4.32	-.97	-4.21	-.95	4.39	-.99
DUNR		-.33	-1.59	-.33	-1.59	-.33	-1.60
CONSER		.60	.18	.49	.15	.65	.20
URPOP		-.43	-.16	.34	-.12	-.46	-.18
CP0		-1.66	-1.62	-1.68	-1.64	-1.64	-1.60
L/D		.13	.04	.47	.18	-.23	-.09
SIZE		-2.32	-4.58***	-2.32	-4.56***	2.32	-4.57***
CLOSSG		-1.12	-1.99**	-1.14	-2.03**	-1.10	-1.96*
ADJ.R^2		.42		.42		.42	
WHITE, (sign. level)		.982		.986		.974	
JARQUE-BERA, (sign.level)		.00		.00		.00	
TESTS: Significance levels							
CAP & COST		.52		.46		.50	
CGL&NPA	CB'S	.05		.51		.52	
	SB'S	.00		.00		.00	
CGL&NPA	CB'S	.00		.00		.00	
&BUS	SB'S	.00		.00		.00	
DEMAND		.52		.53		.51	

As discussed above, measuring capital at the beginning of the period may not be appropriate. An obvious alternative is the end of the two-year period. The central results of such regressions are reported in Table 4. Now the effect of bank capital (excluding the government supplied capital) on lending appears to be significantly negative, irrrespective 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 discussed above. To overcome it, one needs to use instrumental variables approach in the estimation.

[14] For these diagnostic tests see White (1980), and Jarque and Bera (1980).

Table 4. **OLS equation with the end-of-period capital, the capital and cost effects**

Variable	BISRAT92* coef-ficient	BISRAT92* t-value	DBARAT92* coef-ficient	DBARAT92* t-value	CORRAT92* coef-ficient	CORRAT92* t-value
CAP:	-.31	-2.18**	-.21	-1.84*	-.61	-3.96***
GOV. CAP	.75	1.20	.65	1.02	.60	.97
COST	-24.8	-.42	-15.2	-.26	-46.4	-.80
ADJ.R^2	.43		.43		.45	
WHITE, (sign. level)	.515		.003		.876	
J-B, (sign. level)	.00		.00		.00	

* The government capital injection excluded.

However, before turning to the instrumental variables estimation, the problem of the indicated non-normality of the error terms must be tackled. Just as the coefficients of the other variables than capital are not affected by the change in the dating of the capital variables, the Jarque-Bera test suggests of non-normality of the error term also in the case of the Table 4 equation. A closer look reveals, that the residual series displays both non-zero skewness and kurtosis. There are outliers, the behaviour of which cannot be well described by the equation with a normally distributed error. Furthermore, the specification with DBARAT fails to meet the homoscedasticity assumption which also is required for the OLS to be efficient.

There are in principle two ways of handling the outlier problem. One is to simply discard a selected group of observations. The other one is to use some robust estimation technique. It has been shown that in many typical cases of non-normality, minimizing the sum of absolute deviations is superior to least squares, see eg. Harvey (1981). The least absolute deviations estimator (LAD) gives much less weight to far-away observations but does not discount them fully 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 4 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-the-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.[15] The excluded observations are typically small cooperative banks. The LAD results and some characteristics of the excluded outliers

[15] The exact procedure used was to discard observations the LAD residual of which was in absolute value more than 3, 2.5, and 2 times the standard deviation of the residual series, to run an OLS regression to check the Jarque-Bera statistic. 2.5 times the standard deviation was a sufficient limit for all equations (with different capital variables).

are reported in Appendix 2. The instrumental variables estimates are reported in Table 5.

Table 5. **Instrumental variables estimation with the end-of-period capital, 10 outliers excluded**
Dependent variable GL9290

		BISRAT92*		DBARAT92*		CORRAT92*	
Variable		coef-ficient	t-value	coef-ficient	t-value	coef-ficient	t-value
CONSTANT,	CB'S	26.4	4.60***	24.3	3.85***	26.4	4.74***
	SB'S	9.6	1.55	7.6	1.19	9.8	1.58
CAP:		-.06	-.34	.03	.22	-.08	-.39
GOV. CAP		.83	1.48	.92	1.54	.82	1.48
COST		-20.0	-.38	-13.3	-.26	-20.9	-.40
CGLOSS91		-.15	-.52	-.15	-.54	-.15	-.52
NPA91	CB'S	-.01	-.14	-.00	-.05	-.01	-.14
	SB'S	-.51	-4.27***	-.50	-4.13***	-.50	-4.27***
BUSSHA,	CB'S	-.19	-5.18***	-.19	-5.14***	-.19	-5.18***
	SB'S	.02	.31	.03	.34	.02	.30
DINC		-1.77	-.46	-2.05	-.52	-1.75	-.45
DUNR		-.20	-1.12	-.20	-1.10	-.20	-1.12
CONSER		.49	.18	.40	.14	.53	.19
URPOP		-2.71	-1.17	-2.58	-1.09	-2.69	-1.16
CP0		-2.06	-2.31**	-2.07	-2.30**	-2.05	-2.30**
L/D		1.06	.46	1.61	.67	.95	.40
SIZE		-1.75	-3.94***	-1.74	-3.86***	-1.75	-3.95***
CLOSSG		-1.21	-2.46**	-1.23	-2.49**	-1.21	-2.48***
ADJ.R^2		0.47		0.46		0.47	
TESTS: Significance levels							
CAP & COST		0.43		.45		.42	
CGL&NPA	CB'S	0.86		.86		.86	
	SB'S	.00		.00		.00	
CGL&NPA	CB'S	.00		.00		.00	
&BUS	SB'S	.00		.00		.00	
DEMAND		.56		.58		.56	

* Excludes the government capital injection

The IV results for the non-outlier sample resemble remarkably the OLS results for the whole sample. In particular, the capital variables and the cost variable again turn out insignficant 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 3, now the competitive situation matters; CP0 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 reestimated with the adjusted capital ratios as explanatory variable, 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 the local banks' loan stock appears to have been the smaller in 1991-1992, the more non-performing assets at the end of 1991 (savings banks), the more 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 operation area, contraction of credit was stronger. And even after accounting for these factors, the savings banks contracted lending in 1991-1992 stronger than the cooperative banks.

4.2 Stability over time and some other checks of robustness

With the drastic steepening of the economic crisis through 1991 and 1992, the banks' situation evolved rapidly. It is quite possible that bank behaviour as a result changed in response to mounting non-performings assets and credit losses and the general economic decline. To examine this possibility the equation with anticipated core capital (excluding the government capital injection) as the capital variable was estimated separately for 1991 and 1992. For the reasons discussed earlier, the credit and guarantee loss variable CGLOSSN and the non-performing 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 in Table 6.

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

The most striking difference concerns the effect of bank capital. While it remains insignificant in the first sub-period, it obtains a significantly negative coefficient in the 1992 regression. Instead, addition to capital through the government capital injection continues to be insignificant. The cost variable remains insignificant in all versions. Credit growth in 1992 reacts more negatively to non-performing assets and the the share of business loans than in 1991. Interestingly, the reaction of the savings banks changes sign. In 1991 the savings banks decreased lending the higher the share of business loans at the end of 1990 while in 1992 they decreased lending the higher that share was at the end of 1991 just as the cooperative banks. Demand factors also become significant in 1992 in contrast to 1991: unemployment and the share of urban population exerted negative impacts on bank lending in 1992.

Table 6. **IV estimates for 1991 and 1992 separately**

Period		Dependent variable GL9190		Dependent variable GL9291					
		CAP= CORRAT91		CAP= CORRAT92*		CAP= CORRAT92*		CAP= CORRAT92*	
Variable		coef-ficient	t-value	coef-ficient	t-value	coef-ficient	t-value	coef-ficient	t-value
CONSTANT	CB'S	8.82	2.25***	19.3	5.82***	21.6	5.86***	20.8	6.46***
	SB'S	-2.91	-.65	14.3	4.01***	16.2	4.05***	16.8	4.75***
CAP		.19	1.36	-.29	-3.15***	-.30	-2.98***	-.27	-3.00***
GOV. CAP		-	-	.39	1.17	.42	1.17	.60	1.86*
COST		-.17	-.48	-.57	-1.53	-.33	-.79	-.61	-1.65*
CGLOSS91		-.20	-.97	-.00	-.02	-.02	-.09	-.00	-.00
NPA	CB'S	-.20	-.39	-.00	-.00	-.03	-.48	-.03	-.73
	SB'S	-.21	-2.62***	-.33	-4.71***	-.33	-4.20***	-.33	-4.83***
BUSSHA,	CB'S	-.08	-3.18***	-.11	-5.20***	-.13	-5.52***	-.12	-5.59***
	SB'S	.09	1.73*	-.07	-1.68*	-.09	-1.83*	-.11	-2.49**
DINC		.96	.19	2.41	.97	1.49	.54	2.49	1.03
DUNR		.03	.16	-.30	-1.70*	-.42	-2.09**	-.40	-2.24**
CONSER		-.06	-.03	.76	.46	.72	.39	.66	.42
URPOP		.61	.37	-3.39	-2.46**	-2.59	-1.71*	-2.55	-1.92*
CP0		-.65	-1.05	-1.30	-2.44**	-1.23	-2.07**	-1.28	-2.48**
L/D		1.70	1.00	-1.20	-.80	-1.62	-.98	-1.51	-1.05
SIZE		-.74	-2.51**	-.88	-3.27***	-1.18	-3.99***	-1.02	-3.94***
CLOSSG		.72	-1.09	-1.23	-3.33***	-1.22	-2.99***	-1.19	-3.34***
ADJ. R^2		.29		.42		.39		.45	
SAMPLE		excl. 10 outliers		excl. 10 outliers		incl. outliers		excl. 7 outliers	
N=		378		378		388		381	
TESTS: Significance levels									
CAP & COST		.30		.00		.01		.00	
CGL & NPA	CB'S	.54		.99		.88		.75	
	SB'S	.02		.00		.00		.00	
CGL & NPA & BUS	CB'S	.011		.00		.00		.00	
	SB'S	.013		.00		.00		.00	
DEMAND		.99		.03		.08		.03	

* = end-of-1992 tier-I capital (BIS) excluding the government capital injection.

The capital effect in 1992 requires further examination to ascertain that it is not simply an artifact 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 observation and excluding observations that turned out outliers with the 2.5 standard error criterion in a LAD regression on the 1992 data. These results are reported in the last two columns of in Table 6. They show that the negative effect of capital on lending is not a result of a small number of outliers or their exclusion but is rather robust to small changes in the data set. In contrast, the effects of the government supplied capital and bank costs *are* sensitive to these changes in the data set. One should therefore not make any strong conclusion on these variables.

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 in the beginning of the period is used instead of the end-of-period CORRAT, qualitatively

the same result obtains. On the other hand, the relevant capital variable indeed seems to be the core capital. Unlike in the whole-period estimation, CORRAT now is superior to both BISRAT and particularly to BDARAT (Table A3.1 in Appendix 3).

Given the perverse effect of bank capital on lending in 1992, the question naturally arises, whether this phenonemon could 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" ones. The three splits are "bislow" banks ie. the banks whose BISRAT at the end of 1991 was below 8 per cent vs. "bishigh" banks (the rest), "npahigh" banks ie. the banks whose NPA ratio at the end of 1991 was above the medium value vs. the "npalow" banks (the rest), and finally the savings banks vs. the cooperative banks. The gist of the regression results are presented in Table 7, the full results in tables A3.2 and A3.3 of Appendix 3.

Two observations stand out from the sub-sample regressions. First, the equation explains much better the behaviour of the weak banks both in the capital ratio sense and the non-performing asset sense; the R^2 's are at least twice as high for the weak banks than for the strong banks. This suggests that bank capitalization and portfolio credit risks indeed were important for the banks' loan supply: For the banks whose capital position was strong or the share of problem assets low, the changes in the loan stock cannot be very well explained by the examined factors, while these factors exerted a strong influence on the weak banks' behaviour. Similarily the lending behaviour of the a priori weak savings banks can be much better accounted for than that of the 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 non-performing assets, but if anything, obtains among the strong banks. Similarily, the perverse effect obtains rather among the cooperative banks than among the savings banks which were on average plagued with much more serious asset quality and capital problems than the cooperative banks. This is in sharp contrast to the results of the companion study on the 1980s, which suggested that particularly the savings 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. However, as noted above the results concerning bank costs may not be very reliable as they are rather sensitive to small changes in the data set.

In any case, these findings suggest that to the extent there was a "gamble for resurrection" in 1992, and some of it 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 equivalent in Finland for the formal regulatory enforcement actions, which have been implemented in the U.S., 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 7. **Comparison of the capital and cost effects in subsets of banks**

	BISLOW		BISHIGH		NPAHIGH		NPALOW		SAVINGS BANKS		COOPERATIVE BANKS	
Variable	coef-ficient	t-value	coef-ficient	t-value	coef-ficient	t-value	coef-ficient	t-value	coef-ficient	t-value	coef-ficient	t-value
CAP: CORRAT92*	-.10	-.33	-.41	-3.11***	-.19	-1.66*	-.37	-2.47*	-.13	-.64	-.41	-4.13***
GOV. CAP	.75	1.34	.43	1.03	.31	.78	.99	1.71	1.60	1.79*	.00	.00
COST	-1.50	-2.20**	-.72	-1.59	-.65	-1.35	-.62	-1.04	-.16	-.22	-.91	-2.16**
ADJ. R^2	0.67		.29		.55		.25		.55		.22	
N	124		257		195		186		79		302	

The finding that bank capital had a statistically significant impact on bank lending only 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 the aggregate loan stock. A noteworthy finding is that unemployment seemed to affect only lending to the households, not that to the firms. The unemployment rate is thus likely to proxy for the willingness to borrow by the 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 the bank characteristics than that of the individual lending components. This gives some confidence that the aggregate loan variable focused in other empirical exercises indeed is the relevant loan concept.

4.3 Conclusions from the loan equation estimation

The estimation results do not contain any evidence of a credit crunch in the sense that bank capital had constrained bank lending in 1991 or 1992. No significant positive effect of bank capital on bank lending can be detected once one controls for the riskiness of bank portfolio and market conditions in the local market. Although in certain subsets of the observations a negative cost effect is found, this is not a robust results. These results do not depend on the exact definition of bank capital used; 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 stiffer for small than large banks, as the latter presumably have advantages of lower transctions costs in the capital market, and may also benefit from potential "too-big-to-fail" policies. The negative effect of bank size on growth of lending may in part have to do with differences in the composition of lending unaccounted for by the business share and demand variables. But may also reflect the weak deposit growth of the larger banks reported in Appendix 1. To the extent this is true, it suggests of a "credit crunch" due to financing difficulties for some other reason 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 in 1992 less lending. 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 1980s results. First, the perverse effects obtain only in 1992 but 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 but 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 and weak banks in general adopted a more conservative attitude towards lending, while among stronger banks, typically cooperative banks, there emerged an attempt overcome the difficulties of capital adequacy and delinquent assets through further extension of credit. The theoretical model suggests two reasons for these type of discrepancies. One is that the pricing of the weak banks' / savings banks' marginal funds became more responsive to risk, while no change or change in the opposite direction took place for the strong banks / cooperative banks. The other possibility is that regulatory pressures on the weak banks became much more stringend 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 the Autumn of 1991. The take-over of the Skopbank including an immediate dismissal of the top management by the authorities 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 the Skopbank and held by the savings banks. In 1992 about half of the savings bank unit 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 radically declined.[16] 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 the cooperative banks did not seem to have problems with their deposit funding either. On the other hand, the cooperative banks benefited, as did other banks, of the repeated signals of the authorities of their willingness to support the banking systems' liquidity and solvency.[17] Thus the lending decisions of the banks, which due to their weak state were not directly subject stringent regulatory control, may not have been too much constrained in 1991 or 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 non-performing 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 riskiness of lending opportunities, and perhaps as far as BUSSHA is concerned also pure demand effects ie. customers' willingness to borrow.

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[16] 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 too small write-offs.

[17] Examples of the readiness for bank support are the rescue of the Skopbank in September 1991, the Government offer of capital injection and the establishment of the Government Guarantee Fund in the Spring of 1992 and the Government's statement about the support of the banking system in August 1992.

However, unlike in the analysis of 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 growth of lending 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 plans. Thus most genuine demand side impulses came from the 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 to cut lending than otherwise.

5 Subordinated debt

As was discussed in section 2, subordinated debt may also be informative about the pricing principle of banks' marginal liabilities or enforcement of capital regulations. In Vihriälä (1996c) it was shown that the subordinated debt volumes issued by the cooperative banks and savings banks were consistent with the hypothesis that either money market debt was underpriced or the banks did not expect any positive penalties for capital insufficiency or both. These conclusion was particularly clear in the case of the savings banks. Importantly, the findings about subordinated debt were in line with the premise of the model that demand for subordinated debt is highly elastic: the 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 towards 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 8).

Table 8. **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 greater than the regulatory maximum = 0.5, "SUBSHA"	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 not anymore willing to absorb additional issues without significant lemons premia. Thus although the banks now would 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 over Tier-I capital would be negatively associated with the 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 9 reports equations for the change in the ratio of subordinated debt over Tier-I capital (ΔSUBSHA) in the period end of 1990 - end of 1992. The behaviour of the cooperative banks' subordinated debt is essentially random, only 3 per cent of variation can be explained by the beginning-of-the period SUBSHA, L/D and CORRAT90, NPA91 as well as by size. Of these only CORRAT90 obtains a significant - negative - coefficient suggesting of a continued - and at least to some extent succesful - attempt of the weakly capitalized banks to add to capital through 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 9. **Simple models of subordinated debt**

OLS equation for the change in SUBSHA 1990-1992[a)]

	COOPS	SAVINGS
Constant	.03	-.29
	(.42)	(-3.19***)
SUBSHA90	-.01	.25
	(-.16)	(.44)
L/D90	.00	.22
	(.03)	(2.55)
CORRAT90	-.006	.002
	(-2.01**)	(.76)
NDA91	.001	-.006
	(.38)	(-2.32**)
SIZE	.016	.034
	(1.58)	(3.30***)
$\bar{R}^2$	.03	.28

[a)] 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.

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, non-performing 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 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 yields at issue suggest of no subordinated debt premium in the yields relative to senior debt. 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.

In sum, the observations about 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. Now savings banks were in relative terms somewhat more active in the issuance of net debt. This change also seems to be consistent with the observed differences in the 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 on the issuers of subordinated debt by the investors 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 regulaory maximum in 1991 and 1992 reflected unwillingness of the cooperative banks to do so.

6 Conclusions

The estimation results of a reduced form loan growth equation on cooperative and savings bank data do not give support to the hypothesis of a credit crunch or capital crunch in the sense that bank capital had 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. Consistently with this, in general bank costs failed to have a negative impact on bank lending.

The results thus overturn the findings by Solttila and Vihriälä (1992), which suggested of a statistically significant even though quantitatively weak capital crunch in 1991. Their analysis was nevertheless based on only the savings banks data, controlled for the demand factors only very roughly and and not at all for the competitive conditions. Furthermore, in the statistically best formulation of their analysis, the capital concept used incorporated the anticipated effect of non-performing 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. These differences in the results are in line with much of the American literature on the credit slowdown in the early 1990s. Once risk and demand factors are brought to bear, the constraints imposed by bank capital appear less important (Berger and Udell, Lown and Wenninger).

In the present analysis high credit risks of lending and weak demand for credit were the main factors behind the weak growth (the cooperative banks) and decline (the savings banks) of lending in 1991 and 1992. In other words, weak borrower quality or "collateral squeeze" combined with the unwillingness of creditworthy borrowers to borrow dominated the overall behaviour of credit. Also the competitive situation appears to have played a role: the presence of commercial banks in the local market had a positive effect on the local banks' extension of credit. Finally, even taking into account the effects of risk, demand and competition, savings banks contracted lending more than the cooperative banks.

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 nature: weak capital induced banks to increase lending. This suggests that the factors which were likely to create the moral hazard problem of 1980s - implicit creditor protection and insufficiently stiff regulation or perhaps better inadequate enforcement of regulations - had not at least fully disappeared by 1992. It seems however that these factors had not remained unchanged either.

The negative effect of bank capital on lending appears to hold only in 1992 of the two years and only for some subset of the banks examined. Furthermore, the government capital injection of 1992 does not seem to be associated with a negative lending effect. The perverse effect can be found rather among the strong banks in terms of capital asset ratios and the 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 to the savings banks and weak banks in general. Bank behaviour appears to have changed in the early 1990s.

A reasonble explanation is that in the early 1990s pressures from both the creditors and regulators started to limit the weak banks' and particularly the savings banks' possibilities and willingness of risk taking while such pressures were small or non-existent for stronger banks ie. typically cooperative banks.

Although in general the creditors continued to believe in the banks' creditworthiness, probably not least thanks to the strong public sector support to the banking system, the savings banks experienced some loss of deposits in 1991 and 1992. In contrast, the cooperative banks did not seem to face such problems. Similarily, risky savings banks (the banks with high shares of non-performing assets) failed to increase the use of subordinated debt to improve the 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 started to be paid to the savings banks through 1991 and in 1992. Particularly the close scrutiny and the ultimate take-over of the 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 a failure to satisfy the supervisors' 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 lending strongly 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 towards the better capitalized banks or banks with lesser credit risks on the balance sheet. Among these banks, typically cooperative banks, an element of "gample for resurrection" can be detected in 1992: the lower the capitalization, the more expansive credit supply. The best banks presumably had no need to continue financing customers in financial distress but could take the losses without endangering their posted capital adequacy ratios. In contrast, the banks which were not so weak as to be closely constrained by either the regulators or the creditors, but which nevertheless could not take the pending losses without violating the capital adequacy constraint played for time by financing the customers with difficulties in debt service.

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Appendix 1

The exogeneity of deposit rates and deposit volumes

The exogeneity of bank deposit rates and the growth rates of deposits are tested by estimating analoguous equations for the average deposit rate and the average deposit growth rates for the preiods 86-90 and 90-92 as for the loan equation. The results are reported in the Table A1:1. Cross-sectional variation in both the deposit rate and the deposit growth rate cannot really well explained by the examined bank characteristics in the 1980s, the R^2 's are .10 and .07, respectively. In contrast, in the 1990s both the deposit rates and the growth rates of bank deposits depend much more on bank characteristics. These conclusion remains the same if the interest rate and the growth rate are considered annually. Thus treating these variables exogenous would not seem justified in the 1990s.

A couple of interesting observations can be made about the 1990s equations. Just as in the 1980, bank operation costs lowered the average deposit rate suggesting that investment in and the usage of an extensive branch network indeed allowed banks to collect deposits deposits which were "cheap" in terms of interest costs. The significance of the coefficient of the share of business loans presumably simply reflects the fact the that banks lending heavily to businesses also obtain higher shares of zero or low yielding demand deposits of the firms. Interestingly, the banks with a high loan-deposit ratio at the end of 1990 payed clearly higher deposit rates subsequently while no such relationship existed in the 1980s. This suggests that such banks attempted to increase their deposit funding by price competition in the 1990s. This also seems to have been successful in a degree, as there is a significant positive effect of deposit rates on the deposit growth in the 1990. However, there is also a significant negative effect of non-performing assets on deposit growth, particularly in the case of the savings banks. This suggests that bank risk affected the 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.

Table A1.1 **Equations for the deposit rate R^D and growth of deposits GD**

Dependent variable / explanatory		R^D (aver. 87-90)		R^D (aver. 91-92)		GD9086		GD9290	
Variable		coef-ficient	t-value	coef-ficient	t-value	coef-ficient	t-value	coef-ficient	t-value
CONSTANT	CB'S	.063	12.7***	.068	18.4***	1.69	15.1***	7.08	.84
	SB'S	.067	13.4***	.072	17.1***	.49	.03	-5.56	-.59
K/A86		-.00	-.47			-.50	-.73		
CORRAT90				.00	.11			.09	.60
COST		-.18	-2.60***	-.15	-4.02***	4.43	2.41**	-.25	-.40
CGLOSS91				.00	.92			-.38	-1.26
NPA91	CB'S			.00	.34			-.18	-1.99**
	SB'S			.00	.21			-.61	-4.39***
BUSSHA	CB'S			$-7.1e^{-5}$	-2.80***			-.11	-2.56**
	SB'S			$-8.2e^{-5}$	-1.57			.07	.77
DINC		.003	.79	-.001	-.39	41.3	4.99***	6.71	1.48
DUNR		-.000	-.15	.000	1.28	.39	.78	-.69	-3.32***
CONSER		-.006	-1.43	-.002	-.88	1.55	.15	.99	.20
URPOP		-.002	-.67	.003	1.56	4.85	.81	-1.71	-.60
CP0		-.002	-2.38**	.000	.08	1.32	.59	.60	.57
L/D		-.002	-.79	.008	5.03***	25.8	4.08***	4.76	1.73*
SIZE		.00068	1.79*	-.00	-.00	.36	.36	-2.63	-5.31***
R^D (over 87-90)						1.28	.97	3.74	4.37***
ADJ. R^2		.07		.31		.10		.35	

Appendix 2

The LAD regression and excluded observations

Table A2.1 **The lad results**

		CORRAT92*		BISRAT92*		DBARAT92*	
Variable		coefficient	t-value	coefficient	t-value	coefficient	t-value
CONSTANT	CB'S	35.5	7.20***	33.7	6.72***	38.5	7.72***
	SB'S	19.6		16.3		22.3	
CAP		-.54	-4.55***	-.30	-2.75***	-.33	-4.20***
GOV. CAP		.49	1.09	.71	1.57	.43	.94
COST		-.99	-2.69**	-.89	-2.40**	-1.05	-2.84***
CGLOSS91		-.13	-.59	-.10	-.44	-.13	-.57
NPA91	CB'S	-.02	-.26	-.06	-.96	-.03	-.49
	SB'S	-.54		-.51		-.53	
BUSSHA	CB'S	-.17	-5.72***	-.17	-5.59***	-.18	-5.92***
	SB'S	.02		.02		-.01	
DINC		.65	.19	-.68	-.20	-.88	-.26
DUNR		-.20	-1.39	-.30	-2.01**	-.31	-2.06**
CONSER		1.53	.89	2.89	1.66*	3.11	1.80*
URPOP		.22	.09	1.39	.62	.69	.31
CP0		-1.49	-1.98*	-1.73	-2.26**	-1.88	-2.46**
L/D		-3.94	-2.62**	-3.79	-2.55**	-5.13	-3.44***
SIZE		-1.71	-4.89***	-1.68	-4.77***	-1.76	-4.99***
CLOSSG		-.73	-1.73*	-.82	-1.93*	-.65	-1.53
ADJ. R^2			.43		.43		.44
N			388		388		3.88
TESTS: Significance levels							
CAP & COST			.00		.03		.00
CGL & NPA	CB'S		.52		.38		.46
	SB'S		.00		.00		.00
CGL & NPA &	CB'S		.00		.00		.00
BUS	SB'S		.00		.00		.00
DEMAND			.48		.32		.25

Table A2.2 **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 3

Further Regression Results

Table A3.1 **Different capital concepts for 1992**

Variable		CAP = CORRAT91 coefficient	t-value	CAP = BISRAT92* coefficient	t-value	CAP = DBARAT92* coefficient	t-value
		excl. outliers					
CONSTANT	CB'S	19.8	6.27***	20.1	5.97***	16.9	4.93***
	SB'S	16.1	4.55***	15.4	4.27***	12.9	3.65***
CAP		-.25	-2.95***	-.17	-2.01**	-.05	-.78
GOV. CAP		.69	2.13**	.58	1.79*	.67	2.02**
COST		-.51	-1.39	-.64	-1.71*	-.38	-1.04
CGLOSS91		-.02	-.17	-.00	-.00	-.03	-.17
NPA91	CB'S	-.02	-.47	-.04	-.78	-.05	-1.16
	SB'S	-.34	-4.88***	-.34	-4.93***	-.33	-4.78***
BUSSHA	CB'S	-.12	-5.47***	-.12	-5.69***	-.10	-4.82***
	SB'S	-.11	-2.39**	-.10	-2.35**	-.10	-2.28**
DINC		2.23	.91	1.97	.80	1.55	.64
DUNR		-.33	-2.22**	-.42	-2.33**	-.41	-2.33**
CONSER		.56	.35	.69	.42	.62	.39
URPOP		-2.53	-1.88*	-2.46	-1.83*	-1.67	-1.25
CP0		-1.36	-2.58**	-1.17	-2.24**	-1.31	-2.54**
L/D		-1.46	-1.00	-1.12	.78	.68	.48
SIZE		-1.01	-3.88***	-.90	-3.43***	-1.05	-4.09***
CLOSSG		-1.23	-3.40***	-1.21	-3.37***	-.96	-2.61***
ADJ. R^2		.43		.43		.43	
N		381		380		378	
Est. method		OLS		IV		IV	
TESTS: Significance levels							
CAP & COST		.00		.06		.48	
CGL & NPA	CB'S	.87		.73		.48	
	SB'S	.00		.00		.00	
CGL & NPA & BUS	CB'S	.00		.00		.00	
	SB'S	.00		.00		.00	
DEMAND		.04		.04		.09	

Table A3.2 **1992 IV estimates for weak and strong banks**

		BISLOW		BISHIGH		NPAHIGH		NPALOW	
Variable		coef-ficient	t-value	coef-ficient	t-value	coef-ficient	t-value	coef-ficient	t-value
CONSTANT	CB'S	23.1	5.41***	23.9	5.47***	21.0	4.82***	21.8	4.09***
	SB'S	18.6	3.17***	15.6	3.24***	15.9	3.20***	16.3	2.94***
CAP: CORRAT		-.10	-.33	-.41	-3.11***	-.19	-1.66*	-.37	-2.47**
GOV. CAP		.75	1.34	.43	1.03	.31	.78	.99	1.71*
COST		-1.50	-2.20**	-.72	-1.59	-.65	-1.35	-.62	-1.04
CGLOSS91		-.21	-.87	.12	.65	.00	.07	-.10	-.13
NPA91	CB'S	-.05	-.64	-.05	-.80	-.10	-1.49	.01	.05
	SB'S	-.30	-3.57***	-.09	-.71	-.37	-4.12***	-.18	-.44
BUSSHA	CB'S	-.07	-1.66*	-.15	-5.75***	-.09	-3.08***	-.14	-4.29***
	SB'S	-.09	-1.46	-.07	-1.03	-.06	-1.06	-.11	-1.50
DINC		3.78	.98	1.43	.45	1.28	.51	4.55	.64
DUNR		-.39	-1.23	-.47	-2.23**	-.46	-2.00**	-.31	-1.09
CONSER		3.31	1.67*	-1.91	-.73	2.88	1.09	.78	.35
URPOP		-5.00	-2.20**	.80	-.47	-4.67	-2.52**	-2.09	-1.01
CP0		-1.66	-1.72*	-1.18	-1.90*	-1.62	-2.11**	-1.11	-1.46
L/D		-5.28	-2.20**	.62	.34	-3.43	-1.92*	.44	.18
SIZE		-.28	-.63	-1.35	-4.06***	-.58	-1.75*	-1.62	-3.27***
CLOSSG		-1.62	-3.14***	-.97	-1.84*	-.90	-2.35**	-1.84	-2.05**
ADJ. R^2		.67		.29		.55		.25	
N		124		257		195		186	
TESTS: Significance levels									
CAP & COST		.09		.00		.15		.04	
CGL & NPA	CB'S	.51		.63		.32		.99	
	SB'S	.00		.63		.00		.89	
CGL & NPA & BUS	CB'S	.17		.00		.00		.00	
	SB'S	.00		.63		.00		.50	
DEMAND		.09		.15		.04		.52	

Table A3.3 **1992 IV estimates for savings banks and cooperative banks**

	SAVINGS BANKS		COOPERATIVE BANKS	
	coef-ficient	t-value	coef-ficient	t-value
CONSTANT	11.9	2.07*	21.9	5.82***
CAP	-.13	-.64	-.41	-4.13***
GOV. CAP	1.60	1.79*	.00	.00
COST	-.16	-.22	-.91	-2.16**
CGLOSS91	-.96	-2.56**	.19	1.22
NPA91	-.13	-1.61	-.05	-.99
BUSSHA	-.04	-.86	-.12	-5.71***
DINC	2.49	.59	2.35	.82
DUNR	-.11	.27	-.54	-2.78***
CONSER	-1.63	-.52	1.61	.88
URPOP	-3.64	-1.14	-2.08	-1.43
CP0	-.38	-.23	-1.12	-2.07**
L/D	-6.02	-2.05**	.12	.07
SIZE	-.34	-.66	-.87	-2.67***
CLOSSG	-.96	-.84	-1.62	-4.24***
ADJ. R^2	.55		.22	
N	79		302	
TESTS: Significance levels				
CAP & COST	.79		.00	
CGL & NPA	.00		.35	
CGL & NPA & BUS	.00		.00	
DEMAND	.55		.03	

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