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JOB MARKET PAPER

Market concentration and loan portfolios in commercial banking

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Abstract

This paper estimates the relationship between market concentration in commercial banking and the riskiness of bank loan portfolios. I use the unprecedented changes in the degree of competition in local banking markets that occurred between 1980 and 1994 to estimate the impact of market competition on the risk profile of commercial bank lending. I find evidence that increasing concentration has been associated with reductions in the flow of bank capital to construction and land development loans, which are the highest-risk category of commercial bank loans. The magnitude of this effect is large: an increase in concentration from the 25^{th} to the 75^{th} percentile is associated with a 20 percent drop in the share of bank lending going to construction loans. Robustness to a variety of control and instrumental variables strategies supports a causal interpretation of this empirical relationship. Increasing concentration also appears to increase average bank capitalization, raise the average share of assets loaned out to borrowers, and reduce bank failure rates during this period. Because the Federal Deposit Insurance Corporation stands ready to assume the assets and liabilities of failing banks, changes in bank portfolio risk affect the value of the government's contingent liability to the banking sector, as well as the health and stability of the financial sector and the larger economy.

JEL Classification: G2; G3; L1; L5

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The period between 1980 and 1994 saw large changes in the degree of competition in local banking markets. These changes stemmed in part from more permissive government policy toward mergers and geographic expansion in the banking sector, increases in the rate at which new banks were chartered, and rising rates of bank failure. Across local banking markets, concentration moved in different directions; some metropolitan areas saw increasing banking sector concentration, while in other markets concentration fell. The relevance of observed market concentration as a measure of competition may also have fallen during this period, as almost all states enacted legislation that eased long-standing restrictions on the geographic expansion of banks and expanded the scope for potential competition to impact incumbent banks in local markets.

I use this recent historical record to estimate the relationship between market concentration and the risk profile of commercial bank lending. I find evidence that increasing competition, while reducing the overall share of assets that banks lend out, leads banks to shift lending toward the types of loans that have historically been most risky. This shift is associated with increasing overall portfolio risk and risk of bank failure. Because the federal government, through the Federal Deposit Insurance Corporation, stands ready to assume the assets and liabilities of failing banks, government policy that affects market concentration thus affects the value of the contingent liability from the government to the banking sector. Merton (1977), Kane (1985), and Boskin (1988) have pointed out that this contingent liability represents a very real and measurable cost borne by the federal government, though it is not explicitly accounted for in the official government budget

This paper is designed to evaluate two potential mechanisms through which concentration may affect bank risk and lending activity. The first mechanism, prominent in the FDIC’s evaluation of the bank failures of the period, is that increasing competition erodes the value of existing banks and increases their willingness to invest in more speculative assets. However, if the return on safe assets is relatively unaffected by local market concentration, then competition may shift lending *away* from some risky loans. One mechanism for this effect, prominent in recent work by Petersen and Rajan (1995) is based on the implicit equity stake in "captive" borrowers that banks with market power enjoy. With risky new borrowers seeking loans, only banks with market power will have enough of an implicit equity stake in new borrowers to make risky loans profitable. The empirical evidence suggests that increasing concentration raises the total share of assets that banks lend out rather than invest in securities and other liquid assets, but shifts bank portfolios toward safer classes of loans, a result that is consistent with both types of models.

The paper proceeds in seven sections. The first section documents changing local banking market concentration, and describes the changing legislation regarding entry, both at the state and federal levels. The second section reviews the existing empirical literature on the impact of competition on bank risk-taking and on bank behavior more generally, while the third section addresses theoretical work on the risk-competition relationship. The fourth section describes aggregate banking portfolios and the characteristics of the sample that provides the backbone of my empirical analysis: 69,748 bank-year observations from FDIC Call Report data. The fifth section evaluates the empirical evidence from the 1980s and early 1990s, and finds that reductions in market concentration were associated with increasing investment in the riskiest class of loans and decreasing bank capitalization.

A sixth section discusses the implications of these empirical findings for the magnitude of the FDIC's implicit liability to the banking sector, finding evidence that changes in banking market concentration during the sample period affected the cost of the FDIC's guarantee to bank depositors. Bank regulatory policies that affected market concentration had an indirect but important impact on the cost of FDIC guarantee. This finding illustrates the principle that policies set by one government authority can often affect the cost of guarantees issued by another arm of government. A brief final section concludes.

1. Changing market concentration since 1980

The period since 1980 has seen enormous changes in the market structure of the American commercial banking industry. These changes reflect the confluence of several factors, including more permissive legislation for geographic expansion, a shift in the regulatory environment for new bank chartering, an increase in merger activity, and a wave of bank failures in the late 1980s and early 1990s. Measured at the national level, banking market concentration has increased dramatically over this period. At the level of local Metropolitan Statistical Areas (MSAs), the experience is much more varied: concentration has increased in about half of MSAs and decreased in the remaining half. Subsections that follow document first the observed changes to market structure over this period and then changes in banking policy behind them.

1.1 Changing market concentration: empirical facts

At the national level, a sequence of large bank mergers between 1980 and 1998 increased the share of assets held at the twenty-five largest banking organizations from 29.1 percent to 51.2 percent. Over the same period, the share of assets at the 100 largest banks increased from 46.8 percent to 62.6 percent (Rhoades, 2000). By 1998, more than one-third of the assets of the banking sector were held at the ten largest banks. Nationwide, the number of FDIC-insured commercial banking institutions fell from 14434 to 8581 between 1980 and 1998, a decline of over 40 percent.

This increasing concentration at the national level has attracted a great deal of attention and has often obscured the more varied experiences of individual local banking markets, where concentration, on average, has been almost constant. Data from Rhodes (2000) show that across urban areas, the average share of banking assets held by the largest three banks remained steady, rising from 66.4 percent to 66.6 percent, and the average Herfindahl-Hirschman Index (HHI) increased very slightly, rising from 1973 to 1976 index points.[1] Around the steady average, individual banking markets have varied substantially, with roughly half becoming more concentrated and half becoming less concentrated. Tables 1 and 2 present data based on the sample of 200 MSAs used in the analysis throughout this paper, and describe the changing market concentration at the MSA level.[2] With 200 MSAs and 15 years of data over the

[1] The Herfindahl-Hirschman Index is constructed from individual firms' market shares according to the following formula: HHI = 10000 * Σ_i ($share_i^2$). A market with two equal-size firms, for example, would have an index value of 5000. The U.S. Justice Department uses a HHI of 1800 to divide moderately from highly concentrated markets.
[2] I am grateful to Philip Strahan for providing these data, which are also the basis for the analysis of section 5.

period between 1980 and 1994, this sample has 3000 MSA-year observations.[3] The characteristics of this sample differ slightly from the numbers reported by the Federal Reserve study above, but the broad outlines of the data are the same. Table 1 shows that in my sample, with metropolitan areas weighted equally, the median Herfindahl Index was 1782.9. Half of the MSA-year observations are within the 1353-2323 interquartile range. The median Herfindahl Index in 1980 was 1736, 25 percent of the observations had scores less than 1273 and 25 percent had scores greater than 2400. The median in 1994 was 1784, an increase of 48 index points from 14 years earlier. While the mean and median have changed little over the period, the variation across MSAs has decreased substantially. The standard deviation fell by 17.4 percent, from 807 in 1980 to 667 in 1994, and the interquartile range also narrowed considerably.

The steady mean concentration in this sample of MSAs conceals a great deal of variation across the individual markets, with some markets becoming substantially more concentrated and some becoming substantially less concentrated. Table 2 shows the variation in the experiences of different metropolitan areas. On an unweighted basis, the mean change in concentration over the 14 years is 40.8 Herfindahl Index points. But 25 percent of MSAs saw decreases in concentration of greater than 258 Herfindahl Index points, and 25 percent saw increases in concentration of more than 387 points. The rising concentration measured at the national level, coupled with the varied experiences of local markets, reflects the fact that over this period, a declining number of increasingly regional and national banks were competing over multi-MSA market areas.

1.2 Banking policy changes

Much of the change documented above stemmed from changes in government regulation of the banking sector. Several regulators direct policy in this sector is directed, including the Federal Reserve Board (Fed), the Office of Comptroller of Currency (OCC), the Federal Deposit Insurance Corporation (FDIC), and the elements of the Federal Trade Commission and Justice Department's Antitrust Division

[3] These MSAs are chosen for relatively consistent definitions over time and exclude MSAs that are merged into other MSAs during the sample period.

that focus on the banking system. Beginning with regulation of merger activity, each of these regulators during the 1980s was much more permissive than in previous decades. Mergers in the banking sector can be divided into two types, depending on whether the merging banks are located in the same market: "market-extension" mergers take place between banks in different locations, and lead to a combined bank that has extended geographic reach but does not necessarily have greater market power in its regions;[4] "horizontal" mergers occur between banks operating in the same location, and generally increase measured local market concentration. Increasing permissiveness applied to both horizontal and to market-extension mergers, with changing attitudes at antitrust authorities initiating the horizontal merger boom and changes in branching legislation prompting an increase in market-extension mergers.

Focusing on regulation of "horizontal" mergers prior to 1980, the Fed had very broad powers to block proposed mergers on the basis of "potential anticompetitive effects", even if the Fed could not demonstrate that the proposed merger would increase measured market concentration. The U.S. Supreme Court's 1963 ruling that obligated the Justice Department to prevent mergers that were likely to significantly increase local banking markets' concentration provided another basis for banking antitrust policy.[5] The Bank Merger Act Amendments of 1966 gave the Justice Department authority to stay any merger that violated this standard, putting enormous enforcement power behind the legal authority granted in 1963. Because most significant mergers were likely to increase observed market concentration, and because the Justice Department could automatically prevent any merger that violated this standard, merger activity prior to 1980 remained at low levels.

At the beginning of the 1980s, this regulatory authority to prevent bank mergers was sharply curtailed. A U.S. Appeals Court decision in 1981 restricted the Federal Reserve's ability to prevent proposed mergers, ruling that the Fed needed more concrete reasons than nebulous "potential effects" to

[4] Market-extending mergers may increase concentration measures based on geographic areas wider than the MSA. While it is generally accepted that the metropolitan area is the relevant market scale for commercial bank competition, if banks that compete in many markets behave differently from banks that compete only in one market, market-extension mergers may raise effective concentration without raising MSA-level concentration measures. For more on the multi-market contact literature in banking, see Heggestad and Rhoades (1983).

block proposed mergers. Following this decision, the Federal Reserve became substantially less aggressive about blocking proposed mergers. The Reagan Administration Justice Department and FTC appointments ushered in an era of more relaxed merger regulation. Indeed, the head of the Reagan transition team at the FTC proposed eliminating the Commission's entire antitrust arm. As Assistant Attorney General William Baxter noted, "[The Reagan Administration's] underlying philosophy is that mergers are a very, very healthy phenomena of the capital market and should not be interfered with except under exceptional circumstances." The 1982 and 1984 Horizontal Merger Guidelines set forth the analytical framework behind this relaxed enforcement attitude.

As regulatory policy toward horizontal mergers was becoming more relaxed, legislative restrictions preventing market-extension mergers were also beginning to fall. At the end of the 1970s, most states still limited the geographic expansion of banks; often, these state laws prevented both mergers between banks in different markets and de novo bank branching into new markets. These limitations reflected, in part, America's historical wariness of concentrations of financial power, and they created a banking sector that was fragmented and vulnerable to sectoral and regional shocks (Calomiris, 1993).

Until the 1990s, the Douglas Amendment to the 1956 Bank Holding Company Act was the key restriction on interstate branching. This amendment prohibited a bank holding company (BHC) from acquiring a target bank in another state unless the target state permitted the acquisition. No state did so until 1978, when Maine first permitted out-of-state banks to purchase banks within its borders. Over the following decade, most states entered into reciprocal agreements enabling banks from neighboring states to branch within each others' borders. By 1990, all states but Hawaii allowed at least some out-of-state banks to branch within their borders. This sequence of changes culminated in the passage in 1994 of the Riegle-Neal Interstate Banking and Branching Efficiency Act, which effectively allowed nationwide interstate branch banking.

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[5] United States v. Philadelphia National Bank, 374 U.S. 321 (1963). Among other things, the Court ruled here that antitrust legislation applied to banking, a matter that had previously been in doubt.

States simultaneously relaxed restrictions on within-state branching. In 1975, most states restricted in some way banks' ability to open new branches, and only fourteen states permitted full state-wide branching. Sometimes branching was allowed only by the purchase of existing branches ("branching by merger"); in other states, banks were allowed to start up entirely new branches ("de novo branching"). Often states passed legislation at the same time allowing both types. By 1992, all but three states (Arkansas, Iowa, and Mississippi) allowed full statewide branch banking. The upswing in market-extension mergers, from 105 in 1980 to a peak of 436 in 1987, reflects the increasingly permissive environment for bank expansion.

In theory, the relaxation of long-standing branching restrictions may have ambiguous effects on the observed competitiveness of banking markets. Allowing de novo branching allows new competitors to enter previously closed local markets by opening new branches, while allowing branching by merger can allow increases in concentration, as banks expand into new markets by purchasing existing branches. Regardless of the effect on observed concentration, however, the relaxation of restrictions introduced potential competition in markets, even markets that appeared fairly concentrated. For this reason, the empirical work in section five generally estimates the impact of concentration separately in the years before and after deregulation of branching restrictions.

New bank chartering and rose in the 1980s and 1990s as well. Like the increases in merger and branching activity, the growth of new bank chartering stemmed from changing regulatory attitudes. In the early 1980s, Congress directed to the OCC (the regulator responsible for new bank chartering) to immediately increase the pace at which it chartered new banks. The OCC responded by becoming substantially more lenient in granting charter applications, and the percentage of applications for charters approved by the OCC rose from 58% in the 1970s to 89% during the 1980s. Many state chartering authorities followed suit and increased their own chartering of new banks. At the peak of the mid-1980s chartering boom, newly chartered banks as a share of all banks topped 3 percent, where it had been around 1 percent only a few years before.

The period that followed the mid-1980s chartering boom saw the most spectacular spate of bank failures since the early 1930s. Banks failed at rates unprecedented in the postwar period; in both 1989 and 1990 more than 1.5 percent of existing banks failed. This increase in failures reflected fallout from energy and real estate crises in Texas and the Southwest, as well as prolonged recessions in California and in the Northeast.

2. Banking market concentration: existing empirical literature

The roots of the literature on market concentration and risk go back at least to the first half of the 20th century; John Hicks' famous remark that "the best of all monopoly profits is the quiet life" is famous even to non-economists. His intuition that firms will not only use market power to raise expected profits, but also seek to lower the variability of their profits, has a powerful appeal. Caves (1970) touched on the same notion, noting that "...a significant portion of the potential profits latent in [the large firm's] monopoly position is taken in the form of avoiding uncertainty, with important allocative effects on the economy." This Hicks-Galbraith-Caves hypothesis inspired empirical work on the banking sector by Edwards and Heggestad (1973) and Rhoades and Rutz (1982). Edwards and Heggestad, looking at 66 large banks over the 1954-1966 period, find that the variance-mean ratio of profits[6] is decreasing in (cross-sectional) market concentration. Rhoades and Rutz, looking at 6,500 unit banks over the 1969-1978 period, also find that banks in more concentrated markets have less variable net income and report higher capitalization and profits. Taken together, these papers document a robust cross-sectional relationship over twenty-five years between banking market concentration and profit variability and were interpreted as providing empirical support for the Hicks-Galbraith-Caves hypothesis.

The FDIC and FSLIC crises of the 1980s motivated a later literature on the relationship between deposit insurance and risk. Keeley (1990) empirically addresses the same question as Edwards and Heggestad and Rhoades and Rutz. Analyzing a sample of the 150 largest bank holding companies, he finds evidence that the relaxation of state branching restrictions reduces the market-to-book ratios and equity ratios of incumbent commercial banks. These banks, newly exposed to potential competition, also pay higher interest rates on uninsured CDs. He concludes that banks with reduced market power have increased portfolio risk, and pay higher default premia on these uninsured deposits.[7] In looking at the impact of deregulation, Keeley's paper is similar to more recent work by Jayaratne and Strahan (1998, 1999). They analyze the impact of the relaxation of geographic restrictions on bank performance, and present evidence that branching restrictions slow the process of natural selection by which inefficient banks lose market share to their more efficient competitors. Jayaratne and Strahan find that deregulation is followed by increases in efficiency, as well as reductions in costs and loan losses. The finding that reductions in loan losses follow the easing of restrictions seems to contrast with Keeley's assertion that deregulation led to increases in risk, but their larger sample and inclusion of more recent data may explain this difference.

While most of the papers cited above concern the concentration-risk relationship, Gilbert (1984) surveys a voluminous empirical literature on the relationship between market concentration, interest rates, and bank profits. The basic conclusion of his survey is that increases in competition lead to rising deposit interest rates, falling lending interest rates, and reduced bank profitability. Reflecting enormous variation in sample and empirical technique, point estimates of the relationships listed above vary substantially. In particular, estimates of the impact of a 10 percentage point increase in (3-firm) market concentration on net income as a share of assets range from 1.7 to 8.6 basis points.[8]

More recent work by Berger and Hannan (1998) extends the literature Gilbert reviews by evaluating the welfare costs of market power in commercial banking. They show that because market power allows inefficient banks to survive, the costs of monopoly are much greater than measured by simple reductions in output and higher markups. In a sample of 5000 banks, they find that banks in more concentrated markets have less operating efficiency; Berger and Hannan derive high estimates of the welfare cost of market power. While their paper does not focus on risk-taking, its focus on the welfare

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[6] The variance-mean ratio of profits is the measured variance of a bank's earnings divided by their mean.

[7] Keeley argues that the interest rates for large uninsured CDs are determined at the national level, so that local market competition exerts no effect on these rates independent of the effect of competition on risk.

[8] See Demsetz (1973) and Baumol (1982) for criticism of the structure-conduct-performance literature.

cost of monopoly is an important counterpoint to the analysis that follows. Finally, work by Sapienza (2002) uses a unique dataset that identifies the contract terms of loans to individual borrowers for a sample of Italian banks. With these data she addresses the empirical debate regarding the impact of bank mergers on the supply of loans to small businesses. She finds that when the acquired bank is large, mergers reduce the supply of loans to small borrowers. When the acquired bank has a low market share, however, mergers do not reduce loans to small businesses.

This paper offers several innovations to the literature on market concentration and risk. First, I follow the recent literature on market structure and small business lending by looking at banks' actual portfolio holdings of banks and documenting the shifts in portfolio allocation that accompany market structure changes. Second, I examine at the structure-conduct-performance relationship both before and after deregulation. In the period prior to deregulation, when potential competition is precluded, observed market concentration is a true proxy for market power. After deregulation the relationship between concentration and market power is more ambiguous due to the existence of potential competition. Finally, this paper considers the impacts of both concentration and of deregulation on portfolio holdings and risk, and employs a large dataset: all metropolitan commercial banks between 1980 and 1994.

3. Banking market concentration: theory

Beginning with the seminal work of Merton (1977), economists have understood that deposit insurance introduces moral hazard and may induce banks to increase portfolio risk. Keeley (1990) and Hellman, Murdock, and Stiglitz (2000) touch on this notion as well. Because depositors are insured by the FDIC, they will place deposits with the bank offering the highest interest rates, regardless of the risk of the bank's underlying assets. Because bank owners enjoy limited liability, they have a call option on the value of their loan portfolio, with a strike price equal to the cost of their deposits. As in other options models, the bank has an incentive to increase portfolio risk, which effects a transfer from the FDIC to the bank. Addressing this moral hazard problem is a key component of bank regulation.

Figure 1 more concretely illustrates this intuition. A bank pays deposit interest rate D, and has the opportunity to invest in one of three assets. Each of the assets has the same expected return. There is a safe asset, which pays S with certainty, a risky asset, which pays $S + K_S$ with probability ½ and $S – K_S$ with probability ½, and an extremely risky asset, which pays $S + K_L$ with probability ½ and $S – K_L$ ($K_L > K_S$) with probability ½. As the figure shows, very small additions of risk to the safe asset's return do not increase the bank's expected return; because the bank will remain in operation regardless of which state is realized, the pain of the bad state balances the profits of the good state. Beyond a certain point, however, increases in risk increase the bank's expected profit because the limited liability constraint places an upper bound on the "pain" of the bad-state outcome. Because of this nonlinearity in the bank's return to its portfolio, the expected one-period profit to the bank increases in the scale of risk that the bank takes on.

Equations (1) and (2) describe the value of banks investing this period in safe and very risky assets, and thereafter investing in only the safe asset (V_S and V_R, respectively).

(1) $V_S = (S – D) + (S – D) * [\beta/(1 – \beta)]$

(2) $V_R = ½ * (S + K – D) + (S – D) * ½ * [\beta/(1 – \beta)]$

The discount rate is β, meaning that profits of X one period hence are valued at βX today, and a perpetuity of X starting today is valued at X/(1-β). The first part of each expression gives the one-period expected profit from the strategy, and the second part gives the discounted flow of expected profits from investing in the safe asset.

K represents the size of the gamble available to a bank choosing the risky strategy. Because the bank enjoys both the entire upside of a successful gamble and the ability to put its assets and liabilities onto the FDIC in the event of bankruptcy, the private value of the risky bank (V_R) is everywhere increasing in K. The increase in V_R from the mean-preserving increase in the variance of the risky asset is mirrored by a reduction in the value of the FDIC, which must take on the bank's assets and liabilities in the event of default.

Define a level of K, as a function of the other parameters, such that the monopolist is indifferent between safe and risky assets. This value K* represents the minimal attractiveness of the risky asset necessary to induce a bank to gamble. If we think of banks occasionally observing draws of K from some distribution, then a reduction in K* means that banks opt to gamble more frequently than before. Equation (3) below shows that this level of K is decreasing in the competitiveness of the marketplace:

(3) $V_S(K^*) = V_R(K^*)$

Equation (3) above represents the solution when equations (1) and (2) above are set equal to each other. This solution defines implicitly a level K* as a function of the other parameters of the model:

(3') $K^* = (S - D) / (1 - \beta)$

This level K* is decreasing in the deposit interest rate D, which is the proxy for the level of competitiveness in the bank's market.

(3'') $dK^*/dD = -1 / (1 - \beta) < 0$

From equations (1) and (2), increasing competition, proxied by increases in D, reduces V_S by more than V_R; increases in competition reduce the value of the safe bank more than the risky bank. This difference is the basis for the intuition that monopolist banks will invest in safe assets; the risk of losing monopoly profits can be a deterrent to risky behavior. Increasing competition, by reducing the future profit streams of safely-managed banks, erodes incentives to invest in safe assets. Thus increasing competition, by this reasoning, may shift bank portfolios towards riskier types of loans.

In a more complete model, competition among banks affects interest rates on bank loans as well as deposits. A recent line of research by Petersen and Rajan (1995; see also papers by Dinc(2000), Hauswald and Marquez (2000), and Marquez (2000)) explores the impact of credit market competition on relationship lending. In the Petersen-Rajan, model loans to credit-constrained firms generate subsequent rents at the surviving firms, which a bank in a monopolistic lending market can extract through interest rates on subsequent loans to the survivors. Because competition among banks reduces their ability to extract these ex-post rents from the firm, as markets become less concentrated banks can only profitably lend to the most creditworthy firms. Only banks with monopoly power will be able to extract, ex-post, the rent necessary to make investment in risky firms profitable. It is important to note that deposit insurance and bank failure do not enter the Petersen-Rajan model. The cost of lending to credit-constrained firms, which in this model comes from their probability of failure, could just as easily be thought of as the bank's cost of gathering information about new borrowers. The crux of this model is that ex-post competition can reduce banks' incentives to invest in relationships with potential borrowers, and shift bank portfolios towards assets (such as securities) where these banker-borrower relationships are less important.

Figure 2 illustrates a very simple formulation of Petersen-Rajan effects. In period 0, the firm makes a loan to a credit-constrained firm. This firm will survive with probability p, and p denotes the 'riskiness' of the loan. This firm, should it survive, will repay the loan with interest in period 1. At that time, it takes out another loan with that bank. When the second loan is taken out, the bank's market power M determines how much rent the bank can extract.

If the bank's per-period gross cost of capital is (1+r), that bank's total profit from a loan of riskiness p is:

(4) $\Pi^{risky} = [((p * R * L_1) / (1+r)) - L_1] + p * [((M * L_2) / (1+r)^2) - (L_2 / (1+r))]$

and the boundary condition separating profitable and unprofitable risky loans is:

(5) $\Pi^{risky}(M,p) = 0$

Equation (5) implicitly defines a value M*(p), a function of p, above which a given loan is profitable:

(6) $M^*(p) = (1+r) * [1 + (L_1 / L_2) * [((1+r) / p) - R]]$

The equation above defines a level of market power M*(p) such that for any given level of p, the risky loan is profitable for the firm. Differentiating that condition gives the following expression:

(7) $dM^*(p)/dp = -(L_1 / L_2)*((1+r)/p)^2 < 0$

From equation (7) comes the intuition that the market power necessary to make a risky loan profitable increases in the risk of that loan. The Petersen-Rajan model provides an intuition for why the effective return to risky loans may fall relative to more liquid assets as local markets become less concentrated.

The models described above provide a guide for interpreting the empirical evidence of the following sections, which represent an attempt to sort out the empirical importance of moral hazard and Petersen-Rajan-style effects on commercial bank portfolios. In line with the moral hazard model above, evidence that risky asset holdings increase with competition would be evidence of moral hazard effects, while evidence that banks in competitive environments shift away from relationship-intensive types of lending towards more liquid assets would be consistent with the Petersen-Rajan model.

4. Empirical approach

Empirical analysis of the competition-portfolio risk relationship motivated by the previous sections is difficult because the risk of a bank portfolio is hard to observe, whether ex-ante or ex-post. Loans that are ex-ante relatively safe occasionally fail, and relatively risky loans are frequently paid off. My approach is to analyze portfolio allocation across sectors, and in particular on the share of loans going to sectors that are typically the riskiest. I also focus directly on bank capitalization and failure rates.

A dataset drawn from the FDIC Reports of Condition and Income (Call Reports) over the period between 1980 and 1994 forms the backbone of the empirical analysis.[9] All banks regulated by the Federal Reserve, FDIC, or OCC are required to submit quarterly reports detailing their assets, liabilities, and income. This paper uses the fourth quarter reports over a 15-year period; excluding observations outside of MSAs and observations that are missing data leaves a sample of 69,748 commercial bank-year observations.[10]

I link the FDIC Call Report data to two auxiliary datasets. The first provides annual Herfindahl Index numbers for almost all MSAs, and the second gives the dates at which each state relaxed restrictions on bank branching activity. The aggregate Herfindahl Index numbers are constructed from underlying branch and office level data from the FDIC's Summary of Deposits database. These data have

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[9] I am very grateful to Adam Ashcraft for providing SAS programs used to manipulate these data.

[10] Census MSA definitions occasionally change, with previously separate MSAs merging and other MSAs being split. I exclude observations from MSAs that merged with other MSAs during the sample period and observations from MSAs that do not exist as separate entities throughout the sample period.

also been used in a recent series of papers by Jayaratne and Strahan (1998, 1999). Where MSAs stretch across state boundaries, I assign that MSA to the state with the bulk of the population.

Table 4 describes portfolio holdings in my sample of 69,748 bank-year observations. At the aggregate level, over 86% of bank assets are interest-earning. The bulk are loans and leases, and securities comprise most of the remainder of assets. The largest loan classes are commercial loans, consumer loans, and real estate loans. Loans to these different sectors have different risk characteristics; traditionally, lending for construction and land development projects has been among the riskier activities of commercial banks. Construction loans between 1980 and 1994 were risky foremost because they were generally not secured by existing assets, unlike home and nonresidential mortgages, which are secured by existing property. Other reasons for the high risk of construction loans include lags between lending and project completion that expose banks to interim market fluctuations and the strong systematic component of the riskiness of individual construction loans. Below I present more detailed evidence about the contribution of construction loans to bank portfolio risk.

The first three lines of Table 4 show the range of bank size, in current-dollar amounts. The mean bank-year observation in the sample has \$367.6 million in assets, \$226.6 million of which are invested bank loan portfolios. On the liability side, the mean bank-year observation has deposits amounting to \$283.8 million. The medians are substantially lower, reflecting the skewed nature of the distribution of bank sizes.

The average bank in the sample lends out 56.1 percent of its assets, and the interquartile range runs from 47.5 percent to 65.9 percent. In the individual years that make up the sample, the average ranges from just below 54 percent early on to above 58 percent through the middle and late 1980s and again in 1994. Over 80 percent of bank-year observations have positive amounts of loans to construction projects; for the mean bank these loans amount to 4.7 percent of the total portfolio of assets. There is a tail of bank-year observations for which these types of loans are very important: for the 90^{th} percentile bank, these types of loans amount to 12.3 percent of the loan portfolio. Among the other types of loans, commercial loans, home mortgage loans, and consumer loans all make up between 13 and 14 percent of assets at the mean bank; nonresidential loans account for somewhat less.

Table 5 shows the share of banks that failed over the period. The sample in 1980 contains 5147 banks, of which 0.08 percent fail in the next year and 0.25 percent in the next two years. Of these banks, 8.22 percent eventually fail, and these failing banks manage 6.16 percent of the assets in the sample that year. Table 5 shows the growth in bank failures during the period; 2.64 percent of the 4583 banks in the sample in 1988 fail within the next year.

Table 6 presents the first evidence in this paper on the relationship between exposure to the commercial real estate sector and bank failure. The first three rows of the table show capitalization levels of all banks, banks that eventually fail, and banks that do not fail, in 1980, 1985, and 1990. In 1980 and 1985, both banks that fail and those that survive report approximately the same capitalization, although by 1990, the banks that will eventually fail are reporting substantially lower capitalizations than the surviving banks. Table 6 shows that throughout the period banks that eventually fail have on average twice the exposure to construction loans of the banks that will survive.

Table 7 moves further to motivate differences in bank portfolio weights as a signal for risky behavior. In each year between 1980 and 1994 I run a linear probability model, equation (8):

$$(8) \qquad I(\textit{ever fail})_{i,t}^{MSA} = \alpha + \Sigma\, \beta_1 * SHR_{j,i,t}^{MSA} + \varepsilon_{i,t}$$

The dummy dependent variable in this model is one if the bank fails between that year and 1998 and zero otherwise. The independent variables $SHR_{j,i,t}^{MSA}$ are the shares of bank i's assets at time t devoted to asset class j. Asset classes include construction and land development loans, nonresidential mortgages, residential mortgages, commercial and industrial loans, loans to individuals, and liquid assets. For each year, Table 7 reports the coefficients on the share variables from equation (8), as well as the number of banks in each year's regression and the share of those banks that eventually fail. In addition to the rows showing separate regressions for each year, the top row of Table 7 presents results from a regression that pools each of the years into a common sample and estimates a version of equation (8) that includes year dummy variables as well as portfolio share variables.

The results in Table 7 are large in economic magnitude, and reflect the outsize risk associated with construction lending. Increasing construction lending by one percentage point in 1983 is associated with a 1.28 percentage point increase in a bank's probability of eventual failure. Comparable figures for commercial and home mortgage lending are 0.45 and –0.08 percentage points, respectively. The decline in the reported magnitudes of all coefficients between 1980 and 1994 reflects the declining share of banks that eventually fail. But in each year until 1994, the coefficient on construction lending is higher, usually significantly higher, than the coefficients on any of the competing loan classes. Consistent with the popular wisdom, construction lending appears to be a risky sector for bank lending. This empirical regularity motivates the use of construction lending as a proxy for risky behavior in section 5.

5. Results

Motivated by the theoretical analysis of section 3, and using the FDIC Call Report dataset described in section 4, I turn in this section to empirical analysis of the relationship between banking market concentration and characteristics of bank portfolios. The section begins with reduced-form analysis of market concentration and portfolio characteristics and continues through a variety of control and instrumental variables strategies designed to assess whether the relationship between market power and risky lending is causal or merely reflects spurious correlation. The evidence, on the whole, supports the hypothesis that changes in market concentration during the sample period caused changes in lending to risky sectors.

5.1 Concentration and portfolio shares

The first regressions are reduced form, and fit bank portfolio shares on MSA Herfindahl Indexes as in equation (9):

$$(9) \qquad SHR_{j,i,t}^{MSA} = \alpha + \beta * HHI_t^{MSA} + X_{i,t}^{MSA}\,\Gamma + \varepsilon_{i,t}^{MSA}$$

where $SHR_{j,i,t}^{MSA}$ is the share of bank i's portfolio that at time t is devoted to asset class j. HHI_t^{MSA} is the Herfindahl-Hirschmann Index, which measures the concentration of the MSA banking sector at time t. $X_{i,t}^{MSA}$, a vector of control variables, includes individual bank size, the size of the MSA banking market (proxied by MSA bank deposits), and county-level employment growth and employment concentration measures.[11] The vector of controls also at times includes year, MSA, and region-year dummies, state-by-state fixed effects and trends, and MSA-specific linear trends. Table 8 shows empirical results based on equation (9). In Table 8 each row presents results for a different portfolio share variable, and reading along the row gives the coefficients on market concentration for a different set of controls and fixed effects.

The variety of fixed-effect strategies illustrates the cross-sectional and time series relationships between concentration and portfolio allocation. Column (1) has neither control variables nor fixed effects of any kind. Column (2) has control variables for bank size, but no fixed effects. Column (3) adds year fixed effects, and column (4) adds region-by-year fixed effects, controlling for the different patterns over time across the 9 census-defined regions in the US. Column (5) has only MSA fixed effects, and column (6) adds both MSA and year fixed effects. Column (7) includes all of the controls of column (6), as well as MSA-specific linear trends. Columns (6) and (7), which control for both fixed variation across MSAs, and for variation across time in overall lending patterns, are the preferred regressions.

The most robust of the results in Table 8 is that increasing concentration of the banking sector reduces the share of bank assets loaned to construction projects. Loans to these projects are the riskiest of the loan categories for which data exist. Also robust is the relationship between concentration and bank capitalization. A 500-point increase in the MSA Herfindahl Index is associated with a 35 to 40 basis point increase in the ratio of equity to assets. The finding that increasing concentration increases the total share of assets loaned out, as opposed to invested in liquid securities and cash, is somewhat less robust. While columns (1) through (6) support the notion that increasing concentration and increased total lending are linked, column (7) reveals that this relationship is not robust to the inclusion of MSA-specific trend variables. This difference may reflect the different time horizon of effects picked up by the regressions reported in columns (6) and (7). Column (6), without MSA trends, picks up long-horizon

[11] The employment growth measure is a predicted employment growth measure, constructed by multiplying lagged county employment shares by national growth rates for different 2-digit SIC codes. The employment concentration measure is the county-level Herfindahl Index of employment shares at the 2-digit SIC level.

empirical correlation between concentration and portfolio shares, while column (7), with trends removed, picks up shorter-horizon shifts than column (6).

Again, the coefficients of Table 8 are large in economic magnitude. Focusing on the point estimate from column (6), an increase in market concentration of 500 Herfindahl Index points is associated with a 33 basis-point reduction in construction loans as a share of assets, and a 52 basis-point reduction in construction lending as a share of loans. With total construction lending in 1990 accounting for 3.97 percent of $3.4 trillion in commercial bank assets, a 33-basis point reduction would amount to an $11 billion reduction in construction loans outstanding, or over 10 percent of the $108 billion in private nonresidental construction spending reported by the Census Bureau in that year.

Viewed in the context of section 3, the results above provide strong evidence for the moral hazard effect of market concentration. Columns (1) through (6) also suggest of Petersen-Rajan effects, with increasing concentration raising the total share of assets that banks loan out. Again, however, adding MSA-specific trends drastically changes the estimated coefficients in the regressions of total lending. The evidence consistent with the moral hazard model is much more robust to the inclusion of MSA-specific trends.

5.2 Concentration and portfolio shares among different types of banks

In this section I evaluate the relationship between concentration and the share of loans going to the riskiest category across different types of banks. These results help assess whether the strong reduced-form relationship between market power and construction lending reflects a true causal relationship or spurious statistical correlation.

Columns (1) and (2) of Table 9 reflect concern about possible reverse causation or spurious correlation by highlighting a sample of banks whose activities had relatively limited effects on changes in market concentration in their local areas. These columns are based on a sample of banks that are never involved in mergers, and whose size ranks them in the bottom 95 percent of banks in the sample. While these banks' activities have less effect on observed market concentration than larger or actively merging banks, the moral hazard model of section 3 suggests that changes in concentration will affect their behavior. The results in columns (1) and (2) of Table 9 are consistent with those in Table 8 and help support a causal interpretation of the relationship between concentration and risk. Among this sample of smaller and non-merging banks, a 500 point Herfindahl Index increase is associated with a 60 to 65 basis point change in construction lending as a share of total loans.

Columns (3) through (6) evaluate the relationship between concentration and portfolio shares across different levels of bank capitalization. In the analysis of the third section, the total capital that banks place at risk consists of both explicit bank capital, measured as the share of equity in assets, and implicit capital based on the opportunity to earn profits from market power in the future. Equivalent changes in the level of this implicit capital, stemming from changes in market concentration, represent a larger percentage change in the total capital of banks with lower amounts of explicit capital. While one would not a priori expect a spurious correlation between construction lending and market structure to affect better (explicit) capitalized banks differently from their undercapitalized competitors, columns (3) through (6) suggest that construction lending by banks with lower levels of explicit capital is more sensitive to market power than for banks with higher levels of explicit capital. Dividing the sample at 8 percent capitalization, for banks in the lower-capitalization group, the coefficient point estimate is –1.20 (standard error 0.19), while for the more highly capitalized banks the coefficient estimate is –0.74 (0.20). This difference again supports a causal interpretation of the relationship between market concentration and the share of lending going to highly risky sectors.

Table 10 focuses on the relationship between concentration and portfolio shares across different types of MSAs. Columns (1) through (4) split the sample into MSAs that see concentration increases over the period and MSAs that see decreases. For construction lending, the evidence is fairly consistent: both types of MSAs see a negative relationship between concentration and the share of lending going to this risky category. The same is true for bank equity ratios; in both samples the relationship between concentration and capitalization is robust. Again, the results are more mixed for total lending. The relationship between concentration and total lending appears positive among the sample of MSAs with increasing concentration, consistent with the Petersen-Rajan model. For MSAs with decreasing concentration, however, there appears to be a negative relationship between concentration and total lending.

Columns (5) through (8) of Table 10 focus on the concentration-portfolio share relationships across different levels of market concentration. The results here are mixed, especially for construction lending. The relationship between concentration and construction lending is negative for the 50479 MSA-year observations corresponding to Herfindahl Indexes in excess of 1000. A Herfindahl Index of 1000 corresponds to a hypothetical market with 10 equal-size banks, and Herfindahl Indexes below 1000 correspond to highly competitive commercial banking markets. Among these most concentrated markets, there appears to be a *positive* relationship between concentration and construction lending. In these highly competitive markets, there is no evidence that small reductions in concentration are associated with increases in construction lending. If anything, the relationship in this small sample appears to go in the other direction.

Columns (1) and (2) of Table 11 focus on a sample of 34360 bank-year observations drawn from MSA-years in which no banks have yet failed. For each MSA, all banks are included until the year in which the first bank fails, after which all of that MSA's banks are excluded from the sample. Splitting the sample in this fashion addresses a particular concern about a possible spurious relationship between market concentration and construction shares. This potential concern is that the observed negative relationship between concentration and construction lending may arise because banks in a market area where a competitor bank has failed react to the failure of their competitor by shifting away from risky lending, at the same time that concentration is increasing due to the failure of this competitor. Among the pre-failure sample, column (1) again shows a negative relationship between concentration and construction lending; in this sample a 500 point increase in the Herfindahl Index is associated with a 24 basis point drop in the construction lending share. Column (2), which adds MSA-specific trends, provides less support. With the inclusion of MSA-specific trends, in such a truncated sample, concentration has no statistically significant effect in any of the five regressions reported in Table 11.

Columns (3) through (6) of Table 11 assess the impact of changes in concentration among banks that maintain significant construction lending throughout the period. Changes in concentration may affect construction lending both on an extensive margin, affecting share of banks doing any construction lending at all, and on an intensive margin, affecting the intensity of construction lending among banks already active in this sector. Columns (3) through (6) focus on the intensive margin of the relationship between concentration and construction. Columns (3) and (4) focus on the 37196 bank-year observations with positive construction lending in every period of their observed existence, and columns (5) and (6) on the 34407 observations whose construction lending exceeds the entire-sample mean in each period. In each of these samples, the estimated coefficients are indistinguishable from the larger sample, suggesting that changes in concentration are active along this intensive margin.

5.3 Instrumental variables estimation of concentration and portfolio shares

Instrumental variables techniques provide another approach to evaluating the relationship between concentration and portfolio shares. IV techniques again regress portfolio shares on measures of concentration, but use only the part of variation in concentration that is statistically explained by a third set of variables, called instrumental variables. If these instruments affect the variation in portfolio shares only through their impact on concentration, then the result is an estimate that is not subject to concerns about bias from spurious correlation or reverse causation. The cost of these techniques is loss of precision, as well as bias if assumptions about the relationship between the instruments and the dependent variables are false.

Table 12 presents both the OLS results from Table 8 and the results of instrumental variables analysis for two different sets of instruments. The first instrument used is a dummy for the removal of restrictions on intra-state branching by merger with existing banks. The implicit assumption is that changes in branching restrictions affect portfolio shares only through their indirect impact on concentration, and not through any direct impact of their own. This assumption is somewhat suspect; recent work, especially by Jayaratne and Strahan (1998), has shown that a variety of changes in banking markets follow deregulation, especially the expansion of more efficient banks at the expense of their weaker competitors.

Columns (5) and (6) employ a different strategy, using instruments that are based on state-level political control. The underlying assumption is that different political parties are differentially hostile to deregulation and changes in banking market concentration, so changes in political control will affect changes in concentration. This assumption is consistent with the empirical model of branching deregulation in Kroszner and Strahan (1999). The key identifying assumption is that these changes in political control only affect portfolio shares through their impact on concentration. The set of political instruments includes dummies for current Democratic Party control of state governorships and lower and higher houses of government, as well as variables describing the share of years (post-1970) that these branches of government have been under Democratic Party control.

The IV regression results in columns (3) through (6) reflect the loss of precision that can accompany IV techniques. Nevertheless, the results are broadly consistent with a negative relationship between concentration and the share of construction lending. In particular, coefficients from columns (3) and (6) point to a negative relationship between concentration and the share of construction lending that is substantially stronger than the relationship documented in the previous subsections. Columns (4) and (5) show statistically insignificant (and highly imprecise) results. The enormous imprecision of column (4) reflects the addition of MSA-specific trends to an IV model with a dummy instrumental variable that turns “on” during the sample. Column (6), using political control instruments and including MSA-specific trends, suggests that a change in concentration of 250 Herfindahl Index points is associated with a greater than 1 percentage point change in the construction lending share. It seems implausible that such a strong relationship holds throughout the entire range of the concentration distribution; and is important to note that the previous subsection documented important nonlinearity in the relationship between concentration and construction lending. The instrumental variables techniques may be focusing empirical analysis on a region of the concentration distribution where construction lending is highly sensitive to concentration. Nevertheless, the results, on the whole, provide some support for a causal interpretation of the concentration-risky lending relationship.

5.4 Concentration and portfolio shares, before and after deregulation

In addition to changing observed concentration, many places in the 1980s saw the repeal of restrictions on banks' geographic expansion. As discussed earlier, the repeal of these restrictions exposed banking markets to potential competition, which can affect behavior even in markets that remain concentrated. In these deregulated markets, potential competition reduces the quality of observed concentration as a measure of the true competitiveness of the local market area. For example, when entry is restricted by regulation, a local monopolist can exploit its market power. With entry allowed, a bank that attempts to exploit its position as the sole bank in a market encourages entry from potential competitors. Thus, following deregulation and the repeal of branching restrictions, observed local market concentration becomes a less relevant measure of market power.

Table 13 reports regressions that separately estimate the impact of concentration before and after the repeal of branching restrictions. Equation (10) below gives the functional form for these regressions:

$$(10) \quad SHR_{j,i,t}^{MSA} = \alpha + \beta^{R} * HHI_{t}^{MSA} * NOBRANCH_{t}^{MSA} + \beta^{NR} * HHI_{t}^{MSA} * (1\text{-}NOBRANCH_{t}^{MSA}) + \delta * (1\text{-}NOBRANCH_{t}^{MSA}) + X_{i,t}^{MSA}\,\Gamma + \varepsilon_{i,t}^{MSA}$$

$NOBRANCH_{t}^{MSA}$ is a dummy variable equal to one for bank-year observations in periods when branching was restricted. The coefficient β^{R} gives the slope of the concentration-portfolio relationship before the repeal of branching restrictions, the coefficient β^{NR} gives the slope afterwards.

As Table 3 showed, different types of restrictions affected branching, and these barriers were generally lifted at different times. In most states, the legalization of branching by interstate multi-bank holding companies, the legalization of intra-state branching through the purchase of existing banks, and the legalization of "full branching" (where banks can open entirely new branches throughout the state) occurred in different years. A slightly different version of equation (10) corresponds to each type of branching restriction.

Columns (1) and (2) of Table 13 show regressions where the NOBRANCH variable identifies the periods before and after the legalization of branching by merger and assumption (corresponding to the second column of table 3); columns (3) and (4) correspond to de novo branching, and (5) and (6) correspond to interstate branching. Column (2) of Table 13 shows that prior to the repeal of branching restrictions, a 1000 point drop in the Herfindahl Index raised the expected value of the construction loan/total loan ratio by about 131 basis points. After deregulation, which may have reduced the link between concentration and market power, the same fall in Herfindahl Index raises the ratio by only 60 basis points. At a Herfindahl Index of 1902 [12], the repeal of branching restrictions seems to exert a very small net effect on the share of loans lent out to this sector.

The results in this section provide more evidence that the relationship between market concentration and the share of loans going to construction projects is causal, rather than reflecting either the influence of some unobserved third factor or reverse causation from portfolio choice to market concentration. In the period prior to the repeal of branching restrictions, when observed concentration is a better proxy for the true competitiveness of the local market area, the impact of concentration on portfolio choice is much greater than in the later periods, when potential competition from outsiders makes observed concentration a worse proxy for the competitiveness of the environment.

5.5 MSA-level regression analysis

The strongest and most regular result of the previous section was that increasing banking sector concentration reduces the flow of bank capital to construction loans. This section presents evidence that this relationship has a measurable real effect on macroeconomic variables at the MSA level: increases in MSA banking market concentration are associated with decreasing employment shares in both the real estate and construction sectors.

[12] This is the MSA-weighted sample mean.

A 15-year sample of 300 MSAs forms the basis for the analysis that follows. Bank-level observations of total loans, assets, and loan types are aggregated to the MSA level. Employment variables are constructed from Census County Business Pattern data; county-level employment observations are aggregated to the MSA level using the bank shares within each county. Table 14 documents sample statistics for this sample of 3000 MSA-year observations.

Table 15 details results from regression analysis at the level of the individual MSA. For the banking-sector variables, I run regressions such as equation (12) below, where the index j indexes the various banking sector balance sheet items:

(12) $SHR_{j,t}^{MSA} = \alpha + \beta * HHI_t^{MSA} + X_t^{MSA\prime}\,\Gamma + \varepsilon_t^{MSA}$

The first five rows of Table 15 show the results of regressions such as (12). At the aggregate level, there is still strong evidence that increasing banking sector concentration reduces the flow of capital to the commercial real estate sector, both as a share of banking assets and as a share of total loans. The results in columns (6) and (7) suggest that a 500 point increase in an MSA Herfindahl Index is associated with a 50 basis point increase in the aggregate share of loans going to construction projects. The evidence on total loans is broadly similar to the analysis at the bank level in the preceding subsections. While in regressions without controls and with only year dummies, increasing concentration is significantly and positively associated with total loans as a share of assets, adding MSA fixed effects makes the estimated coefficient statistically insignificant. Again, adding MSA-specific trends changes the sign of the observed relationship. How this reflects the impact of concentration changes along different horizons is an open question of research.

The results above suggest a relationship between concentration and aggregate lending shares: changes in concentration are associated with shifting bank activity toward construction lending. I now assess whether there is evidence of a relationship between local market concentration and the share of employment in sectors that are sensitive to construction activity. I use annual Census County Business Pattern data, aggregated to MSA level, which breaks out employment to the 2-digit SIC code level. I focus in particular on the share of MSA employment in construction and real estate sectors, two sectors particularly sensitive to bank construction lending activity. The final two rows of Table 15 document the results of this exercise. For real estate employment as a share of total employment, a 500 Herfindahl point increase in concentration is associated with a 4 basis point drop in real estate employment, or about 3.1 percent of the sample mean. For construction employment, the result in column (7) suggests that the same concentration change is associated with a 10 basis point drop in construction employment, or about 1.8 percent of the sample mean. While these estimated impacts are not huge, they are consistent with shifts in bank capital having some impact on aggregate macroeconomic activity.

6. Implications for the FDIC

Because the Federal Deposit Insurance Corporation stands ready to assume the assets and liabilities of failing banking institutions, the impact of concentration on banks' demand for the riskiest of assets that they hold has implications for the FDIC's implicit liability to the banking sector, and thus on the financial position of the federal government. The following section uses the analysis of the previous sections to estimate the impact of changing concentration on the implicit liability of the FDIC.

The aggregate direct cost of bank failure to the FDIC is the product of the number of banks failing and the cost to the FDIC of each failure. The regression results reported in Table 16 are designed to assess the relationship between market structure and the probability of eventual bank failure. The first three columns of Table 16 report the results a linear probability model fit separately in each year of the sample, with the dependent variable equal to one if the bank observed in that year will eventually fail. These models are based on equation (13) below:

$$(13) \qquad I(\textit{ever fail})_{i,t}^{MSA} = \alpha + \beta * HHI_t^{MSA} + X_{i,t}^{MSA}\,\Gamma \; + \varepsilon_{i,t}$$

The final column of the table gives the share of these banks that will eventually fail; this share ranges from a high of 10.27 percent in 1984 to a low of 0.39 percent in the final year of the sample. The first column fits equation (13) with no controls, the second includes controls for the nine census regions, and the third column includes controls for region, individual bank size, and the size of the MSA in which the bank is headquartered. The next three columns of Table 16 report regressions based on data aggregated to the MSA level. These models fit equation (14) below:

(14) $SHR\_BANKS\_EVER\_FAIL_t^{MSA} = \alpha + \beta * HHI_t^{MSA} + X_t^{MSA} \Gamma + \varepsilon_t$

As in the first three columns, the first column has no controls, the second column has nine controls for the census regions, and the third column has controls for MSA size. Table 16 suggests a relationship between market structure and the probability of bank failure, driven by the spate of bank failures during the 1980s. In 1980, across MSAs, a 500 point increase in an MSA's Herfindahl Index is associated with a 0.96 percent reduction in the share of banks in that MSA that eventually fail. Reflecting the reduction in the rate of bank failure since then, regressions fit on data after about 1990 show no relatiohsip between market structure and failure probability.

Table 17 reports the results of regressions that pool observations over time. The first row reports regression results based on equation (15):

(15) $I(\textit{fail in next year})_{i,t}^{MSA} = \alpha + \beta * HHI_t^{MSA} + X_t^{MSA\prime} \Gamma + \varepsilon_t^{MSA}$

Reading across the rows in Table 17 gives the coefficient on the concentration measure for different sets of control variables. The estimated coefficient rates from 0.07 (standard error 0.15) in a regression with only MSA dummy variables to -0.37 (0.26) in a regression with year and MSA effects and MSA trends. The next row in Table 17 fits regressions of equation (16) below:

(16) $I(\textit{fail in next 4 years})_{i,t}^{MSA} = \alpha + \beta * HHI_t^{MSA} + X_t^{MSA\prime} \Gamma + \varepsilon_t^{MSA}$

Reading across the row, we see that in the sample, an increase of 1000 points in the Herfindahl Index is associated with between a 0.46 and 2.97 percent reduction in the probability of failure in the next 4 years for the banks in the sample. The weakest estimated effect comes in a regression that includes separate region dummy variables for each year. A regression that includes MSA fixed effects, year fixed effects, and MSA-specific trends finds the largest estimated effect. The final row of Table 17 shows the results of estimating equation (17) below with a varying set of control variables:

(17) $I(\textit{ever fail})_{i,t}^{MSA} = \alpha + \beta * HHI_t^{MSA} + X_t^{MSA\prime} \Gamma + \varepsilon_t^{MSA}$

In the sample, an increase of 1000 Herfindahl Index points is associated with between a 0.70 and 2.71 percent reduction in the probability of eventual bank failure. In the regression that includes MSA and year fixed effects, as well as MSA-specific trend variables, the coefficient on the Herfindahl Index of –2.00. This implies that a 500 Herfindahl Index point increase in concentration is associated with a 1 percent decrease in the probability of eventual failure.

The second panel of Table 17 reports regressions based on observations aggregated to the MSA level. The first row of the second panel fits equation (18) below with varying sets of control variables:

(18) $SHR\_BANKS\_FAIL\_NEXTYEAR_t^{MSA} = \alpha + \beta * HHI_t^{MSA} + X_t^{MSA\prime} \Gamma + \varepsilon_t^{MSA}$

The next two rows in the panel fit similar regressions, where the share variables are the share of banks that fail in the next four years and the share that fail ever. Not surprisingly, the results are consistent with the results in the first panel and imply that an increase in concentration of 1000 Herfindahl Index points is associated with an reduction in the share of banks failing of between 1.28 and 1.96 percentage points.

Aggregating to the MSA level permits me to assess not just the relationship between the share of banks failing and concentration but the relationship between the share of assets held at banks that will fail and concentration. This analysis goes further toward providing an estimate of the direct costs from liquidation of failing banks to the FDIC. The first row in this sequence estimates equation (19) below:

(19) $SHR\_ASSETS\_FAIL\_NEXTYEAR_t^{MSA} = \alpha + \beta * HHI_t^{MSA} + X_t^{MSA\prime} \Gamma + \varepsilon_t^{MSA}$

While the next two columns estimate two additional models, equation (20):

(20) $SHR\_ASSETS\_FAIL\_NEXT\_4\_YEARS_t^{MSA} = \alpha + \beta * HHI_t^{MSA} + X_t^{MSA\prime} \Gamma + \varepsilon_t^{MSA}$

where the dependent variable is the share of assets at banks that fail within four years, and equation (21):

(21) $SHR\_ASSETS\_FAIL\_EVER_t^{MSA} = \alpha + \beta * HHI_t^{MSA} + X_t^{MSA\prime} \Gamma + \varepsilon_t^{MSA}$

where the dependent variable is the share of assets and banks that fail ever.

The differences across the columns regressions come from the set of control variables added to the regression. For example, column (4) suggests that an increase of 1000 Herfindahl Index points is associated with a 0.23 percent decrease in the share of assets held at banks that will fail in the next year, a 1.10 percent decrease in the share of assets held at banks that will fail in the next four years, and a 1.95 percent decrease in the share of assets held at banks that will fail ever. Column (7), which controls for

MSA and year fixed effects, as well as MSA-specific trends, suggests that an increase of 500 Herfindahl Index points is associated with a 0.73 percent decrease in the share of assets held at banks that will fail ever.

This empirical estimate is an important input to an assessment of the relationship between market structure and the implicit liability from the FDIC to bank depositors. Moving from one to the other requires an assessment of the share of assets that are lost in the bank failures. James (1991) estimates that costs to the FDIC from bank failures amount to approximately one third of the value of assets of failing banks. Losses on the banks' portfolios of assets amounts to about 30 percent of assets, and these losses are primarily related to the recognition of past unrealized losses. An additional 10 percent comes from the administrative and legal costs of executing the transaction.

Matching James' estimate of the costs to the FDIC of bank failure with my empirical estimate from column (7) of Table 17 suggests that a change in market concentration of 500 Herfindahl Index points is associated with a 500* -1.45 = 0.73 percent decrease in the share of assets held at banks that will fail, at a cost to the FDIC of 0.73*0.40 = 0.29 percent of insured assets in the banking sector. With approximately $5 trillion in assets in the banking system, an increase in the Herfindahl Index of 100 points in each market would be associated with a cost to the FDIC of $2.9 billion dollars. This estimate assumes that changes in market structure do not affect the "severity" of failure, conditional on market failure. If the reductions in market concentration also increase the cost of resolution conditional on failure, then the figure above underestimates the impact of changes in market structure on the FDIC's implicit liability.

7. Conclusion

There is strong evidence that increasing concentration has been associated with reductions in the flow of bank capital to construction and land development loans, which are the highest-risk category of commercial bank loans. Robustness to a variety of control and instrumental variables strategies supports a causal interpretation of this empirical relationship. The magnitude of this effect is large: an increase in concentration from the 25^{th} to the 75^{th} percentile is associated with a 20 percent drop in the share of bank lending going to construction loans. Increasing concentration also appears to increase average bank capitalization, raise the average share of assets loaned out to borrowers, and reduce bank failure rates during this period. Because the Federal Deposit Insurance Corporation stands ready to assume the assets and liabilities of failing banks, changes in bank portfolio risk affect the value of the government's contingent liability to the banking sector, as well as the health and stability of the financial sector and the larger economy.

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Table 1

Local commercial bank deposit Herfindahl-Hirschman indexes, by MSA. Herfindahl-Hirschman Index (HHI) figures are computed from the sum of the squared market shares within a local market area according to the formula HHI = $10000*\Sigma s_i^2$,where s_i is the share of a local market's deposits held at bank i. Data provided by Phil Strahan

Year	Number of MSAs	Mean	Standard Deviation	Percentiles 25th	50th	75th	Mean	Mean
		MSA-weighted					Asset-weighted	Bank-weighted
1980	200	1884.4	806.5	1272.7	1736.2	2400.0	1680.4	1403.8
1981	200	1872.7	797.5	1280.3	1740.7	2419.5	1762.2	1413.9
1982	200	1852.4	803.5	1268.3	1684.1	2395.8	1730.9	1398.6
1983	200	1842.1	788.0	1256.5	1714.8	2292.8	1667.0	1403.6
1984	200	1894.4	768.1	1315.6	1766.0	2310.4	1642.3	1442.8
1985	200	1891.7	772.2	1287.9	1768.7	2304.9	1601.7	1412.9
1986	200	1980.4	778.8	1428.1	1882.0	2384.7	1683.2	1483.4
1987	200	1982.2	749.2	1426.6	1862.9	2373.5	1672.0	1522.5
1988	200	1916.1	761.9	1355.4	1819.1	2326.9	1597.0	1421.7
1989	200	1905.6	730.7	1332.4	1796.0	2338.6	1600.8	1452.4
1990	200	1914.5	709.4	1384.4	1810.5	2359.5	1615.0	1479.8
1991	200	1868.8	701.2	1364.8	1747.8	2235.1	1610.1	1432.0
1992	200	1907.8	722.2	1423.1	1772.1	2318.2	1691.0	1475.9
1993	200	1887.4	661.9	1422.4	1821.3	2232.0	1728.6	1493.7
1994	200	1925.2	666.9	1451.8	1784.0	2234.2	1778.7	1554.5
All years	3000	1901.7	748.5	1353.3	1782.9	2322.8	1670.3	1449.5

Table 2
Distribution of changes in local commercial bank deposit Herfindahl-Hirschman Indexes, 1980-1994. Data provided by Phil Strahan.

	Unweighted	Weighted by MSA deposits
Mean	40.8	54.3
Standard Deviation	588.9	505.8
Percentiles		
10^{th}	-709.2	-510.0
25^{th}	-257.9	-228.9
50^{th}	42.6	63.2
75^{th}	386.6	385.2
90^{th}	831.5	724.8
Inter-quartile range	644.5	614.1

Table 3
Deregulation of branching restrictions, 1980-1994. Figure in each cell shows the number of states that have by year listed in row allowed banks to branch according to the means listed in the column headings. Data provided by Phil Strahan.

	Number of states that allow branching			
Year	Through multi-bank holding companies (MBHC)	By merger and assumption (M&A)	Full branching (De novo)	By interstate bank holding companies (Interstate)
1980	38	19	15	1
1981	39	21	16	1
1982	42	22	16	3
1983	44	23	16	5
1984	46	24	17	8
1985	50	28	19	18
1986	50	30	20	28
1987	50	35	23	37
1988	50	41	28	43
1989	50	42	30	45
1990	51	46	36	46
1991	51	48	38	48
1992	51	48	38	49
1993	51	49	39	50
1994	51	50	39	50

Table 4
Descriptive statistics for sample of bank-year observations, 1980-1994. Data come from 1980-1994 fourth-quarter FDIC Reports of Condition and Income. These data are available at the Chicago Fed website, http://www.chicagofed.org.

				Percentiles				
Variable	% > 0	Mean	Stand. Dev.	10th	25th	50th	75th	90th
Bank size								
Assets	100.0	367.6	2375.3	13.8	26.0	55.7	136.2	410.8
Total loans	100.0	226.6	1595.7	6.7	13.6	30.3	77.2	238.5
Deposits	99.9	283.8	1825.7	11.7	22.8	49.0	118.8	341.1
Portfolio characteristics								
Total loans /Assets	100.0	0.561	0.149	0.367	0.475	0.574	0.659	0.730
Construction loans /Assets	80.6	0.028	0.042	0.000	0.002	0.013	0.036	0.074
Construction loans /Total loans	80.6	0.047	0.066	0.000	0.003	0.023	0.062	0.123
Commercial loans /Assets	97.9	0.141	0.100	0.031	0.066	0.122	0.194	0.277
Home mortgage loans /Assets	97.8	0.135	0.104	0.027	0.062	0.115	0.184	0.262
Nonresidential mortgage loans /Assets	93.1	0.073	0.066	0.005	0.025	0.057	0.102	0.156
Consumer loans /Assets	99.3	0.129	0.109	0.033	0.062	0.106	0.167	0.241
Net Liquid Assets /Assets	98.9	0.372	0.168	0.171	0.270	0.366	0.474	0.584
Cash /Assets	100.0	0.095	0.069	0.037	0.053	0.076	0.115	0.173
Nonperforming loans /Assets	67.2	0.008	0.014	0.000	0.000	0.003	0.010	0.021
Equity /Assets	99.6	0.089	0.062	0.056	0.066	0.078	0.095	0.124
Herfindahl-Hirschman Index (HHI)	100.0	1449.5	616.8	777.4	988.9	1332.1	1794.2	2266.4

Table 5
Commercial bank failure rates, 1980-1994. Data come from FDIC Call Reports.

Year	Number of banks	Share of banks failing: Unweighted, Next year	Next 2 years	Ever	Weighted by assets: Ever
1980	5147	0.08	0.25	8.22	6.16
1981	5114	0.18	0.47	8.56	6.89
1982	5159	0.29	0.60	9.09	7.06
1983	5015	0.36	0.86	9.59	6.83
1984	5142	0.47	1.32	10.27	7.27
1985	5166	0.77	2.19	10.22	6.98
1986	5156	1.40	3.55	9.76	6.41
1987	4878	2.13	4.80	8.90	6.59
1988	4583	2.64	4.60	7.16	4.48
1989	4422	1.94	2.94	4.79	3.74
1990	4268	0.98	1.99	2.98	2.82
1991	4077	1.01	1.55	2.04	0.70
1992	4145	0.55	0.70	1.04	0.17
1993	3840	0.13	0.23	0.49	0.08
1994	3636	0.11	0.17	0.39	0.04

Table 6
Characteristics of failing and surviving banks. Data come from FDIC Call Reports.

Characteristic	Year	All banks: Count	All banks: Mean	Banks that fail eventually: Percent of total	Banks that fail eventually: Mean	Banks that do not fail: Percent of total	Banks that do not fail: Mean
Equity /Assets	1980	5147	0.091	8.2	0.092	91.8	0.089
	1985	5166	0.088	10.2	0.089	89.8	0.082
	1990	4268	0.088	3.0	0.089	97.0	0.049
Construction loans/Assets	1980	5149	0.018	8.2	0.030	91.8	0.017
	1985	5170	0.032	10.2	0.060	89.8	0.029
	1990	4280	0.032	3.0	0.063	97.0	0.031
Construction loans/Total loans	1980	5149	0.033	8.2	0.055	91.8	0.031
	1985	5170	0.051	10.2	0.089	89.8	0.047
	1990	4280	0.052	3.0	0.092	97.0	0.051

Table 7

Contribution of portfolio components to bank failure probabilities. Each row shows estimated coefficients based on equation (8): $I(\textit{ever fail})_{i,t}^{MSA} = \alpha + \Sigma\, \beta_1 * SHR_{j,i,t}^{MSA} + \varepsilon_{i,t}$, where $I(\textit{ever fail})_{i,t}^{MSA}$ is an indicator variable set equal to 1 if bank i, observed at time t, eventually fails, and $SHR_{j,i,t}^{MSA}$ is the share of bank i's assets at time t, held in asset class j (asset classes are listed along the column headings). Equation (8) is estimated separately for each year. Data come from fourth quarter FDIC Call Reports. Number of observations ranges from 5166 to 3636.
Number of observations ranges from 5166 to 3636.

year	Net liquid assets /Assets	Home mortgage loans /Assets	Non-residential mortgage loans /Assets	Construction loans /Assets	Com-mercial loans /Assets	Consumer loans /Assets	R^2 (n)	Share of banks eventually failing
1980-1994 pool	-0.069*	-0.094*	0.070*	0.644*	0.297*	0.046*	0.067	6.64%
	(0.019)	(0.022)	(0.035)	(0.074)	(0.030)	(0.023	(69748)	
1980	0.016	-0.295*	-0.231*	0.883*	0.299*	0.079	0.044	8.22%
	(0.040)	(0.049)	(0.092)	(0.133)	(0.052)	(0.044)	(5147)	
1981	-0.036	-0.245*	-0.281*	1.055*	0.334*	0.093	0.053	8.56
	(0.038)	(0.046)	(0.095)	(0.140)	(0.048)	(0.048)	(5114)	
1982	-0.076	-0.160*	-0.156	1.045*	0.391*	0.071	0.060	9.09
	(0.046)	(0.057)	(0.102)	(0.134)	(0.056)	(0.052)	(5159)	
1983	-0.027	-0.077	-0.008	1.284*	0.447*	0.062	0.072	9.59
	(0.046)	(0.059)	(0.099)	(0.115)	(0.056)	(0.055)	(5015)	
1984	-0.015	-0.066	0.262*	1.125*	0.482*	0.086	0.081	10.27
	(0.045)	(0.059)	(0.091)	(0.096)	(0.057)	(0.054)	(5142)	
1985	-0.019	0.051	0.443*	1.021*	0.549*	0.146*	0.085	10.22
	(0.045)	(0.057)	(0.084)	(0.100)	(0.057)	(0.054)	(5166)	
1986	-0.055	0.029	0.394*	0.839*	0.509*	0.136*	0.072	9.76
	(0.045)	(0.056)	(0.078)	(0.097)	(0.057)	(0.054)	(5156)	
1987	-0.129*	-0.109*	0.357*	0.489*	0.316*	0.013	0.056	8.90
	(0.046)	(0.054)	(0.074)	(0.097)	(0.059)	(0.053)	(4878)	
1988	-0.139*	-0.196*	0.296*	0.289*	0.151*	-0.040	0.039	7.16
	(0.046)	(0.050)	(0.069)	(0.090)	(0.055)	(0.050)	(4583)	
1989	-0.051	-0.074	0.133*	0.347*	0.106*	0.002	0.021	4.79
	(0.035)	(0.041)	(0.055)	(0.074)	(0.047)	(0.041)	(4422)	
1990	0.000	-0.010	0.121*	0.341*	0.098*	0.019	0.019	2.98
	(0.029)	(0.033)	(0.045)	(0.062)	(0.039)	(0.034)	(4268)	
1991	-0.005	-0.028	0.061	0.394*	0.048	0.013	0.020	2.04
	(0.025)	(0.028)	(0.036)	(0.059)	(0.034)	(0.029)	(4077)	
1992	-0.024	-0.004	0.011	0.295*	0.017	-0.017	0.019	1.04
	(0.018)	(0.021)	(0.026)	(0.046)	(0.026)	(0.022)	(4145)	
1993	0.021	-0.003	0.035*	0.084*	0.033*	0.009	0.008	0.49
	(0.012)	(0.011)	(0.014)	(0.031)	(0.015)	(0.011)	(3840)	
1994	-0.004	-0.011	0.017	-0.016	0.020	-0.001	0.003	0.39
	(0.010)	(0.013)	(0.015)	(0.027)	(0.017)	(0.013)	(3636)	

Table 8

Regressions of portfolio shares on local commercial banking market concentration. Entries in table show regression coefficient on MSA Herfindahl Index in equation (9): $SHR_{j,i,t}^{MSA} = \alpha + \beta * HHI_t^{MSA} + X_{i,t}^{MSA}\,\Gamma + \varepsilon_{i,t}^{MSA}$, where $SHR_{j,i,t}^{MSA}$ is the share of bank i's assets (or loans), at time t, held in asset class j. The vector of controls $X_{i,t}^{MSA}$ includes bank and MSA size, MSA employment growth (predicted using lagged MSA employment shares at 2-digit SIC level and national growth rates in employment for those 2-digit SIC level employment components), and the concentration (measured by Herfindahl Index) of employment shares in the MSA. Standard errors, reported in parentheses, are corrected for clustering.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Fixed effects	None	None	Year	Region by year	MSA	MSA, year	MSA, year
Controls	None	Yes	Yes	Yes	Yes	Yes	Yes
Trends	None	None	None	None	None	None	MSA
Dependent variable							
Total loans	1.72*	2.07*	1.91*	0.74*	1.47*	1.64*	-0.92*
/Assets	(0.23)	(0.25)	(0.25)	(0.25)	(0.36)	(0.38)	(0.37)
Construction loans	-0.07	0.08	0.04	-0.14*	-0.67*	-0.65*	-0.77*
/Assets	(0.05)	(0.06)	(0.06)	(0.06)	(0.09)	(0.09)	(0.12)
Construction loans	-0.26*	-0.06	-0.13	-0.27*	-1.03*	-1.03*	-1.00*
/Total loans	(0.09)	(0.09)	(0.09)	(0.09)	(0.14)	(0.14)	(0.18)
Liquid assets	-2.15*	-2.63*	-1.96*	-0.91*	-2.92*	-1.48*	1.19*
/Assets	(0.25)	(0.26)	(0.26)	(0.27)	(0.38)	(0.36)	(0.39)
Equity	0.21*	0.22*	0.23*	0.03	0.63*	0.81*	0.73*
/Assets	(0.08)	(0.08)	(0.09)	(0.09)	(0.14)	(0.15)	(0.18)

Table 9

Regressions of portfolio shares on local commercial banking market concentration, selected samples of banks. Entries in table show regression coefficient on MSA Herfindahl Index in equation (9): $SHR_{j,i,t}^{MSA} = \alpha + \beta * HHI_t^{MSA} + X_{i,t}^{MSA} \Gamma + \varepsilon_{i,t}^{MSA}$, where $SHR_{j,i,t}^{MSA}$ is the share of bank i's assets (or loans), at time t, held in asset class j. The vector of controls $X_{i,t}^{MSA}$ includes bank and MSA size, MSA employment growth (predicted using lagged MSA employment shares at 2-digit SIC level and national growth rates in employment for those 2-digit SIC level employment components), and the concentration (measured by Herfindahl Index) of employment shares in the MSA. Standard errors, reported in parentheses, are corrected for clustering.

	(1)	(2)	(3)	(4)	(5)	(6)
Sample	Small, never-merging banks (N=19663)		Well-capitalized banks (N=31318)		Poorly-capitalized banks (N=37932)	
Fixed effects	MSA, year	MSA, year	MSA, year	MSA, year	MSA, year	MSA, year
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Trends	None	MSA	None	MSA	None	MSA
Dependent variable						
Total loans /Assets	0.40	-2.03*	1.26*	-1.28*	2.26*	-0.44
	(0.71)	(0.67)	(0.53)	(0.60)	(0.47)	(0.50)
Construction loans /Assets	-0.76*	-0.94*	-0.47*	-0.50*	-0.74*	-0.92*
	(0.17)	(0.21)	(0.13)	(0.18)	(0.13)	(0.18)
Construction loans /Total loans	-1.23*	-1.32*	-0.74*	-0.59*	-1.20*	-1.21*
	(0.26)	(0.32)	(0.20)	(0.26)	(0.19)	(0.26)
Liquid assets /Assets	-0.23	2.65*	-1.55*	1.45*	-2.12*	0.74
	(0.66)	(0.67)	(0.50)	(0.63)	(0.47)	(0.56)
Equity /Assets	0.85*	1.05*	0.94*	1.19*	0.13	0.34
	(0.30)	(0.38)	(0.26)	(0.34)	(0.59)	(0.07)

Table 10
Regressions of portfolio shares on local commercial banking market concentration, selected samples of MSAs. Entries in table show regression coefficient on MSA Herfindahl Index in equation (9): $SHR_{j,i,t}^{MSA} = \alpha + \beta * HHI_t^{MSA} + X_{i,t}^{MSA}\,\Gamma + \varepsilon_{i,t}^{MSA}$, where $SHR_{j,i,t}^{MSA}$ is the share of bank i's assets (or loans), at time t, held in asset class j. The vector of controls $X_{i,t}^{MSA}$ includes bank and MSA size, MSA employment growth (predicted using lagged MSA employment shares at 2-digit SIC level and national growth rates in employment for those 2-digit SIC level employment components), and the concentration (measured by Herfindahl Index) of employment shares in the MSA. Standard errors, reported in parentheses, are corrected for clustering.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Sample	MSAs with increases in concentration (N=40766)		MSAs with decreases in concentration (N=28484)		Excluding least concentrated MSA-year observations (N=50479)		Least concentrated (HHI < 1000) MSA year observations (18771)	
Fixed effects	MSA, year	MSA, year	MSA, year	MSA, year	MSA, year	MSA, year	MSA, year	MSA, year
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Trends	None	MSA	None	MSA	None	MSA	None	MSA
Dependent variable								
Total loans /Assets	3.70* (0.47)	0.16 (0.47)	-2.47* (0.64)	-2.38* (0.62)	0.02 (0.42)	-1.14* (0.40)	9.83* (1.08)	0.49 (1.94)
Construction loans /Assets	-0.68* (0.14)	-0.72* (0.16)	-0.91* (0.17)	-0.84* (0.19)	-0.94* (0.11)	-1.24* (0.28)	1.07* (0.29)	0.72 (0.44)
Construction loans/Total loans	-1.11* (0.21)	-0.97* (0.24)	-1.21* (0.25)	-1.06* (0.27)	-1.35* (0.16)	-1.24* (0.19)	0.92* (0.47)	0.83 (0.69)
Liquid assets /Assets	-4.17* (0.45)	0.28 (0.50)	2.27* (0.65)	2.37* (0.70)	-0.31 (0.41)	1.22* (0.42)	-9.04* (1.11)	0.32 (2.16)
Equity /Assets	1.24* (0.20)	0.74* (0.20)	0.88* (0.28)	0.73* (0.33)	0.56* (0.16)	0.86* (0.18)	1.59* (0.49)	0.05 (0.86)

Table 11

Regressions of portfolio shares on local commercial banking market concentration, selected samples of banks. Entries in table show regression coefficient on MSA Herfindahl Index in equation (9): $SHR_{j,i,t}^{MSA} = \alpha + \beta * HHI_t^{MSA} + X_{i,t}^{MSA}\,\Gamma + \varepsilon_{i,t}^{MSA}$, where $SHR_{j,i,t}^{MSA}$ is the share of bank i's assets (or loans), at time t, held in asset class j. The vector of controls $X_{i,t}^{MSA}$ includes bank and MSA size, MSA employment growth (predicted using lagged MSA employment shares at 2-digit SIC level and national growth rates in employment for those 2-digit SIC level employment components), and the concentration (measured by Herfindahl Index) of employment shares in the MSA. Standard errors, reported in parentheses, are corrected for clustering.

	(1)	(2)	(3)	(4)	(5)	(6)
Sample	MSAs where no banks have failed yet (N=34630)		Banks with positive construction lending in all periods (N=37196)		Banks with above-mean construction lending in all periods (N=34407)	
Fixed effects	MSA, Year	MSA, Year	MSA, Year	MSA, Year	MSA, Year	MSA, Year
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Trends	None	MSA	None	MSA	None	MSA
Dependent variable						
Total loans	0.87*	-0.47	1.52*	0.06	1.36*	0.27
/Assets	(0.49)	(0.56)	(0.44)	(0.41)	(0.45)	(0.42)
Construction loans	-0.35*	-0.20	-0.73*	-0.82*	-0.79*	-0.84*
/Assets	(0.12)	(0.17)	(0.13)	(0.18)	(0.14)	(0.19)
Construction loans	-0.48*	-0.12	-1.10*	-1.08*	-1.17*	-1.09*
/Total loans	(0.18)	(0.24)	(0.20)	(0.25)	(0.22)	(0.27)
Liquid assets	-1.30*	-0.09	-1.62*	-0.08	-1.44*	-0.40*
/Assets	(0.51)	(0.64)	(0.43)	(0.43)	(0.45)	(0.44)
Equity	0.79*	-0.06	0.59*	0.63*	0.61*	0.67*
/Assets	(0.23)	(0.28)	(0.12)	(0.15)	(0.13)	(0.16)

Table 12
Instrumental variable regressions of portfolio shares on local commercial banking market concentration. Entries in table show regression coefficient on MSA Herfindahl Index in equation (9): $SHR_{j,i,t}^{MSA} = \alpha + \beta * HHI_t^{MSA} + X_{i,t}^{MSA}\,\Gamma + \varepsilon_{i,t}^{MSA}$, where $SHR_{j,i,t}^{MSA}$ is the share of bank i's assets (or loans), at time t, held in asset class j. The vector of controls $X_{i,t}^{MSA}$ includes bank and MSA size, MSA employment growth (predicted using lagged MSA employment shares at 2-digit SIC level and national growth rates in employment for those 2-digit SIC level employment components), and the concentration (measured by Herfindahl Index) of employment shares in the MSA. Standard errors, reported in parentheses, are corrected for clustering. Increment to R^2 from adding branching deregulation instruments to first stage regression is 0.0182. For state political control variables, increment to R^2 is 0.0469.

	(1)	(2)	(3)	(4)	(5)	(6)
Instruments for concentration	None (OLS)		Intrastate branching deregulation (IV)		State political party variables (IV)	
Fixed effects	MSA, Year	MSA, Year	MSA, Year	MSA, Year	MSA, Year	MSA, Year
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Trends	None	MSA	None	MSA	None	MSA
Dependent variable						
Total loans /Assets	1.64*	-0.92*	-13.81*	139.48	11.72*	-17.69*
	(0.38)	(0.37)	(2.59)	(92.00)	(2.05)	(4.70)
Construction loans /Assets	-0.65*	-0.77*	-4.05*	7.93	0.52	-3.65*
	(0.09)	(0.12)	(0.69)	(12.95)	(0.46)	(0.90)
Construction loans /Total loans	-1.03*	-1.00*	-5.58*	1.11	-0.20	-5.43*
	(0.14)	(0.18)	(1.06)	(18.35)	(0.72)	(1.36)
Liquid assets /Assets	-1.48*	1.19*	1.94	-88.36	-13.02*	21.81*
	(0.36)	(0.39)	(2.46)	(66.11)	(2.17)	(4.83)
Equity /Assets	0.81*	0.73*	2.27*	-15.55	5.63*	3.60*
	(0.15)	(0.18)	(1.01)	(19.80)	(0.98)	(1.70)

Table 13
Regressions of portfolio shares on market concentration, before and after deregulation. Entries in table show regression coefficients β^R , β^{NR}, and δ from equation (11): $SHR_{j,i,t}^{MSA} = \alpha + \beta^R * HHI_t^{MSA} * NOBRANCH_t^{MSA} + \beta^{NR} * HHI_t^{MSA} * (1 - NOBRANCH_t^{MSA}) + \delta * (1 - NOBRANCH_t^{MSA}) + X_{i,t}^{MSA}\, \Gamma + \varepsilon_{i,t}^{MSA}$, where $SHR_{j,i,t}^{MSA}$ is the share of bank i's assets (or loans), at time t, held in asset class j. The vector of controls $X_{i,t}^{MSA}$ includes bank and MSA size, MSA employment growth (predicted using lagged MSA employment shares at 2-digit SIC level and national growth rates in employment for those 2-digit SIC level employment components), and the concentration (measured by Herfindahl Index) of employment shares in the MSA. All regressions include controls including bank and MSA size, (predicted) MSA employment growth, and the concentration of employment shares in the MSA. Standard errors, reported in parentheses, are corrected for clustering.

	(1)	(2)	(3)	(4)	(5)	(6)
Branching deregulation measure	Intrastate branching by merger allowed		Intrastate de novo branching allowed		Interstate branching allowed	
Fixed effects	None	MSA, year	None	MSA, year	None	MSA, year
Dependent variable						
Construction Loans/Assets						
HHI*NOBRANCH	-0.38*	-0.88*	-0.30*	-0.71*	-0.11	-0.94*
	(0.06)	(0.09)	(0.06)	(0.09)	(0.06)	(0.10)
HHI*(1-NOBRANCH)	0.31*	-0.30*	0.25*	-0.25*	0.26*	-0.19
	(0.08)	(0.11)	(0.11)	(0.12)	(0.08)	(0.09)
NOBRANCH	0.21	1.20*	-0.47*	1.12*	0.12	1.00*
	(0.15)	(0.13)	(0.21)	(0.15)	(0.13)	(0.12)
Change in ratio with deregulation at mean HHI	1.09	-0.19	1.52	-0.26	0.58	0.44
Construction Loans/Total Loans						
HHI*NOBRANCH	-0.70*	-1.31*	-0.61*	-1.08*	-0.31*	-1.41*
	(0.10)	(0.15)	(0.09)	(0.14)	(0.10)	(0.16)
HHI*(1-NOBRANCH)	0.27*	-0.60*	0.24	-0.51*	0.16	-0.44*
	(0.13)	(0.16)	(0.17)	(0.18)	(0.12)	(0.15)
NOBRANCH	0.33	1.50*	-0.50	1.53*	0.08	1.12*
	(0.24)	(0.21)	(0.32)	(0.24)	(0.20)	(0.20)
Change in ratio	1.51	-0.28	2.12	-0.54	0.81	0.68

Table 14
Sample statistics for data aggregated to MSA level. Data from fourth quarter FDIC Call Reports, 1980-1994; MSA totals constructed by summing individual bank observations. Employment data from Census County Business Patterns, available at http://fisher.lib.virginia.edu.

Variable	Mean	Standard deviation	Percentiles				
			10th	25th	50th	75th	90th
Banking sector size							
Assets	8547.0	20776.4	449.1	940.7	2125.9	5995.1	21926.9
Total Loans	5268.2	13671.6	251.0	510.4	1208.5	3469.9	13353.5
Deposits	6597.2	15926.8	388.8	811.2	1829.9	4904.1	16165.8
Aggregate bank portfolio characteristics							
Total loans /Assets	0.579	0.087	0.467	0.521	0.579	0.636	0.685
Construction loans /Assets	0.028	0.026	0.005	0.010	0.021	0.038	0.061
Construction loans/ Total loans	0.047	0.040	0.009	0.019	0.036	0.065	0.098
Liquid assets /Assets	0.314	0.123	0.158	0.254	0.327	0.393	0.456
Equity /Assets	0.074	0.015	0.058	0.065	0.073	0.081	0.090
MSA employment statistics							
Real estate employment /Total employment	0.013	0.007	0.006	0.008	0.012	0.016	0.021
Constr. Employment /Total employment	0.060	0.045	0.033	0.041	0.053	0.070	0.091

Table 15

MSA-level regressions of portfolio shares on market concentration. Entries in table show regression coefficient on MSA Herfindahl Index in equation (12): $SHR_{j,t}^{MSA} = \alpha + \beta * HHI_t^{MSA} + X_t^{MSA\prime}\,\Gamma + \varepsilon_t^{MSA}$, where $SHR_{j,t}^{MSA}$ is the share of the MSA's banking sector assets (or loans), at time t, held in asset class j. The vector of controls X_t^{MSA} includes MSA size, MSA employment growth (predicted using lagged MSA employment shares at 2-digit SIC level and national growth rates in employment for those 2-digit SIC level employment components), and the concentration (measured by Herfindahl Index) of employment shares in the MSA. Data come from fourth quarter FDIC Call Reports, 1980-1994; MSA totals constructed by summing individual bank observations. Employment data from Census County Business Patterns, available at http://fisher.lib.virginia.edu.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Fixed effects	No	No	Year	Region by year	MSA	MSA, year	MSA, year
Controls	No	Yes	Yes	Yes	Yes	Yes	Yes
Trends	None	None	None	None	None	None	MSA
Dependent variable							
Total Loans	0.77*	1.24*	1.07*	0.36*	0.91*	0.25	-1.65*
/Assets	(0.21)	(0.21)	(0.21)	(0.18)	(0.43)	(0.40)	(0.43)
Construction loans	-0.47*	-0.34*	-0.37*	-0.43*	-0.56*	-0.71*	-0.73*
/Assets	(0.06)	(0.06)	(0.06)	(0.05)	(0.12)	(0.11)	(0.13)
Construction loans	-0.86*	-0.69*	-0.72*	-0.77*	-0.84*	-1.04*	-0.98*
/Total loans	(0.10)	(0.10)	(0.10)	(0.08)	(0.17)	(0.16)	(0.18)
Liquid assets	-0.68*	-1.78*	-1.58*	-1.07*	-1.36*	-1.09*	1.20*
/Assets	(0.30)	(0.30)	(0.23)	(0.22)	(0.69)	(0.46)	(0.53)
Equity	0.07*	-0.03	-0.05	-0.11*	-0.11	-0.11	-0.08
/Assets	(0.04)	(0.04)	(0.03)	(0.03)	(0.08)	(0.07)	(0.09)
Real estate employment	-0.17*	-0.10*	-0.10*	-0.08*	-0.03*	-0.05*	-0.08*
/Total employment	(0.02)	(0.02)	(0.02)	(0.01)	(0.02)	(0.02)	(0.02)
Construction employment	-0.34*	-0.28*	-0.27*	-0.22*	-0.07	-0.13	-0.28*
/Total employment	(0.07)	(0.10)	(0.10)	(0.10)	(0.16)	(0.17)	(0.12)

Table 16

Market structure and bank failure probabilities. In the first three columns, each row shows estimated coefficients based on equation (13): $I(\textit{ever fail})_{i,t}^{MSA} = \alpha + \beta * HHI_t^{MSA} + X_{i,t}^{MSA}\Gamma + \varepsilon_{i,t}$, where $I(\textit{ever fail})_{i,t}^{MSA}$ is an indicator variable set equal to 1 if bank i, observed at time t, eventually fails, and $SHR_{j,i,t}^{MSA}$ is the share of bank i's assets at time t, held in asset class j (asset classes are listed along the column headings). Equation (13) is estimated separately for each year. For the second three columns, each row shows estimated coefficients based on equation (14): $SHR\_EVER\_FAIL_{i,t}^{MSA} = \alpha + \beta * HHI_t^{MSA} + X_t^{MSA}\,\Gamma + \varepsilon_t$. Number of observations for individual bank regressions ranges from 5166 to 3636; for MSA-level regressions number of observations is always 200. Data come from fourth quarter FDIC Call Reports.

Sample Controls	Individual banks: None	Individual banks: Region	Individual banks: Region, Bank size, MSA size	Aggregated to MSAs: None	Aggregated to MSAs: Region	Aggregated to MSAs: Region, MSA size	N	Share of banks that eventually fail
Year								
1980	-1.64* (0.59)	-0.97 (0.61)	-0.86 (0.64)	-1.47 (0.94)	-1.95* (0.68)	-1.92* (0.69)	200 MSAs 5147 banks	8.22%
1981	-1.86* (0.61)	-1.15 (0.63)	-1.03 (0.65)	-1.46 (0.96)	-1.99* (0.71)	-1.97* (0.72)	200 (5114)	8.56
1982	-2.04* (0.64)	-1.44* (0.65)	-1.25 (0.68)	-1.47 (0.94)	-2.13* (0.73)	-2.10* (0.73)	200 (5159)	9.09
1983	-2.09* (0.69)	-1.19 (0.68)	-0.79 (0.72)	-1.61 (0.99)	-1.80* (0.76)	-1.78* (0.76)	200 (5015)	9.59
1984	-4.68* (0.71)	-2.44* (0.70)	-2.21* (0.75)	-2.81* (1.01)	-2.76* (0.78)	-2.72* (0.79)	200 (5142)	10.27
1985	-5.89* (0.70)	-2.53* (0.70)	-2.17* (0.76)	-3.29* (0.96)	-2.61* (0.69)	-2.52* (0.71)	200 (5166)	10.22
1986	-6.05* (0.66)	-2.41* (0.66)	-1.89* (0.73)	-3.15* (0.91)	-2.47* (0.67)	-2.33* (0.68)	200 (5156)	9.76
1987	-3.04* (0.67)	-1.10 (0.64)	-0.09 (0.70)	-2.26* (0.97)	-1.86* (0.69)	-1.69* (0.70)	200 (4878)	8.90
1988	-3.59* (0.59)	-1.47* (0.58)	-0.39 (0.65)	-1.85* (0.90)	-1.52* (0.68)	-1.34 (0.70)	200 (4583)	7.16
1989	-2.00* (0.52)	-1.16* (0.53)	-0.23 (0.59)	-1.29* (0.63)	-1.25* (0.54)	-1.02 (0.55)	200 (4422)	4.79
1990	-0.34 (0.43)	-0.29 (0.44)	0.59 (0.51)	-0.45 (0.53)	-0.47 (0.50)	-0.31 (0.50)	200 (4268)	2.98
1991	-0.51 (0.37)	-0.55 (0.38)	0.12 (0.44)	-0.53 (0.40)	-0.39 (0.38)	-0.27 (0.38)	200 (4077)	2.04
1992	0.62* (0.25)	-0.15 (0.27)	0.38 (0.31)	0.15 (0.23)	0.14 (0.24)	0.23 (0.24)	200 (4145)	1.04
1993	0.23 (0.18)	-0.12 (0.19)	0.19 (0.23)	0.00 (0.19)	0.00 (0.19)	0.03 (0.19)	200 (3840)	0.49
1994	0.08 (0.17)	-0.15 (0.18)	0.06 (0.22)	-0.08 (0.23)	-0.02 (0.25)	-0.02 (0.25)	200 (3636)	0.39

Table 17

Regressions of failure rates on market concentration. Reported coefficients based on equations (14) through (19) in the text. Controls include bank and MSA size. Equation (14) is a linear probability model regression at the bank level of a dummy for failing on market structure $I(\textit{fail in next year})_{i,t}^{MSA} = \alpha + \beta * HHI_t^{MSA} + X_t^{MSA\prime}\,\Gamma + \varepsilon_t^{MSA}$. Equation (15) is a regression at the MSA level of the share of banks failing on market structure: $SHR\_FAIL\_NEXTYEAR_t^{MSA} = \alpha + \beta * HHI_t^{MSA} + X_t^{MSA\prime}\,\Gamma + \varepsilon_t^{MSA}$. Data come from fourth quarter FDIC Call Reports. Standard errors, reported in parentheses, are corrected for clustering.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Fixed effects	None	None	Year	Region by year	MSA	MSA, year	MSA, Year
Controls	None	Yes	Yes	Yes	Yes	Yes	Yes
Trends	None	None	None	None	None	None	MSA
Dependent variable							
			Unit of observation is the bank-year				
Bank fails in next year?	-0.29*	-0.30*	-0.34*	-0.10	0.07	-0.06	-0.37
	(0.05)	(0.06)	(0.06)	(0.06)	(0.15)	(0.15)	(0.26)
Bank fails in next 4 years?	-1.63*	-1.75*	-1.59*	-0.46	-1.84*	-1.33*	-2.97*
	(0.21)	(0.24)	(0.24)	(0.24)	(0.42)	(0.42)	(0.55)
Bank fails ever?	-2.55*	-2.71*	-2.15*	-0.70	-2.92*	-1.64*	-2.00*
	(0.34)	(0.38)	(0.37)	(0.37)	(0.49)	(0.50)	(0.44)
			Unit of observation is the MSA-year				
Share of banks failing next year	-0.20*	-0.19*	-0.20*	-0.16*	-0.22	-0.31	-0.35
	(0.06)	(0.07)	(0.07)	(0.06)	(0.18)	(0.18)	(0.26)
Share of banks failing in next 4 years	-0.96*	-0.94*	-0.93*	-0.77*	-1.68*	-1.85*	-2.83*
	(0.16)	(0.17)	(0.16)	(0.13)	(0.39)	(0.37)	(0.50)
Share of banks failing ever	-1.55*	-1.53*	-1.40*	-1.28*	-1.71*	-1.42*	-1.96*
	(0.22)	(0.22)	(0.22)	(0.16)	(0.43)	(0.39)	(0.36)
Share of assets held at banks failing in next year	-0.26*	-0.27*	-0.29*	-0.23*	0.04	-0.08	-0.12
	(0.09)	(0.09)	(0.09)	(0.08)	(0.24)	(0.24)	(0.35)
Share of assets held at banks failing in next 4 years	-1.28*	-1.35*	-1.38*	-1.10*	-0.57	-0.86	-2.09*
	(0.21)	(0.22)	(0.21)	(0.18)	(0.50)	(0.49)	(0.67)
Share of assets held at banks failing ever	-2.17*	-2.33*	-2.20*	-1.95*	-0.32	-0.03	-1.45*
	(0.29)	(0.29)	(0.29)	(0.23)	(0.54)	(0.51)	(0.43)

Figure 1

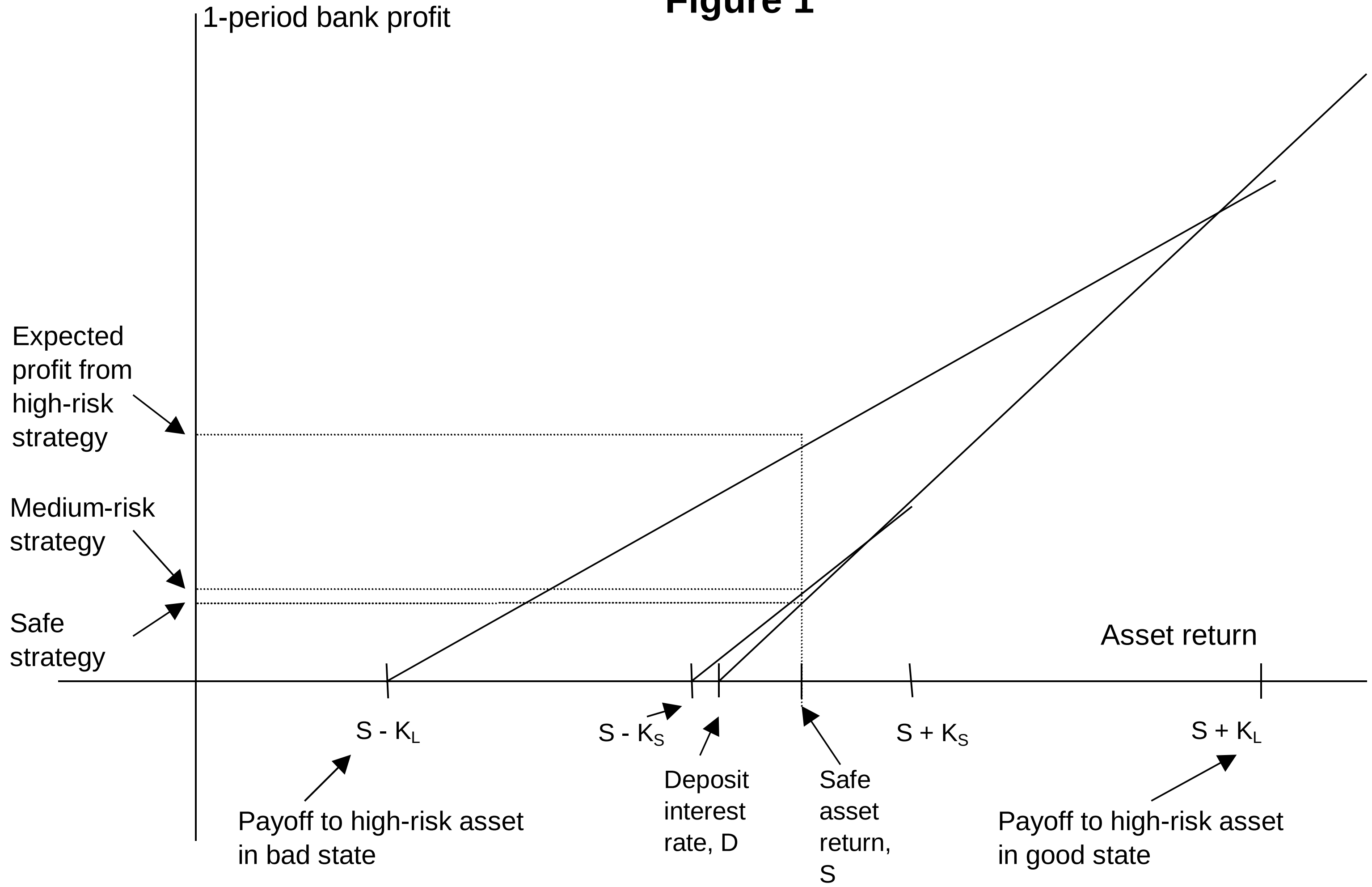
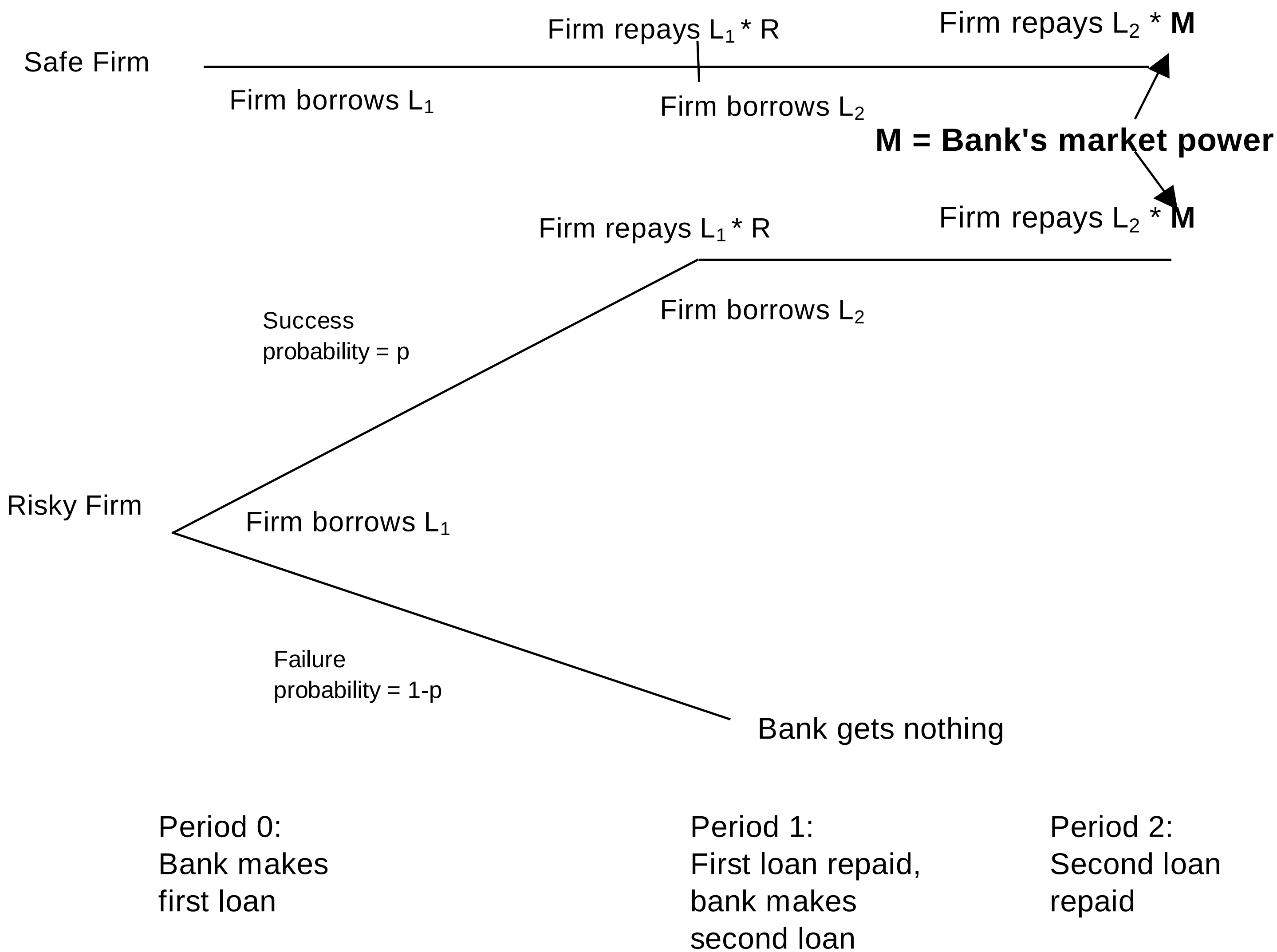

1-period bank profit
Expected profit from high-risk strategy
Medium-risk strategy
Safe strategy
Asset return
S - K_L
S - K_S
S + K_S
S + K_L
Deposit interest rate, D
Safe asset return, S
Payoff to high-risk asset in bad state
Payoff to high-risk asset in good state

Figure 2


Firm repays L1 * R
Firm repays L2 * M
Safe Firm
Firm borrows L1
Firm borrows L2
M = Bank's market power
Firm repays L1 * R
Firm repays L2 * M
Firm borrows L2
Success
probability = p
Risky Firm
Firm borrows L1
Failure
probability = 1-p
Bank gets nothing
Period 0:
Bank makes
first loan
Period 1:
First loan repaid,
bank makes
second loan
Period 2:
Second loan
repaid