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LOAN COMMITMENTS AND BANK RISK EXPOSURE

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ABSTRACT

Loan commitments increase a bank's risk by obligating it to issue future loans under terms that it might otherwise refuse. However, moral hazard and adverse selection problems potentially may result in these contracts being rationed or sorted. Depending on the relative risks of the borrowers who do and do not receive commitments, commitment loans could be safer or riskier on average than other loans. The empirical results indicate that commitment loans tend to have slightly better than average performance, suggesting that commitments generate little risk or that this risk is offset by the selection of safer borrowers.

INTRODUCTION

Increases in off-balance sheet activities by financial institutions have generated a recent surge of interest in these activities. This paper analyzes the risks to banks associated with loan commitments, one of the largest off-balance sheet activities. Such an analysis is important from a public policy viewpoint. Increases in commitments and other off-balance sheet activities have helped to encourage both a public perception of increased risk-taking behavior by banks and regulatory responses to reduce this risk. Unfortunately, little evidence is available on the risk to banks associated with commitments. This paper attempts to fill this gap by modeling and estimating the relationship between loan commitments and bank credit risk.

The theoretical model focuses on the risk to banks from commitment contracts and how this risk may be affected by the processes that determine which borrowers receive these contracts. Several results emerge. All else being equal, a commitment issued to a given borrower for a given project increases a bank's credit risk. Risk is entailed because the bank is locked into lending to a borrower who might suffer a decline in creditworthiness that would otherwise dictate either a higher interest rate or no loan at all. However, all else may not be equal on commitment contracts -- the borrowers and projects financed under commitment may be very different from those financed in the spot loan market. We model two such differences that can be generated by the presence of moral hazard or adverse selection problems.

First, the bank may provide commitment financing for some projects or borrowers that have greater credit risk than would occur with spot market financing alone because the bank has less information when commitment contracts are signed than when spot loan contracts are signed. This lack of information may allow some borrowers to switch to riskier projects (moral hazard) or allow some riskier borrowers to obtain loans that would not be allowed in the spot market (adverse selection). Second, the bank may not offer commitment contracts on the same terms to borrowers associated with these informational difficulties as to other borrowers. Consequently, some borrowers may be rationed or sorted out of commitment contracts and have to wait to finance their projects in the spot market after their informational difficulties have been resolved. If borrowers who do not receive commitment contracts tend

to have riskier projects than those who do, and if this difference in risk is relatively large, then loans issued under commitment could actually be safer on average than other loans. Similarly, banks with high proportions of commitment loans could be relatively safe if these conditions hold. Alternatively, if borrowers who do not receive commitment contracts tend to have safer projects, then the risks created by commitment contracts are augmented.

Thus, the theory finds the relationship between bank credit risk and commitments to be ambiguous. Plausible conditions are derived under which commitment loans are either riskier or safer than spot loans. These conditions are such that a variety of outcomes are likely to occur among different banks, borrowers, markets, and time periods. The important empirical question is to what extent loans under commitment are riskier or safer *on average* than conventional spot loans, i.e., to what extent the conditions that imply riskier or safer commitment loans occur more frequently. Empirical quantification of the exact linkages between the underlying market conditions and commitment risk is also of interest, but as discussed below, such quantification is not possible with existing data sources.

Given the importance of commitment loans, which comprise about one-quarter of all loans and more than one-half of all commercial loans by large commercial banks, it is somewhat surprising that the relationship between commitments and bank risk has not previously been empirically analyzed. The empirical analysis presented here attempts to fill this gap in the literature. We examine the relationship between commitments and bank risk using data from a little-used Federal Reserve Board survey of commitment activity. The data indicate that loans issued under commitment appear to have slightly better performance on average than other loans. This evidence suggests that either little risk is generated by commitments or that the risk that is generated is offset by rationing or sorting processes that tend to link commitment contracts with safer borrowers.

The paper is organized as follows. Section I provides background information on the institutional environment and reviews the theoretical literature. Sections II and III describe the theoretical and empirical results, respectively. Section IV presents conclusions.

I. BACKGROUND INFORMATION

Institutional Environment. Loan commitments issued by U.S. commercial banks fall into two broad categories: formal commitments and confirmed lines of credit. Formal commitments (two-thirds of the total dollars) are promises to lend up to a certain amount within a certain time period at a preset interest rate, usually a fixed markup over a reference rate such as the prime or LIBOR. Whether and when a loan is taken down under the commitment are at the borrower's discretion. Contract features may include revolving credits, where funds may be borrowed and repaid without additional fee, or term loans, which are subject to prepayment penalties. The bank is usually compensated in the form of fees charged on unused balances (e.g., 25 to 50 basis points per year) plus up-front fees and usage fees in some cases.

Formal commitments are used to back many commercial and industrial loans, construction and land development loans, leveraged buyouts, mergers, and acquisitions. Anecdotal evidence suggests two major motives behind their use. The liquidity/flexibility motive is that commitments allow the loan paperwork and evaluation to be performed in advance, permitting funds to be obtained quickly and cheaply exactly when expenditures are required. In some cases, commitments facilitate the funding of multilateral projects for which some of the funding must be in place in advance to assure other parties. Also included under this motive is protection against general "credit crunches," assuring funds availability when credit market conditions are tight. Morgan (1989) showed theoretically how commitments can solve a credit rationing problem, and Sofianos, Wachtel, and Melnik (1990) demonstrated empirically that commitments appear to insure against general credit crunches.

The other major motive for formal commitments is that of risk-averse firms insuring against a potential decline in their creditworthiness. A firm can lock in an interest rate consistent with its current risk class (e.g., prime plus 1 percent), obligating the bank to lend in the future at that rate even if the firm's risk class worsens (e.g., to prime plus 2 percent). In the

limit, a commitment contract may insure funds availability when a firm's decline in credit-worthiness would otherwise result in it being denied a loan altogether. This risk-sharing motive was discussed by Campbell (1978).

Evidence from a recent survey (Board of Governors of the Federal Reserve System [1988]) is consistent with these motives. The most highly ranked reasons given for revolving commitments were "general convenience and minimizing loan arrangement costs," and "protection against general credit crunches," both of which are consistent with the liquidity/flexibility motive. The next most highly ranked reasons were "to ensure credit access against a creditworthiness deterioration," and "to lock in a fixed markup over a reference interest rate," both of which are consistent with the risk aversion motive.

A bank can escape its obligation to lend on a formal commitment only if the borrower's condition has suffered "material adverse change," or if the borrower has violated some other covenant in the commitment contract. Although material adverse change clauses are somewhat vague, banks may nevertheless honor commitments to borrowers to whom they would otherwise refuse credit or charge a higher rate in order to maintain the bank's reputation for future commitments or to avoid legal costs. Note that if banks did not generally lend under commitment when circumstances would dictate different spot market loan terms or rationed credit, then commitments would lose much of their insurance value and firms would not purchase them for the protections cited above. This is discussed further in section II.

Confirmed lines of credit is the other broad category of loan commitment (one-third of the total dollars). These are expressions of a bank's willingness to lend to a customer that are normally extended in order to insure liquidity or to provide third-party guarantees for the commercial paper market or other lenders.[1] Confirmed lines have much lower fees than formal commitments and are generally viewed as much less risky because (1) they usually are issued to higher quality borrowers, (2) they often confer no interest-rate guarantees, and (3) they are taken down much less frequently than formal commitments.

Theoretical Literature Review. The theoretical literature has focused primarily on motivating why commitments exist. Most studies argue that commitments arose primarily as

contingent contracts that helped to perfect financial markets (see Campbell [1978], Thakor [1982], James [1982], and Melnik and Plaut [1986a]). Some recent articles motivate commitments as solutions to moral hazard and adverse selection problems that arise in spot loan markets. Boot, Thakor, and Udell (1987) and Berkovitch and Greenbaum (1990) concentrate on moral hazard. In their models, the two-part pricing structure of commitments (an up-front fee plus a loan interest rate) allows a bank to charge a lower loan interest rate without violating the zero-profit competitive constraint. This lower interest rate reduces moral hazard by encouraging the borrower to take into account a higher proportion of the investment returns. Turning to adverse selection, Thakor and Udell (1987) show that multiple fee structures on commitments (up-front fee, usage fee, and interest rate) can solve some adverse selection problems on spot loan contracts by inducing self-selection, provided that takedown probabilities are related to risk. Similarly, Kanatas (1987) finds that up-front fees on lines of credit that back up commercial paper sales can reduce adverse selection problems by revealing risk.

Our approach differs from those in the literature in several important respects. First, we focus on the credit risk exposure of commercial banks from loan commitments. Given the concerns of policy makers (as well as banks) with regard to bank risk, such an analysis is important. Second, we focus on the moral hazard and adverse selection problems *created* by commitments, rather than viewing commitment contracts as a means of alleviating these problems on spot contracts. Third, we focus on the processes by which some borrowers receive commitment contracts and others must wait for spot loan contracts. The latter two considerations are shown to have important implications for the relationship between commitments and bank risk.[2] Finally, in section III, we conduct an empirical analysis of the average association between commitments and bank risk.

II. A MODEL OF LOAN COMMITMENTS

Consider a firm with a project to be financed at a future date through a debt contract. Before the project is undertaken, additional information will be revealed to all parties about the firm's prospects. If the information indicates a decline in creditworthiness, the firm may

be unable to obtain future financing or may have to pay a higher interest rate for it than if the information were favorable. The firm is risk averse and is therefore willing to pay an up-front fee for a commitment that will guarantee future financing at a known interest rate. The bank is risk neutral and operates in a competitive market, and so will offer this guarantee if it can earn the competitive rate of return on the commitment contract. Under certain circumstances, the bank may be able to exercise an option to refuse funding, but this can only be done at a cost.

The model presented here focuses on formal commitment contracts that hedge a borrower's risk stemming from a potential decline in its creditworthiness. It abstracts from confirmed lines of credit and the liquidity/flexibility motive for commitments. However, the results concerning the risk to banks essentially carry through to confirmed lines, because any commitment contract obligates a bank to honor terms that it may prefer to refuse under some states of nature. In addition, as discussed at the end of this section, the same basic results hold if liquidity/flexibility replaces risk aversion as the motive in the model.

The model has three periods. At t=0, a borrowing firm seeks a commitment for a \$1 loan to finance project α at t=1, with the loan to be repaid at t=2. The bank may give a commitment to lend at a prespecified interest rate and be paid an up-front fee at t=0. Alternatively, it may wait until t=1 and then decide whether to offer a spot loan to the firm and, if so, at what interest rate. Project α has a payoff $g_\alpha(s)$ at t=2, where $s \in S$ is the state of nature at t=2. There is a two-point payoff function: $g_\alpha(s) = x_\alpha$ if $s \in S_\alpha$, and $g_\alpha(s) = 0$ if $s \notin S_\alpha$, where $S_\alpha \subset S$ is the subset of states in which project α is successful. The borrower's liability to repay the loan at t=2 is limited to $g_\alpha(s)$. It is assumed that a loan backing project α has a non-diversifiable component, so that its addition to the bank's portfolio increases credit risk.[3]

A critical difference between a loan commitment and a spot loan is that a smaller information set is available when the commitment is considered. When a commitment contract is considered at t=0, all parties know that the economic environment for project α will either be "good" (G) or "bad" (B), where G indicates a higher probability of success, i.e., $P(s \in S_\alpha | G) > P(s \in S_\alpha | B)$, or $P_{\alpha G} > P_{\alpha B}$ for short. The probabilities of these environments at t=0 are P(G) and

P(B). When spot loans are considered at t=1, the environment has been revealed to all parties. Thus, at t=0, the unconditional probability of success, $P_{\alpha} \equiv P(G) \cdot P_{\alpha G} + P(B) \cdot P_{\alpha B}$, is used, which is replaced at t=1 by the more accurate conditional probability, $P_{\alpha G}$ or $P_{\alpha B}$.

The market's risk-free, gross rate of interest (1 plus the net rate), denoted by r_m, is assumed to be constant over time. The bank is risk neutral and competitive and therefore must expect to earn r_m on both spot and commitment contracts. If the economic environment $\theta = G$ or B is revealed at t=1, then the gross interest rate charged in the spot loan market is $r_{\alpha\theta} = r_m/P_{\alpha\theta}$, provided that $x_{\alpha} \cdot P_{\alpha\theta}$ is at least as large as r_m. Otherwise, the project has a negative present value and is uncreditworthy, so that credit is refused in the spot loan market.

We consider here the case of a bank that can distinguish between two groups of loan applicants, one that generates no information problems for the bank, and one that is subject to a moral hazard problem. This case is sufficiently rich in possible outcomes to demonstrate how commitment loans may be riskier or safer than other loans. We then discuss how adverse selection can create essentially the same outcomes as moral hazard.

We first consider the bank's treatment of loan applicants who have no information problems. These applicants are risk averse and have identical projects i (i.e., $\alpha = i$), where project i is creditworthy in the spot market under at least the good economic environment (and possibly both environments), so that $x_i \cdot P_{iG} > r_m$. It is assumed that commitment contracts specify the interest rate from environment G, r_{iG}, as the guaranteed interest rate. This simplifies the model and makes it adhere to market practice, but does not affect the basic conclusions.[4] If environment B is revealed and a loan is issued under commitment, the bank will take an expected value loss relative to its opportunity cost of $[r_m - r_{iG} \cdot P_{iB}]$ at t=2. It is assumed that the bank cannot refuse credit under the provisions of the commitment contract simply because the bad environment has been revealed. In a competitive equilibrium, an up-front fee, f_i, compensates the bank for its expected loss discounted to t=0:

$$f_i = P(B) \cdot [r_m - r_{iG} \cdot P_{iB}]/r_m^2. \qquad (1)$$

We assume that the bank does not keep the fee income in the form of increased capital to defray the risk created by commitments, but rather pays it out in dividends or (more likely) uses it to replace capital that would otherwise have to be raised. This allows for a cleaner examination of the direct effects of commitments on bank risk and is consistent with the observation that most commitments are issued by banks that are at or near the regulatory minimum capital standards.

The borrowers are willing to pay up to a reservation fee, $\bar{f}_i$, such that their expected utility at t=0 is equal for signing the commitment or waiting for a spot contract at t=1, where $\bar{f}_i$ satisfies:

$$P_i \cdot u(x_i - r_{iG} - \bar{f}_i \cdot r_m^2) + (1 - P_i) \cdot u(-\bar{f}_i \cdot r_m^2) =$$

$$\begin{cases} P(G) \cdot P_{iG} \cdot u(x_i - r_{iG}) + P(B) \cdot P_{iB} \cdot u(x_i - r_{iB}) + (1 - P_i) \cdot u(0) & \text{if } P_{iB} \cdot x_i \geq r_m \quad (2a) \\ P(G) \cdot P_{iG} \cdot u(x_i - r_{iG}) + (1 - P(G) \cdot P_{iG}) \cdot u(0) & \text{if } P_{iG} \cdot x_i \geq r_m > P_{iB} \cdot x_i \quad (2b) \end{cases}$$

where P_i is the unconditional probability of success at t=0 and u is the borrowers' utility function with $u' > 0$ and $u'' < 0$. Equation (2a) applies if project i is creditworthy in the spot market under either environment, while equation (2b) applies if spot market financing would not be forthcoming under environment B. If $\bar{f}_i \geq \underline{f}_i$, a commitment is issued at the competitive fee $\underline{f}_i$.

We state without proof that for borrowers such as these who invest in the *same* project under either a commitment or spot contract, bank credit risk can only be increased and not decreased by a commitment. This holds because when the unfavorable environment B is revealed, a commitment might obligate the bank to issue loans under contract terms it would otherwise refuse.[5] As shown below, however, the borrowers and projects do not always remain the same under a commitment as under a spot contract because of moral hazard and adverse selection problems. As a result, the overall relationship between commitments and risk is ambiguous.

We next consider the bank's treatment of loan applicants who have moral hazard problems. These applicants have access to identical projects j that are creditworthy over all

future economic environments (i.e., $P_{j\theta} \cdot x_j > r_m$, $\theta = G,B$). However, they also have the opportunity to switch into identical riskier projects k, but cannot do both projects.[6] Project k has a lower success probability but a higher payoff when successful than project j, which may be conveniently parameterized as

$$P_{k\theta} = e \cdot P_{j\theta}, \quad x_k = (x_j/e) - a > x_j, \qquad \theta = G,B, \tag{3}$$

where $e \in (0,1)$ is the ratio of success probabilities between projects k and j and $a \geq 0$ is a shift parameter. If $a > 0$, then project k has lower expected returns than project j. For certain parametric values, project k is uncreditworthy (has negative present value) under one or both economic environments $[(x_j - ea) \cdot P_{j\theta} < r_m]$.

The timing and information assumptions are as follows. At t=0, the bank knows the applicants' preferences and the distributions of returns on projects j and k, but it does not have sufficient information to differentiate between them in writing in a loan commitment contract. After the bank offers or refuses commitment contracts to these applicants, the applicants choose whether to take the commitment (if offered) and make irrevocable decisions about which project (j or k) to undertake. At t=1, the bank learns both the environment type (G or B) and which project (j or k) has been undertaken.[7] At that time, if no commitment has been issued, the bank can choose loan terms or refuse credit in the spot market. If a commitment has been issued and project k has been chosen, the bank may invoke the material adverse change or other clause in the commitment contract and refuse to extend credit at the agreed-upon terms, but only at a cost A. This cost may be thought of as arising because the bank and borrowers share more information about the borrowers' actions (project j or k) and environment (G or B) than do other parties. The bank must incur the costs of informing the market or the legal system that the commitment was justifiably dishonored because the borrowers shifted into a riskier project, rather than because of a change in the economic environment for which insurance was purchased. Otherwise, the bank may lose its reputation for providing insurance against "bad" environments or lose a lawsuit.[8,9]

Note that in contrast to other models of loan commitments, the moral hazard problem in this model occurs *because* of the existence of commitments. This is because commitment

contracts must be signed in advance of spot loan contracts, when less information is available to the lender and more opportunities to increase project risk are available to the borrowers.

There are three possible outcomes for the identifiable sets of borrowers who are characterized by moral hazard, depending upon parametric values. Commitments may be issued, with borrowers choosing either project j or k, or commitments may be rationed and spot loans issued only to finance project j. Formally, at t=0, borrowers would choose project k given the commitment terms for project j if

$$e \cdot P_j \cdot v[(x_j/e) - a - r_{jG} - \underline{f}_j \cdot r_m^2] + (1 - e \cdot P_j) \cdot v(-\underline{f}_j \cdot r_m^2) >$$

$$P_j \cdot v(x_j - r_{jG} - \underline{f}_j \cdot r_m^2) + (1 - P_j) \cdot v(-\underline{f}_j \cdot r_m^2), \qquad (4)$$

where r_{jG} is the interest rate specified in the commitment contract (the spot market rate from the good environment) and v is the borrowers' utility function with $v' > 0$ and $v'' < 0$. If a borrower does undertake project k under the terms for project j, the bank loses in expected value if it lends at t=1. Given that the project choice is identified to the bank at that time, the bank would do so only if the expected costs from lending on project k were less than the costs of exercising its option to refuse credit (A), i.e., if

$$A > [r_m - r_{jG} \cdot e \cdot P_{j\theta}]/r_m, \qquad \text{where } \theta \text{ is known to be G or B.} \qquad (5)$$

If condition (4) holds and condition (5) also holds (under one or both economic environments), then no commitment offering the terms for project j would be offered by the bank, since it would lose in expected value on such a contract. A commitment contract offering terms consistent with project j would be agreed upon only if the borrower is sufficiently risk averse or the expected return on project k is sufficiently low so that condition (4) does not hold, or if the cost of breaking the commitment is sufficiently low so that condition (5) does not hold. In the latter case, borrowers would be credibly deterred from choosing project k, knowing that the commitment would be broken.

If conditions (4) and (5) both hold, then the borrower and the bank may agree to commitment contract terms that compensate the bank for its losses on project k. This would

occur if the borrowers' expected utilities were higher from financing project k under commitment than from financing project j in the spot market due to the insurance aspect of commitments, i.e., if

$$e \cdot P_j \cdot v[(x_j/e) - a - r_{jG} - \underline{f}_k \cdot r_m^2] + (1 - e \cdot P_j) \cdot v(-\underline{f}_k \cdot r_m^2) >$$

$$P(G) \cdot P_{jG} \cdot v(x_j - r_{jG}) + P(B) \cdot P_{jB} \cdot v(x_j - r_{jB}) + (1 - P_j) \cdot v(0), \qquad (6)$$

where $\underline{f}_k$ is the fee that would compensate the bank for its expected losses on project k (from equation [1]). Condition (6) would be likely to hold if e is close to one and a is close to zero, so that project k itself is not much riskier and has almost the same expected return as project j. If conditions (4) and (5) hold but condition (6) does not, then no commitment agreement is possible. The borrowers must wait until t=1 for the moral hazard problem to be resolved and finance project j in the spot market.

Two important empirical consequences of moral hazard on the relationship between commitments and bank risk can now be identified. First, depending on parametric values, moral hazard may result in a riskier project being financed under commitment than would be the case under spot market financing. This occurs when borrowers choose to increase risk and take advantage of the bank (condition 4), it is not profitable for the bank to exercise its option to refuse credit under commitment (condition 5), and borrowers prefer the protection of a commitment to the reduced risk of the safer project (condition 6). This is most likely to occur when the cost of refusing credit under commitment is relatively high and the increase in risk from switching projects is relatively low.

Second, commitment loans may be either safer or riskier than spot market loans, depending on whether moral hazard borrowers are rationed out of commitments and whether their projects are safer or riskier than those of borrowers without moral hazard problems. All borrowers without moral hazard problems receive commitments to finance project i, provided that $\bar{f}_i \geq \underline{f}_i$. If the moral hazard borrowers are rationed out of commitments and must wait for spot market loans to finance project j (which occurs when conditions [4] and [5] hold but condition [6] does not), then the relative risk of commitment and spot market loans depends in

part on the relative risks of projects i and j. Specifically, if j is riskier than i and the difference in risk is large relative to the risks created by the commitment contract itself on project i, then commitment loans may actually be safer than spot market loans. However, rationing can also have the opposite effect. If project i is riskier than project j, then rationing increases the risks of commitment loans relative to spot loans beyond the risks created by the commitment contracts themselves.

Although we do not present a formal derivation here, the lack of information available at t=0 when commitment contracts are considered can create adverse selection problems as well as moral hazard problems. The consequences for the relationship between commitments and loan risk are virtually the same for both problems. Adverse selection arises if there is a group of borrowers whose projects have different payoffs, but the bank cannot distinguish among them until t=1. As with moral hazard, commitments may result in riskier projects being financed, since there may be a pooling equilibrium in which borrowers with both creditworthy and uncreditworthy projects receive commitments. Also as with moral hazard, commitment loans may be riskier or safer than spot market loans, since the entire adverse selection group may be rationed out of commitments, or a sorting equilibrium may occur in which some choose commitments and others choose spot market loans. Under either rationing or sorting, the relative risk of commitment loans and spot market loans depends in part on the relative risks of the underlying projects financed under each contract type.[10]

In sum, three separate associations between bank risk and loan commitments are identified. First, when the borrowers and projects are unchanged by the availability of commitment contracts, bank risk is unambiguously increased by commitments because in some states of nature the bank is committed to honor loan contract terms that it might otherwise refuse. Second, moral hazard and adverse selection problems created by commitments may cause a bank to finance riskier projects than it would under spot loan contracts, further adding to bank risk. Finally, because of moral hazard or adverse selection problems, some creditworthy borrowers may be rationed or sorted and have to wait and borrow on the spot market once these problems are resolved. This makes ambiguous whether loans under commitment are safer or

riskier than spot market loans and whether banks with high proportions of loans under commitment are safer or riskier than other banks.

It may also be seen that these results generally hold even if risk aversion is not the motivation behind the demand for commitment contracts. Suppose that the utility functions (u and v) were replaced by risk-neutral utility functions with a positive constant added if a loan were made under commitment, representing the liquidity/flexibility motive for commitments discussed above. This would tend to exacerbate the moral hazard and adverse selection problems because risk-neutral borrowers would be even more likely to take on risky projects for given commitment contract terms. The basic ambiguity with respect to whether commitments are associated with safer or riskier loans and banks would remain.

III. EMPIRICAL RESULTS

The arguments presented above suggest that while commitments increase a bank's risk exposure, the rationing or sorting of commitments among borrowers according to their association with moral hazard and adverse selection problems could offset this risk and make loans issued under commitment safer on average than other loans. Undoubtedly, conditions that give rise to either relatively risky or safe commitment loans both occur to some degree for various banks, borrowers, and time periods. This section investigates the policy question of whether commitment loans are riskier or safer *on average* than other loans. In particular, we examine the relationship between loan performance and whether the loan was issued under commitment. The results may be interpreted as an examination of whether, overall, the conditions giving rise to relatively risky or safe commitment loans occur more frequently.

Ideally, the examination should be made at the individual loan level, but both commitment and performance information in our data sources are only available at the bank level. Data are taken from a Federal Reserve survey of commitment use and matched with information from the Report of Condition and Income (Call Report). We regress measures of the current performance of a bank's portfolio -- the share of nonperforming loans (past due, nonaccruing, and renegotiated), the net charge-off rate, and the rate of earning on assets (income)

-- against the share of the bank's loans that were made under commitment at several points in the past. The nonperforming loan and charge-off regressions are used to examine whether commitment loans tend to have higher losses than other loans. Similarly, the income regressions are used to examine whether losses are adequately compensated for by fees.

Note that we test the average relationship between commitments and risk, rather than testing the individual conditions derived in the theoretical model. Tests of the frequency of occurrence of individual model conditions would require data on individual borrowers, loans, and markets, which are unavailable with our data set. However, note also that none of the previous empirical studies of commitments has examined the relationship between commitments and risk at all because their data sets were even more limited than the one used here.[11]

Our primary focus is on the relationship between loans taken down under commitment and loan performance, since commitments create measured losses only after loans have been taken down.[12] The relationship between unused commitment lines and performance is investigated as well, because unused lines create future bank liability and risk and are regarded by policy makers as a major source of risk.[13] The regressions with unused lines are, in effect, reduced forms that combine the effects of making takedowns possible with any performance differences after takedown.

The definitions and sample means of the variables used are presented in table 1. The data were drawn from two sources. Banks report only one summary item on unused commitments in the Call Report, and this information has only been collected since 1983. However, the Federal Reserve has also collected monthly data on used and unused commitment lines for a sample of approximately 125 large commercial banks since 1973.[14] These survey data were aggregated to semiannual form for each of the survey banks and matched with the balance sheet and performance variables drawn from the Call Report, giving semiannual observations from 1973 to 1986. The pre-1975 observations were discarded because lags are used in the analysis, leaving a sample of 2,827 observations, including 23 semiannual time periods, with the number of banks ranging from 127 in 1975 to 109 in 1986.[15] The sample includes virtually all of the largest U.S. commercial banks. As of December 1986,

sample banks held 47.6 percent of all bank assets and 78.8 percent of all unused commitment lines.

Table 2 displays the regressions for the three measures of loan performance -- nonperforming loans (NONPERFORM), net loan charge-offs (CHARGE-OFF), and net income (INCOME). The model in column 1 reflects the relationship between a bank's current ratio of nonperforming loans (NONPERFORM) and its share of loans drawn under commitment (USEDCOM) for four semiannual lags. Column 2 shows a similar model using the ratio of unused commitment lines to total loans (UNUSEDCOM). In both cases, data on formal commitments and confirmed lines are combined, but as noted below, separate treatment of the two types of commitments yields similar results. In each model, variables are added for the proportions of different types of loans in the bank's portfolio (LOANCO, AG, REALEST, DEALER, CONSUME) and the log of total assets (LOGTA) to control for loan characteristics other than commitment that are related to performance, as well as potential bank scale effects. These same variables are included in the CHARGE-OFF and INCOME regressions. The INCOME regressions also include contemporaneous commitments to allow for current fee income and additional variables for other assets (SECURITY, MUNIS, FEDFUNDS) and liabilities (DEMAND, TIME, FOREIGN) to control for other income.[16]

The sum of the lagged commitment coefficients (denoted as TOTAL) and its associated t-statistic are displayed for each regression. We focus attention on the sum as the appropriate statistic, rather than on the individual lagged coefficients, because the sum captures the total effect of the commitment over the life of the loan. For instance, if commitments were to be associated with a decrease in performance at one lag distance and an increase in performance of the same amount at another lag distance, the sum would appropriately record this as no net positive or negative relationship on average between commitments and risk.

Each regression also includes dummy variables for *each* bank and *each* time period (not displayed) to control for any systematic variation across banks or across time that may be related to both loan performance and commitment use, possibly creating a spurious relationship. The inclusion of the bank and time dummies implies that the regression coefficients

measure the relationship between a bank's performance at a given time and its commitment activity with the systematic factors particular to that bank and that time period removed. The use of these variables allows for a purer test of the relationship between commitments and bank performance than is possible with virtually any other control variables.

The coefficient sums in table 2 are generally small and suggest that commitment loans may be associated with lower bank risk and better loan performance. Five of the six sums indicate fewer problem loans or higher bank income associated with commitments, with three of the six significant at the 10 percent level or better. Whether these results are interpreted as a modest positive relationship between commitments and bank performance or as a negligible relationship, they clearly suggest that either commitments create little risk, or that the rationing or sorting of relatively risky borrowers out of commitment contracts offsets this risk.

Although the reported results combine the data from formal commitments and confirmed lines, regressions were also run on these categories separately and the results were qualitatively unchanged. The findings are also robust to a number of other variations that are not displayed. These include splitting the sample by time period, varying lag lengths, including used and unused lines in the same regressions, adjusting the performance measures (e.g., nonperforming loans split by type, gross charge-offs, pre-tax income), adding more control variables, and dropping the time or bank dummy variables, or both. As in the displayed results, only modest relationships between commitments and performance were found, and except in the simplest regressions lacking all control variables, the statistically significant results generally implied that commitments were associated with better bank performance.

IV. CONCLUSIONS

Loan commitments play important roles in commercial bank lending, yet little is known about their implications for bank risk. The model presented here shows that all else being equal, commitments unambiguously increase a bank's risk exposure, and that this exposure may be increased further by the moral hazard and adverse selection problems created by commitments. However, some borrowers associated with these problems may also be rationed or

sorted out of commitment contracts and borrow on the spot loan market when more information becomes available to clear up these problems. If the projects of borrowers associated with these problems are riskier on average than the projects of other borrowers, and if this difference in risk is large relative to the risks created by the commitment contracts themselves, then loans under commitment and banks with high proportions of these loans could actually be safer than other loans and banks, respectively. Of course, if the rationed or sorted borrowers have safer than average projects, then the risks created by commitment contracts may be augmented.

The empirical results link commitment use with slightly better than average loan performance in a model with numerous controls for bank, time, and portfolio variables. These findings are robust to a number of specification changes. This evidence suggests that either commitments create little real risk to banks, or that the rationing or sorting of relatively risky borrowers out of commitment contracts offsets the risk created by commitments.

FOOTNOTES

1. Kanatas (1987) shows that lines of credit backing commercial paper issues can credibly transmit credit quality information to other lenders.

2. Kanatas' (1987) model also has sorting in which some borrowers do not receive commitment contracts. However, his model focuses on back-up lines of credit, where third parties generally provide the financing rather than the bank.

3. Although we assume that the bank is risk neutral, regulators and policy makers may still be concerned about its risk.

4. In practice, the rate guaranteed in a commitment contract typically reflects the borrower's current risk class (e.g., prime plus 1 percent) and insures against the relatively small probability that its risk class will worsen (e.g., to prime plus 2 percent). Presumably, the current rate (corresponding to r_{iG}) is specified so that in the most likely environment of no substantial change in risk, the liquidity/flexibility of the commitment is maintained and any search or renegotiation costs of resetting the interest rate are avoided.

5. Note that if at t=1, environment B is revealed and project i is uncreditworthy, it would be Pareto-improving for the bank not to fund the project and instead make a side payment to each borrower of the bank's expected losses at t=2 discounted to t=1. This would increase each borrower's expected return and eliminate the borrower's risk. Despite these arguments, such side payments do not occur, perhaps because of transactions or monitoring costs.

6. The switch to a riskier project could take the form of underinvestment in developing a single project, as in Boot, Thakor, and Udell (1987).

7. The bank may become better informed about projects between t=0 and t=1 for several reasons, including (1) the borrower has incurred project-specific developmental costs, (2) specific plans have been filed for construction or development, (3) contracts with other counterparties have been signed, (4) a specific site has been chosen, etc.

8. See Boot, Thakor, and Udell (1988) for a more explicit model of the legal verification process. In that model, *ex post* verification of unwarranted breach of contract is state-dependent.

9. Alternatively, we could have assumed the limiting case where the information known to the bank and borrower about the environment and project chosen could not be verified at any cost by third parties. In this case, advance contract terms cannot possibly be written based on realization of the future environment. A similar assumption is made by Boot, Greenbaum, and Thakor (1990) in a model of financial guarantees with ambiguity. A similar assumption is also made in a different context by Diamond (1990).

10. See our working paper (Avery and Berger, 1989) for a complete moral hazard-adverse selection model.

11. Sofianos, Wachtel, and Melnik (1990) and Glick and Plaut (1989) used time series data on aggregate commitments. Koppenhaver (1987) used bank-level data, but only examined whether banks do or do not issue commitments. Brewer, Koppenhaver, and Wilson (1986) used bank-level data, but only on unused commitments. Melnik and Plaut (1986b) and Ham and Melnik (1987) did use data on individual loan commitments, but they lacked information on loan performance.

12. Clearly, a bank may incur an economic loss on a commitment contract before a loan is taken down. However, accounting losses are booked only on the loan itself, making the loan performance measures the correct variables on which to focus.

13. For example, unused commitment lines figure prominently in the international risk-based capital accord.

14. Board of Governors of the Federal Reserve System, Commercial and Industrial Loan Commitments at Selected Large Commercial Banks, Statistical Release G.21. This series was discontinued in August 1987.

15. Data on nonperforming loans are only available since June 1983, so only 1,038 observations are used with this dependent variable. Note that some banks did drop from the survey over time, primarily due to mergers. In constructing the charge-off and income variables, the

June values, which represent only half-year totals, were multiplied by a conversion factor (approximately two) so that their means equal the December means.

16. It is not suggested that this is a fully developed bank profit function with an exhaustive list of control variables. For example, the Call Report loan data are not broken out by type of industry or country of origin.

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Table 1

VARIABLE DEFINITIONS AND SAMPLE MEANS

Symbol	Definition	Sample Mean
	PERFORMANCE MEASURES	
NONPERFORM	Ratio of nonperforming loans (including past-due, nonaccruing, and renegotiated) to total loans (available only since June 1983)	.049
CHARGE-OFF	Ratio of net charge-offs to total loans	.005
INCOME	Ratio of net income to assets	.006
	COMMITMENT VARIABLES	
USEDCOM	Ratio of loans against commitments to total loans	.246
UNUSEDCOM	Ratio of unused commitments to total loans	.433
	CONTROL VARIABLES	
LOANCO	Ratio of loan types likely to be used for commitments (C&I, real estate development, and finance company loans) to total loans	.603
AG	Ratio of agricultural loans to total loans	.011
REALEST	Ratio of consumer real estate loans to total loans	.116
DEALER	Ratio of loans to security dealers to total loans	.020
CONSUMER	Ratio of consumer loans to total loans	.178
LOGTA	Log of total assets (in $1,000's)	15.042
SECURITY	Ratio of taxable securities to total assets	.087
MUNIS	Ratio of municipal bonds to total assets	.070
FEDFUND	Ratio of net federal funds sales minus purchases to total assets	-.069
DEMAND	Ratio of demand deposits to total assets	.251
TIME	Ratio of time deposits to total assets	.397
FOREIGN	Ratio of foreign deposits to total assets	.093

Source: Board of Governors of the Federal Reserve System.

Table 2

REGRESSION RESULTS

Exogenous Variables	Dependent Variable NONPERFORM (1)	(2)	Dependent Variable CHARGE-OFF (3)	(4)	Dependent Variable INCOME (5)	(6)
USEDCOM-0	---	---	---	---	.005**	---
					(2.59)	
USEDCOM-1	.000	---	-.006*	---	-.000	---
	(.02)		(2.55)		(.10)	
USEDCOM-2	.017	---	.000	---	-.001	---
	(1.21)		(.18)		(.55)	
USEDCOM-3	-.028*	---	.002	---	.000	---
	(2.01)		(.72)		(.07)	
USEDCOM-4	-.007	---	.002	---	-.001	---
	(-.65)		(.56)		(.32)	
USEDCOM (TOTAL)	-.018*		-.002		.003	
	(2.30)		(1.30)		(1.83)	
UNUSEDCOM-0	---	---	---	---	---	.001
						(1.22)
UNUSEDCOM-1	---	.003	---	-.000	---	-.002
		(.50)		(.05)		(1.31)
UNUSEDCOM-2	---	-.008	---	-.002	---	.002
		(1.12)		(1.56)		(1.31)
UNUSEDCOM-3	---	.005	---	-.002	---	.002
		(.74)		(.96)		(1.34)
UNUSEDCOM-4	---	.001	---	.002	---	-.002
		(.13)		(.92)		(1.65)
UNUSEDCOM (TOTAL)		.001		-.003**		.001
		(.24)		(2.68)		(.73)
LOANCO	-.006	-.007	.019**	.019**	-.005*	-.005*
	(.60)	(.65)	(7.55)	(7.60)	(2.13)	(2.18)
AG	.051	.052	-.045**	-.046**	.016	.016
	(.82)	(.82)	(3.57)	(3.62)	(1.44)	(1.43)
REALEST	.006	.011	.017**	.017**	-.012**	-.012**
	(.37)	(.71)	(4.49)	(4.63)	(3.54)	(3.62)
DEALER	-.116**	-.117**	-.011	-.010	.004	.003
	(3.79)	(3.80)	(1.54)	(1.36)	(.67)	(.54)
CONSUMER	-.022	-.020	.016**	.016**	.001	.001
	(1.63)	(1.47)	(4.85)	(4.90)	(.26)	(.22)
LOGTA	-.002	-.002	-.003**	-.003**	.004**	.004**
	(.96)	(1.21)	(5.63)	(5.47)	(8.30)	(8.33)
SECURITY	---	---	---	---	-.001	-.001
					(.51)	(.53)
MUNIS	---	---	---	---	.039**	.039**
					(9.87)	(9.82)
FEDFUND	---	---	---	---	-.003	-.003
					(1.05)	(1.10)
DEMAND	---	---	---	---	.019**	.019**
					(6.32)	(6.31)
TIME	---	---	---	---	.013**	.013**
					(5.50)	(5.45)
FOREIGN	---	---	---	---	.003	.003
					(1.04)	(.99)
R-SQUARED	.15	.16	.15	.15	.10	.10
SAMPLE SIZE	1038		2827		2827	
DATES	(1983 - 1986)		(1975 - 1986)		(1975 - 1986)	

* (**) Significantly different from zero at the 5 percent (1 percent) level, two-sided.
Separate intercepts for each bank and each time period were included but not reported.
Absolute values of t-statistics are in parentheses.
Source: Board of Governors of the Federal Reserve System.