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Theories of Bank Loan Commitments

by O. Emre Ergungor

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Introduction

Bank loan commitments—contractual promises to lend to a specific borrower up to a certain amount at prespecified terms—are widely used in the economy. A recent Federal Reserve survey shows that 79 percent of all commercial and industrial lending is made under commitment contracts.[1] Moreover, as of March 2001, outstanding (unused) loan commitments of U.S. corporations exceeded $1.6 trillion, up from $743 billion in 1990.[2]

As the use of loan commitments has grown, so has the literature on them. This article seeks to summarize what we have learned after years of research and to determine whether we have a reasonable idea of what value loan commitments provide to borrowers and lenders.

Two features of loan commitment contracts—various fees, which must be paid over the life of the commitment, and the material adverse change (MAC) clause—turn out to be particularly important in theoretical models.[3]

The fee structure may include a commitment fee, which is an up-front fee paid when the commitment is made, an annual (service) fee, which is paid on the borrowed amount, and a usage fee, which is levied on the available unused credit. A loan commitment contract seldom includes all three kinds of fees together. Booth and Chua (1995) study a sample of 1,347 loans and find that only 46 percent had a commitment fee, 38 percent had an annual fee, and 69 percent had a usage fee. A loan commitment without a fee structure is rare but possible.

The second important feature, the MAC clause, grants the bank some measure of discretion over whether to honor the contract. A typical MAC clause reads: "Prior to [loan] closing, there shall not have occurred, *in the opinion of the Bank,* any material adverse change in the Borrower's financial condition

■ **1** Board of Governors of the Federal Reserve System, "Survey of Terms of Business Lending," *Federal Reserve Board Statistical Releases*, E.2 (June 2000) <http://www.federalreserve.gov/releases/E2/200008/e2.pdf>.

■ **2** Federal Deposit Insurance Corporation, *Statistics on Banking*, table RC-6 (August 2001) <http://www.fdic.gov/bank/statistical/statistics/0103/cbrc06.html>.

■ **3** Because banks do not disclose the features, such as the fee structure, of the commitments they are selling, the loan commitment literature contains few empirical papers. Consequently, this article focuses on theoretical models.

from that reflected in its annual report for its fiscal year ending December 31, ____, or in the Borrower's business operations or prospects." Note that a bank may repudiate the contract based solely on *its own* opinion about a borrower's financial condition. That is, the clause allows the bank to use its private information about the borrower, which outsiders may be unable to verify.

To show what a typical loan commitment looks like, table 1 provides a sample of 15 loan commitments. To give a more informative picture, Shockley and Thakor (1997) study a sample of 2,513 variable-rate loan commitments, offering funds at a *fixed markup* over a market interest rate, purchased by very large firms. Table 2 presents their summary statistics. Shockley and Thakor find that the market interest rate used is usually prime or LIBOR (the London interbank offered rate). The borrowing firm is offered takedown alternatives of predetermined markups over several different indexes, such as Treasury, federal funds, CD, and A1/P1 commercial paper rates. These authors also observe that although few commitments carry all three fees, many combine a usage fee with either a commitment fee or an annual fee.

I organize this review around three main questions. Because these are very general, however, the literature has divided them into

TABLE 1

Sample of 15 Loan Commitment Contracts

			Fees (basis points)			
Commitment buyer	**Credit limit (millions of dollars)**	**Stated use**	**Commitment**	**Annual servicing**	**Usage**	**Take-down alternatives**
Turner Broadcasting	200	Commercial paper backup	0	0	62.5	Prime + 75, LIBOR +175, CD + 187.5
Levi Strauss	500	Debt repayment/consolidation	12.5	0	0	Prime, LIBOR + 100, CD + 112.5
Safeway Stores	480	Debt repayment/consolidation	0	0	0	Prime
Seagull Energy	60	Debt repayment/consolidation	0	12.5	17.5	Prime, LIBOR + 87.5, CD + 87.5
Blockbuster Entertainment	200	General corporate purposes	0	12.5	12.5	Prime, LIBOR + 50, CD + 62.5
J.C. Penney	750	General corporate purposes	0	0	18.75	Prime, LIBOR + 37.5
AT&T	6,000	Takeover	79.17	13	0	Prime, LIBOR + 37.5, CD + 50
Union Pacific	550	General corporate purposes	0	0	15	Prime, LIBOR + 25, CD + 37.5
UAL Corporation	1,300	Leveraged buyout	157.64	0.69	50	Prime + 100, LIBOR + 200
John Fluke Manufacturing	37.5	Stock buyback	0	0	0	Prime, LIBOR + 50, CD + 50
Universal Corporation	150	Working capital	0	14.17	0	Prime, LIBOR + 37.5
Dunkin' Donuts	35	Working capital	28.57	0	37.5	Prime, LIBOR + 100
L.A. Gear	150	Working capital	0	0	50	Prime + 100
R.H. Macy & Co.	600	Working capital	150	4.84	50	Prime + 150, LIBOR + 250
American Oil and Gas	20	Working capital	0	0	50	Prime, LIBOR + 300

SOURCE: Greenbaum and Thakor (1995).

TABLE 2

Summary Statistics of a Sample of 2,513 Loan Commitments

Mean, (Standared deviation), [Minimum–Maximum]

Stated use	N (percent of total)	Size (millions of dollars)	Duration (months)	Interest rate mark-up (basis points)		Fees (basis points)		
				Prime +	LIBOR +	Upfront	Annual	Usage
Commercial paper backup	42 (1.7)	557.5 (800.5) [30–4,300]	39 (16.3) [11–84]	45.8 (26.0) [25–75]	47.8 (37.8) [12.5–175]	3.1 (8.7) [0–50]	6.2 (7.9) [0–25]	11.4 (17.9) [0–62.5]
Liquidity	857 (34.1)	56.9 (148.7) [0.1–2,000]	28.4 (22.3) [1–126]	115.6 (73.2) [–75–500]	135.4 (81.4) [9–350]	24.2 (52.0) [0–366]	6.1 (18.7) [0–200]	22.8 (25.5) [0–400]
Capital structure	470 (18.7)	142.6 (352.0) [.2–5,500]	39.7 (26.8) [3–121]	115.6 (64.4) [–50–450]	148.4 (82.8) [15–425]	28.6 (56.7) [0–550]	3.6 (10.6) [0–100]	27.8 (21.3) [0–125]
General corporate purposes	931 (37.0)	179.1 (449.2) [.1–6,000]	38 (27.7) [1–198]	105.6 (72.9) [–50–500]	90.6 (77.2) [15–425]	18.6 (49.3) [0–550]	4.5 (11.0) [0–135]	19.6 (19.8) [0–100]
Takeover	65 (2.6)	74.6 (136.6) [0.3–845]	36.2 (25.2) [3–120]	111.3 (82.3) [12.5–450]	125.1 (80.3) [12.5–325]	13.8 (26.5) [0–100]	3.2 (8.5) [0–40]	29 (20.1) [0–50]
Leveraged buyout	137 (5.5)	139.3 (288.4) [1.5–1,848]	65.2 (26.4) [11–122]	149 (32.6) [75–400]	244.6 (43.5) [80–475]	89.8 (88.3) [0–302]	4.2 (9.6) [0–54]	40.3 (19.0) [0–62.5]
Debtor-in-possession	11 (0.4)	120 (100.9) [3.3–250]	14.2 (8.6) [1–30]	188.6 (30.3) [150–250]	293.7 (31.5) [250–325]	112.8 (106.8) [0–235]	16.7 (44.5) [0–150]	43.18 (16.2) [0–50]

SOURCE: Shockley and Thakor (1997), table 1.

smaller, related questions:

1) Why do loan commitments exist and how are they priced?
   a) Why do borrowers demand them?
   b) Why do banks offer them?
   c) Why are loan commitments sold by banks and not by individuals or other financial intermediaries?
   d) Are loan commitments put options?
   e) Why are loan commitments not exercised up to the credit limit?
2) How do loan commitments affect the bank's risk exposure?
   a) How should the bank's risk exposure be managed?
   b) Do loan commitments affect the bank's risk exposure?
   c) Should loan commitments be regulated?
3) How do loan commitments affect the interest rate and rationing channels of monetary policy?

On the first main question, presented in this article's section I, the essence of what we know is that loan commitments are a contractual mechanism for optimal risk sharing when borrowers are risk averse and future interest rates are random. Even under universal risk neutrality, loan commitments may still be used to attenuate moral hazard or resolve precontract informational asymmetry. On the valuation question, the principal insight is that loan commitments can be priced as put options where the borrower's debt is the underlying deliverable. The main findings are summarized below:

- Borrowers demand loan commitments because
  – Loan commitments prevent banks from exploiting borrowers and extracting rents by threatening to withhold credit;
  – Loan commitments can prevent market failure by attenuating moral hazard and resolving precontract informational asymmetry.

- Banks sell loan commitments because
  - Loan commitments facilitate forecasting future loan demand;
  - By honoring discretionary loan commitments, banks may enhance their reputation for keeping their promises and charge higher fees for future promises;
  - Lenders may use the fee structure of loan commitments as a screening mechanism for distinguishing among borrowers with a priori unobservable characteristics.
- Loan commitments are sold by banks alone because
  - It is more costly for an organization not to honor its contractual commitments than it is for an individual;
  - Reserves that the bank keeps to fund unexpected demand deposit withdrawals can also be used to fund unexpected loan commitment takedowns. Therefore, deposit-taking institutions have a cost advantage over other financial intermediaries in issuing loan commitments.
- Loan commitments can be priced as put options where the underlying deliverable is the debt instrument of the commitment buyer.
- Borrowers limit their loan takedown because banks penalize borrowers that fully exploit their put options with higher future fees.

The second main question, presented in section II, asks about the effect of loan commitments on the bank's risk exposure. In selling fixed-interest-rate loan commitments, banks assume the risks associated with three uncertain quantities: the future level of interest rates, the borrower's uncertain credit needs, and the borrower's future creditworthiness. The issues are how a bank can manage these risks and whether loan commitments should be regulated to protect the deposit insurer. The main conclusion is that banks have the tools they need (for example, the MAC clause) to protect themselves against the risks involved in selling loan commitments. There is little theoretical or empirical support to justify regulation. The important findings are:

- The bank cannot fully hedge against interest rate and takedown-quantity risks through financial futures contracts.
- Loan commitments reduce the bank's risk exposure by inducing it to manage its credit portfolio better.
- Capital requirements, imposed on loan commitments by regulators to protect the deposit insurer, are not needed because loan commitments with a MAC clause do not impose any additional credit risk on the bank.

The third main question, presented in section III, deals with loan commitments' effects on the transmission of monetary policy. Monetary policy is conducted through quantity rationing and interest rate channels by altering the quantity of credit and its price, the interest rate. Loan commitments help attenuate rationing by providing a guarantied source of funds, and thus reduce monetary policy's ability to affect bank lending. The main finding is:

- Loan commitments introduce significant lags in the effect of monetary policy.

While the current literature improves our understanding of loan commitments considerably, some stylized facts remain unexplained. First, courts limit banks' use of discretionary powers, often ruling that a bank's use of the MAC clause is an *abuse of power and lack of good faith*. (See Goldberg [1988], Mannino [1994], and Budnitz and Chaitman [1998]). If the MAC clause is so difficult and costly to exercise, then why do banks continue to incorporate it into contracts? Second, moral hazard in spot lending, which can be resolved by loan commitments, can also be resolved through relationship (repeated) lending (Sharpe [1990], Rajan [1992], Petersen and Rajan [1995], and Boot [2000]); why, then, do we have loan commitments? I discuss these and other unresolved issues briefly in the final section of this article.

I. The Purpose and Pricing of Loan Commitments

I will investigate the existence and pricing literature in four subsections. First, I will discuss why borrowers demand loan commitments (demand-side explanations). Then, I will explain why banks sell loan commitments (supply-side explanations). Next, I will focus on the question of why banks alone sell loan commitments. Finally, I will recapitulate what we know about the similarities between loan commitments and put options.

Demand-Side Explanations

The literature has suggested five benefits that loan commitments offer purchasers.[4]

Loan Commitments Improve Risk Sharing between the Bank and the Borrower

When a bank sells a fixed-rate loan commitment, it accepts the interest rate and quantity risk that the borrower would bear if he were to borrow in the spot market. Borrowers who are more risk-averse than the bank are willing to pay the bank a premium for taking the interest rate risk on their behalf. In Campbell (1978), the premium is the usage fee. In Thakor and Udell (1987), it is the commitment fee. With a fixed-rate commitment, the bank bears the risk of changes in the index rate as well as of changes in the borrower's credit risk premium. With a variable-rate commitment, the bank bears only the latter risk. I will further investigate this issue in section II, where I discuss the bank's risk exposure.[5]

Loan Commitments Help Attenuate Moral Hazard

With risky debt and limited liability, the higher the loan interest rate, the lower the borrower's net return from a project and the greater his incentive to switch to a riskier project (Boot, Greenbaum, and Thakor [1993]) or to undersupply effort (Boot, Thakor, and Udell [1987, 1991]). To illustrate this concept, consider the following example.

There are two periods and three points in time {0,1,2}. At time 0, the borrower knows that he needs funds next period ($t = 1$) to invest in one of two mutually exclusive projects $\{h, l\}$. Each project requires a $1 investment, which is assumed to be financed by a bank loan. The projects have the following characteristics: If the project is successful with probability μ_i, it generates a cash flow X_i, $i \in \{h, l\}$ and zero otherwise. It is also assumed that $X_h > X_l$ and $\mu_h < \mu_l$. Hence, l is a low-risk project and h is a high-risk project. It is further assumed that $X_l \mu_l > X_h \mu_h$. That is, the low-risk project is socially optimal. At time 0, the market interest rate at time 1 is random. It can be shown that when the market interest rate at time 1 is greater than $(X_l \mu_l - X_h \mu_h)(\mu_l - \mu_h)^{-1}$, the borrower prefers the risky project as a consequence of limited liability.[6]

Boot, Thakor, and Udell (1987, 1991) and Boot, Greenbaum, and Thakor (1993) propose the following solution to this problem. At time 0, the bank sells the borrower a loan commitment with a fixed interest rate of

$$R = (X_l \mu_l - X_h \mu_h)(\mu_l - \mu_h)^{-1}.$$

If the market interest rate is less than R, the borrower is free to use the market. Otherwise, he exercises his option and takes down the loan from the commitment contract. Hence, the loan commitment guarantees that the borrower always chooses the safe project. Note that the bank suffers a loss when the borrower exercises the option. To break even, the bank charges a commitment fee at time 0 equal to the expected loss to the borrower at time 1. Also note that because the commitment fee becomes a sunk cost at time 1, when the borrower makes the investment decision, it does not affect the borrower's incentives.

Boot, Thakor, and Udell also show that loan commitments are more effective than equity investment in attenuating moral hazard. The intuition is as follows: When a borrower invests in equity, he reduces his interest burden for all realizations of future interest rates. This is clearly inefficient because low interest rates are not distortionary, yet the equity still reduces the payment burden in those states. The effect of a loan commitment, on the other hand, is selective across interest rates. When market rates are low, the borrower can still benefit from them. The loan commitment reduces the interest burden only when market rates are high. Therefore, the commitment fee required to mitigate moral hazard is less than the equity investment needed to create the same effect.

■ **4** Some of these benefits arise from the possibility of solving information problems by using the multiple-fee structure. Clearly, these papers could be reviewed as part of the pricing literature discussed at the end of section I, but I prefer to group all the demand-side explanations in a single section.

■ **5** Also see Hawkins (1982) and James (1982).

■ **6** $(X_l \mu_l - X_h \mu_h)(\mu_l - \mu_h)^{-1}$ is the rate at which the borrower's expected profit from the safe project equals its expected profit from the risky project if the lender believes that the borrower will invest in the safe project and prices the loan accordingly. In other words, if the spot rate is greater than this critical value, the lender must believe that the borrower will invest in the risky project if it borrows from the spot market.

Boot, Thakor, and Udell's model explains the commitment fee and the interest rate guaranty of loan commitments. Other important aspects of the contract, such as the multiple fee structure or the MAC clause, are assumed away by simplifying modeling choices, which are summarized below.

One-period simple projects: A sure investment is made at time t and the outcome is realized at time $t+1$. After the loan commitment is purchased, no new information about the project is revealed to the borrower or the bank, which may induce parties to renegotiate or walk away from the deal. This assumption will be relaxed in the next section.

Homogeneous investors: Every investor has the same project choice at the time the loan commitment is negotiated, so problems like adverse selection are not at issue. This assumption will be relaxed when we discuss the informational role of loan commitments.

Credible precommitment: In the model of Boot, Thakor, and Udell, the bank commits itself to provide a subsidy at time 1 and is compensated for the expected subsidy at time 0. Note that at time 1, when the market rate is high, the actual subsidy is greater than the expected subsidy. Despite the obvious loss, the bank still honors the commitment. We will discuss this issue further in the "Loan Commitments Help Banks to Balance Reputational and Financial Capital Optimally" section, below.

A final caveat: The results of Boot, Thakor, and Udell apply only to fixed-rate commitments. Within their sample of 2,526 loan commitments, Shockley and Thakor (1997) found only 13 (0.5 percent) that had fixed rates. Therefore, although preventing moral hazard is a plausible reason for the existence of loan commitments, it does not seem to be the driving force behind them.

Loan Commitments Help Reduce Other Investment Distortions

Moral hazard created by debt financing is not limited to the asset-substitution problem described above. Loan commitments also address overinvestment, underinvestment, and suboptimal liquidation problems. From a modeling point of view, papers in this category use Boot, Thakor, and Udell's "tax now, subsidize later" idea but relax the "simple-project" assumption.

Consider a project with two investment periods, 0 and 1.[7] At time 0, the time-1 investment is random. A risk-neutral borrower considers only the expected time-1 investment and takes the project at time 0 if the expected net present value (NPV) is positive. With equity financing, the time-0 investment is a sunk cost at time 1, so the borrower continues the project if the expected terminal cash flows exceed the second-period investment. With debt financing, however, the borrower proceeds differently. He repays the initial loan when cash flows are realized at the end, so the initial investment is not sunk and causes underinvestment if the repayment obligation is sufficiently large.

A loan commitment with a usage fee reduces the borrower's payment burden from the first-period loan without negative profit implications for the bank. The usage fee, paid on the available unused credit, compensates the bank for the interest rate concession, but its incidence is selective across borrowers. More fortunate investors, with lower second-stage requirements, pay more because of the gap between their borrowing and the credit limit of the loan commitment. Investors with higher second-stage requirements pay smaller fees because their borrowing is closer to the credit limit. That is, borrowers with low funding needs subsidize the less fortunate borrowers, giving not-so-lucky—but still profitable—investors an incentive to proceed with their projects.

In a similar setting, Houston and Venkataraman (1996) further relax the "simple-project" assumption and analyze the firm's liquidation decision. This time, the equity-financed firm compares its liquidation value at time 1 to future cash flows and liquidates if the liquidation value is greater. With short-term debt, the initial investment is not sunk, but is a liability to be covered by the expected payoff. The firm liquidates when the debt obligation (not the liquidation value) is greater than the expected payoff. As a result, bondholders receive the liquidation value, which is less than the expected payoff. Thus, short-term debt leads to too-frequent liquidations. With long-term debt, firms never liquidate when the firm's liquidation value is less than the initial borrowing, because the liquidation value goes to bondholders. Thus, long-term debt causes too-infrequent liquidations.

A short-term loan with a loan commitment for future funding alleviates the problem. The

7 This example is from Berkovitch and Greenbaum (1991).

bank gives an interest rate subsidy and reduces the borrower's debt burden. This solves the too-frequent liquidation problem. The borrower compensates the bank with a commitment fee. However, because the fee must also be financed ex ante, the amount of debt that the firm must issue at the outset increases as well. This offsetting effect limits commitments' ability to reduce the costs of suboptimal liquidations.

One problem with this explanation is that the subsidized interest rate on the initial loan may cause overborrowing. Shockley (1995) points out that a loan commitment that includes a MAC clause mitigates this distortion; the commitment interest rate can be set low enough to prevent debt overhang, while the MAC clause allows the bank to prohibit excessive reinvestment. As usual, the bank breaks even with the commitment fee.[8] Shockley provides evidence that loan commitments reduce the cost of debt. Therefore, the capital structure of firms that use loan commitments is tilted in favor of more debt.

In all the papers discussed above, the bank provides a sufficiently low interest rate and the borrower always takes the right action. However, these papers do not consider an important question: If the bank *commits* itself to provide a subsidy, can the borrower exploit that commitment and extract rents from the bank?

Houston and Venkataraman (1994) address this question.[9] Banks acquire private information about their borrowers, which enables them to extract rents from successful firms by threatening to withhold further credit.[10] This reduces the borrower's effort input, which determines the probability that the borrower's project will turn out to be *good* or *bad*; that is, the project will have safe and positive NPV or risky and negative NPV. By providing a prearranged source of funds, loan commitments limit the lender's ability to extract rents from successful projects. However, when the bank commits itself to lend, two problems arise. The borrower may exploit the commitment and extract rents from the bank by threatening to liquidate when the project is good and continuing when liquidation is more advantageous. More specifically, when the project is bad, the borrower refuses to liquidate unless the bank is willing to share the liquidation value with the borrower. With a loan commitment, the bank charges a sufficiently high interest rate to induce liquidation. Note that this argument contradicts previous papers that found that banks reduced the interest rate by using a loan commitment to prevent debt overhang. However, as I explain next, loan commitments create a selective debt overhang problem in this model. Houston and Venkataraman assume that in a competitive banking market, the borrower's project quality may be revealed to other lenders with positive probability. So, although the high interest rate also hurts the good project, a borrower with a good project can borrow from another bank and avoid commitment financing altogether if his type is revealed. Therefore, the loan commitment's high interest rate hurts borrowers with bad projects that cannot find an alternative funding source more than it hurts borrowers with good projects. Selective debt overhang resolves the moral hazard problem because the borrower increases his effort supply to avoid the high interest rate and the bad project.

The literature shows that loan commitments also solve precontract information problems. This is what I discuss next.

Informational Role of Loan Commitments

In this section, I relax the "homogeneous investors" assumption and introduce borrowers with unobservable characteristics.

James (1981) is one of the early papers showing that loan commitment parameters can be designed to reveal a borrower's unobservable characteristics. By demonstrating that the cost of maintaining compensating balances differs among customers of different credit quality, James proved that the customer's choice of payment option can be an effective tool in separating borrowers with different credit qualities.

The observation that loan commitments can be used as a screening or signaling mechanism helps clarify a puzzle in the loan commitment market. Borrowers often purchase loan commitments in order to back up commercial paper issues. The argument is that loan commitments provide insurance to commercial paper lenders. If the borrower's cash flows are not sufficient to cover its repayment obligation, it can always take down a loan under the commitment to meet its obligation. The problem with this argument is the MAC clause. The fact

8 Also see Morgan (1993).

9 I will present a simplified version of the intuition here.

10 See, for example, Rajan (1992).

that the borrower cannot repay its commercial paper loan is sufficient reason for the bank to void the commitment. Then why do borrowers purchase back-up loan commitments? Kanatas (1987) solved this puzzle.[11] He showed that a loan commitment reduces a corporation's borrowing cost in the commercial paper market, *not* because it provides a guaranty to commercial paper investors but because the purchase of the loan commitment, along with its associated price and future borrowing rate, communicates payoff-relevant information to the commercial paper market.

The intuition is as follows: As of time 0, there are three possible states at time 1. If the firm realizes the "good" state, it will be viewed as an improved credit risk and be able to roll over its first-period commercial paper at a lower cost than it would have by exercising the commitment. Alternatively, the firm may be in one of the unobservable states in which its default risk has increased. In the "impaired" state, the firm's default probability has increased in such a way that the commitment-borrowing rate is lower than the new commercial paper rate and the commitment is exercised to repay the first-period commercial paper debt. In the "very bad" state, the firm's default risk has increased to such an extent that the commercial paper market denies the firm further credit and the bank refuses to honor the commitment. The firm is thus forced to default. Firms with a greater probability of exercising the commitment (a higher probability of being in the impaired state, given that the default risk has increased) are induced to purchase a larger commitment. An increase in the commitment fee (expressed as a percentage of the credit line) and a decrease in the interest rate with increasing probability of the impaired state is incentive compatible. Firms with a high probability of being in the impaired state recognize their greater likelihood of being able to exercise the commitment advantageously and are therefore willing to pay a higher fee. Firms with a low probability of impairment (higher likelihood of the very bad state) pay a lower fee in exchange for a higher commitment-borrowing rate in the unlikely event that they are able to exercise the commitment.

Deterioration in the borrower's credit quality is not the only risk a bank faces. Whether the borrower will actually take down the loan is another uncertainty. Thakor and Udell (1987) show that when the bank does not know borrowers' takedown probabilities, commitment and service fees[12] induce borrowers to separate themselves through contract choice. One contract will have a high commitment fee and a low service fee, whereas the other will have a low commitment fee and a high service fee. A borrower with a high takedown probability will want to avoid a large service fee because the likelihood of actually paying it is greater. On the other hand, a borrower with a low takedown probability is less averse to accepting a high service fee because the likelihood of actually paying that fee is lower. Such a borrower would like to minimize the commitment fee because it is a sunk cost that is incurred regardless of whether he exercises his commitment option. The borrower with a high takedown probability finds the large commitment fee less burdensome because it represents the price of an option that he is very likely to exercise. Thus, the difference in takedown probabilities fundamentally alters the appeal of varying combinations of commitment and service fees to different borrowers, inducing each borrower to reveal his type.

The commitment and service fee combination is not the only screening mechanism. Shockley and Thakor (1997) develop a rationale for using commitment and usage fees jointly. In their model, there are three types of borrowers: good (G), medium (M), and bad (B). G is more likely than M to have a profitable project and therefore more likely to take down the loan. B does not have a project to invest in. The bank wants to lend to G and M but not to B. In this case, the commitment fee alone is not enough to separate the types because if the fee is set to a level at which M can invest and B does not wish to invest, G will mimic M although he can pay a higher fee. Note that the commitment is more valuable to G than to M because G is more likely to exercise its option. Solving this problem requires making M's contract less attractive to G's manager. This is achieved by reducing the payoff to firm M in the state in which the loan is taken down, by increasing the interest rate. This increase diminishes the value of the commitment less for M than for G because M has a lower probability of taking down the loan. Because the bank operates in a competitive market, it reduces the commitment fee to compensate M for the higher interest rate. The

■ **11** Also see Calomiris (1989).

■ **12** The paper refers to *usage* fees, but it is more accurate to call fees levied on the borrowed amount *service* fees.

problem is that this simultaneous reduction in the commitment fee makes the contract attractive to *B*. A usage fee makes the contract expensive for *B* because he never takes down the loan. On the basis of their model, Shockley and Thakor make the following four predictions and provide evidence to support them. First, if the fee structure helps reveal the borrower's type, loan commitments should contain a pricing structure with multiple fees when the firm has assets that are hard to value or the firm's credit quality is poor. Second, there must be a negative correlation between interest rate markups and usage fees. Third, announcing a loan commitment purchase should generate an abnormal positive price reaction. Fourth, the price reaction must be greater if the commitment has a multiple fee structure because the commitment reveals information about a firm that is hard to value.

Although it is possible to obtain a full separation of types by using the multiple fee structure, this method is limited to two—or at most three—types. If there are several unobservable types, the multiple fee structure alone may not be enough to separate all of them. Thakor (1989) analyzes this case, deriving the conditions under which a forward contract is more effective than a spot contract in separating types. The intuition is that in the forward market, the future state of the world is still uncertain. If the relationship among types is such that, for each type, there is at least one state of the world where that agent type is the most likely to attain that state, state-specific subsidies can be used as an additional contracting variable. For example, at some point in time, the bank promises an agent of a given type a subsidized contract in a particular state at the next point in time. In exchange, the bank demands a fee at the first point in time. Types that are less likely to attain that state find the subsidy too expensive. A separate fee-subsidy combination can be designed to be the most attractive for each agent type.

Finally, Duan and Yoon (1993) explain how loan commitments can be used as a signaling device. Like Shockley (1995) and Morgan (1993), Duan and Yoon recognize that the subsidized funds provided by a loan commitment lead to overinvestment. So the larger a borrower's credit line is, the higher is the cost of overinvestment. Note that borrowers with high success probabilities (high expected profits) can operate at higher costs than borrowers with low success probabilities. Therefore, a borrower with a high probability of success can use overinvestment to distinguish itself from other borrowers, anticipating that it will be treated favorably in terms of loan pricing. That is, the credit limit can be used to signal a borrower's quality. Once the credit lines are in place, the firms with higher success probabilities will engage in suboptimal investments when future spot rates are higher than loan commitment rates. Thus, the signaling equilibrium destroys value.

Loan Commitments Give Borrowers a Strategic Advantage

Maksimovic (1990) shows that the structure of the borrower's industry determines the terms of loan commitments. In industries with imperfect competition, the option to acquire financing at predetermined rates enhances the borrower's strategic position and creates value for the borrower. A firm that has access to resources at a lower marginal cost than its competitors has a strategic advantage that it can exploit to gain a larger market share and higher profits. A firm can create such an advantage by purchasing, for a fixed initial fee, an option to acquire financing on favorable terms. The ability to exercise the commitment makes the firm a strategic threat to its rivals and moves the industry to an equilibrium more favorable to that firm. Therefore, it is optimal for all firms to acquire bank loan commitments, altering the industry equilibrium in the process.

All the models that attempt to explain why loan commitments exist have two major shortcomings. First, as I noted earlier, the models that assume a fixed interest rate can justify only a small fraction of the outstanding loan commitments. Second, models that rationalize the multiple fee structure as a screening mechanism are applicable only to situations in which there are at most three unobservable types of borrowers. Although Thakor (1989) allows for several types, his model imposes very strong restrictions on the attributes of types. The conclusion is that we still have a lot to learn about the significance of loan commitments' fee structure.

Supply-Side Explanations

Loan Commitments Help Lower Regulatory Taxes for Banks

Regulatory taxes are defined as the costs of the federal deposit insurance premium, the constraints placed on increased financial intermediation by regulators' capital requirements, and the opportunity cost of maintaining legally required reserves. It has been argued that off-balance-sheet activities allow banks to generate fee income and bypass regulatory taxes. For example, until the commitment is taken down, there is no loan, which means that the bank does not have to collect deposits, keep reserves, or pay deposit insurance premiums. Actually, the bank can sell the commitment, collect the fee, and avoid regulatory taxes altogether by selling the loan to another bank as soon as it is originated.[13] However, Kareken (1987) reports that there was no change in bank regulatory policy of the sort that would have prompted banks to start issuing loan commitments suddenly. From April 1969 through mid-1973, the Federal Reserve System's reserve requirement schedule was changed only once, in November 1972, when the average reserve requirement was *decreased*. The effective per dollar deposit insurance premium was not changed in that period either. In 1971, there were no minimum capital-asset ratios. Thus, regulatory taxes fail to explain the existence of loan commitments.

Loan Commitments Improve Banks' Forecasts of Future Loan Demand

Greenbaum, Kanatas, and Venezia (1991) suggest that loan commitments reduce banks' uncertainty about future loan demand and its attendant costs. In their setting, banks can borrow after the loan demand is known or by prearrangement. Prearranged funds can be obtained at a lower interest rate. Recognizing their informational disadvantage, banks offer to share the benefit of their lower funding costs, provided that clients disclose private information regarding prospective credit demand. A loan commitment contract incorporating a usage fee and a forward interest rate motivates honest disclosure of the borrower's loan demand information. The usage fee will be higher for firms that report higher expected loan demand, whereas the loan rate offered to such firms will be lower. The intuition is that firms with high loan demand are insensitive to high usage fees because they will most likely use the entire credit line and not pay the usage fee. Firms with low loan demand will report their information truthfully despite the low interest rate offered to investors with high demand because they wish to avoid the high usage fee.

Loan Commitments Help Banks Balance Reputational and Financial Capital Optimally

Loan commitments are discretionary contracts because the MAC clause gives the bank the right to refuse a loan when the borrower requests it. However, if a bank honors its commitment even when it is costly to do so, it can enhance its reputation for keeping its promises. A good reputation makes its future commitments more valuable because borrowers are willing to pay a premium for a credible commitment. Thus, a bank may use the loan commitment to enhance its reputation.

Boot, Greenbaum, and Thakor (1993) formalize this idea. The party that has discretion gains the option of taking a costly action. If the cost is sufficiently high, only agents that can afford to pay the cost can take the action, signal their types, and improve their reputations. In Boot, Greenbaum, and Thakor's model, future spot rates are uncertain. The bank promises to give the borrower an interest rate subsidy if the future spot rate is too high. The bank is compensated beforehand with a fee that represents the *expected* cost of the subsidy.[14] The cost of honoring a discretionary loan commitment is that when the borrower takes down the loan, the *actual* subsidy is greater than the expected subsidy that the

13 Greenbaum (1986) argues that banks became high-cost lenders because the Federal Reserve and the FDIC ceased to set limits on the rates that banks could pay to creditors; as a result, banks are burdened by higher borrowing costs as well as regulatory taxes. However, they still maintain their cost advantage as raters of borrowers. Hence, they offer loan commitments and then sell the loans they originate.

14 I discussed the same model in the section titled "Loan Commitments Help Attenuate Moral Hazard."

bank was compensated for when the spot rate was still uncertain. Therefore, it is costly for a bank to honor a commitment. Then, high-quality banks with more economic power than low-quality banks can signal their type and improve their reputational capital by honoring the discretionary contract and reducing their current financial capital, while low-quality banks repudiate their commitments, preserve their financial capital, and forgo the future benefits of a better reputation. In other words, a loan commitment helps the bank to manage its portfolio of financial and reputational capital optimally.

The idea that banks can use loan commitments as a signaling mechanism has been empirically verified by Mosebach (1999). His argument is based on a paper by Billett, Flannery, and Garfinkel (1995) reporting that "more reputable" lenders give the market more new information than "less reputable" lenders do. Billett, Flannery, and Garfinkel also propose that firms endeavor to send the strongest signal possible to the market by using the best lender. Mosebach argues that large companies, wishing to send the strongest possible signal to the market, use the best bank and largest line of credit available. So the purchase of a loan commitment transmits the following information: First, by selecting a particular bank, the borrower signals his belief that this is the best lender available to him. Second, the purchase communicates to the market new, positive information about the bank's current and future financial position. Mosebach's findings show a positive and significant market reaction to the bank's stock when the bank grants a line of credit.

Banks' Advantages over Individuals and Other Institutions in Providing Liquidity through Commitments

If loan commitments have the benefits described in the previous section, then why do not other financial intermediaries offer them? The literature on this question builds on literature dealing with the emergence of organizations. So I first explain why institutions' commitments are more credible than individuals' and then describe banks' advantage over other financial intermediaries in selling loan commitments.

Banks Can Commit Themselves Credibly but Individuals Cannot

When individuals sign up for the future delivery of a product or service, they prefer to contract with a firm or organization rather than another individual. Thus, individuals buy insurance from insurance companies and rarely from other individuals; loan commitments are sold by banks and not by individuals. Why can firms—but not individuals—credibly commit themselves to supply a product or service in the future in exchange for current compensation?

Boot, Thakor, and Udell (1991) offer the intuition that it is more costly for an organization not to honor its contractual commitments than it is for an individual. In a setting where risky debt and limited liability create moral hazard at sufficiently high interest rates, the lender gives the borrower a subsidized rate to prevent moral hazard and recovers that subsidy with an up-front fee paid when the commitment is sold. The problem with an individual lender offering a commitment is that he can collect the commitment fee, consume his entire wealth, and repudiate the commitment. No penalty or other legal enforcement mechanism can remedy the situation. To prevent the individual lender from consuming his wealth, an individual banker with a nonconsumable project endowment can collect this wealth as a deposit and sell a commitment to the borrower. If the banker repudiates the contract, a court can seize the banker's project endowment. The trouble with this setting is that because the subsidy is provided only when interest rates are high, the commitment fee reflects only the subsidy's expected cost and therefore is less than the ex post amount of the subsidy. Therefore, the banker will repudiate the contract if the loss from honoring it (the difference between the commitment fee and the subsidy) is greater than the cost of losing its project endowment. In contrast, a bank is made of a countable infinity of individual bankers (equity holders), each with a project endowment that will be seized if the commitment is repudiated. Note that in this case, the loss incurred by each banker from honoring the commitment is zero because a finite loss is divided among an infinity of bankers, while repudiation entails the loss of each banker's project endowment. Clearly, the bank always honors the commitment. Hence, the emergence of organizations prevents market failure

that might be caused by individuals not honoring contracts. Although this result is quite intuitive, it is unclear why individuals cannot place a fraction of their wealth in an escrow fund that the courts may seize if the individual fails to honor his commitment. Such an escrow fund would easily make individuals' commitments credible.

Finally, note that the courts play an important role in Boot, Thakor, and Udell (1991) by penalizing bank shareholders when commitments are not honored. Boot, Greenbaum, and Thakor (1993) ignore the judiciary and show that reputational concerns may be enough to induce the banks to keep their promises. However, reputational concerns are not enough to explain why banks *alone* sell loan commitments; an individual might have similar concerns and honor his commitments.

Banks Have a Cost Advantage over Other Institutions

It is clear from the previous discussion that loan commitments will be sold by institutional lenders. The question is, why must this institution be a bank and not another form of financial intermediary? Kareken (1987) argues that technological advances decreased the cost of acquiring and processing information, which opened the direct credit market to a large number of borrowers. These borrowers, however, have to be rated and monitored by market participants. Kareken assumes that technological advances created a larger decrease in banks' information acquisition costs than in those of other lenders. Then, purchasing a bank loan commitment results in lower direct costs for lending, rating, and monitoring because the bank assumes the default risk and does the monitoring. Two objections may be raised against this argument. First, it is not clear why technological advances benefit banks more than they benefit other intermediaries. Second, Kareken ignores the MAC clause that relieves the bank of its commitment when the borrower's financial condition deteriorates. Therefore, Kareken's argument does not explain why banks alone offer loan commitments.

Kanatas (1987) provides an informal solution to this puzzle, arguing that only banks sell loan commitments because they have access to the discount window. Their ability to meet unexpectedly high commitment loan demand with relatively low-cost funds from the discount facility makes their expected cost of funding commitments lower than that of nonbank competitors. If this subsidy more than offsets the cost of the reserve requirement, only banks will sell commitments.

Similarly, Kashyap, Rajan, and Stein (forthcoming) allude to the cost of the reserve requirement to formalize the cost advantage issue and explain why the intermediary selling the loan commitment must be a bank. They show why deposit taking and lending activities are carried out by a single institution (commercial bank) rather than separate institutions. They argue that loan commitments let a bank take advantage of economic synergies between its deposit-taking and lending activities. Demand deposits and loan commitments both provide liquidity on demand to bank customers who have unpredictable liquidity needs. If these contracts require costly overhead in the form of cash and security holdings, a synergy will exist to the extent that the two activities can share some of the costly overhead. A bank that offers both deposits and loan commitments can get by with a smaller total volume of cash and securities on its balance sheet than would two separate institutions, each specializing in only one of the two functions. Hence, efficiency is enhanced.

Pricing Loan Commitments as Put Options

Loan commitments have several similarities to put options. The commitment buyer pays a commitment fee for the right to sell a security to the bank at a prespecified price over some previously established time interval. The security is the commitment owner's debt, and the strike price is the dollar amount of the borrowing. The buyer will exercise the put option and take down the loan if the value of his debt on the exercise date is less than the committed loan amount. Clearly, this description excludes the two most important features of loan commitments that the literature attempts to explain: the multiple fee structure and the MAC clause. Yet, these and other simplifying assumptions, which I review next, are needed to apply the option pricing theory to loan commitments.

Thakor, Hong, and Greenbaum (1981) made the first attempt to rationalize and price loan commitments as put options.[15] Their paper develops a model for valuing *variable-rate* bank loan commitments within the framework of the Black and Scholes methodology.[16] It is a preliminary step in the valuation of loan commitments and therefore ignores several key factors in order to obtain a valuation formula.

There are four key differences between loan commitments and exchange-traded put options.

1) Exchange-traded options are binding, while loan commitments are discretionary because of the MAC clause.
2) Loan commitments are not transferable.
3) Loan commitments have a different pricing structure (usage and service fees).
4) A put option is either exercised in full or not at all. Loan takedowns, however, are usually only a fraction of the commitment's face value.

The literature has not addressed the question of how the first three points affect the valuation of loan commitments as put options. Attempts have been made, however, to explain the partial takedown phenomenon.

Thakor, Hong, and Greenbaum (1981) provide the first explanation of the partial takedown phenomenon. They argue that the future pricing and availability of bank services are influenced by the degree to which a customer exercises his loan commitment, because a gain for the customer is a loss to the bank. In establishing the price of the commitment and the size of the fixed mark-up, the bank considers expected borrower behavior under alternate states of the world. If the borrower surprises the lender by borrowing more than expected, the lender revises his expectations and adjusts upward the price and/or the mark-up applicable to future commitment transactions. Therefore, when the firm chooses the takedown fraction, it minimizes the expected cost of the next loan plus the opportunity loss from not taking down the current loan fully.

In Thakor, Hong, and Greenbaum, the bank uses an exogenous process for updating the commitment fee and the fixed mark-up based on take-down behavior. Greenbaum and Venezia (1985) endogenize this process by assuming that the loan amount taken down by the borrower depends on his productivity, unobservable to the bank. The borrower's productivity is subject to random mean-zero changes. The bank infers the borrower's productivity from the takedown. High takedown signals high productivity; this means that high future takedowns are associated with higher net costs to the bank since they imply that the borrower is exercising his put option more. As the bank obtains new estimates of the borrower's productivity, the average of those estimates yields a less noisy signal of productivity, so price adjustments to unexpectedly high takedowns become less significant over time. The interest rate smoothing that results from the bank–borrower relationship prevents the borrower from switching to other banks. This last result, however, depends on the strong, if not unrealistic, assumption that the new bank knows nothing about the client's takedown history and that new customers are indistinguishable from switching customers.

II. The Effects of Loan Commitments on the Bank's Risk Exposure

I have already mentioned that when a bank sells a loan commitment, it accepts the interest rate and quantity risk that the customer would bear if he were to borrow in the spot market. Although the commitment fee is expected to compensate the bank for its risk exposure, regulators believe that loan commitments increase the risk exposure of banks and the deposit insurer. Regulators argue that because the potential liability of a loan commitment is not quantified and reflected in the deposit insurance premium, a bank may be tempted to take on excessive risk by expanding its loan commitments, which may result in an underestimation of the deposit insurer's risk exposure. Therefore, regulators have imposed capital requirements against bank loan commitments to control their growth. Some of the literature on loan commitments provides insight on the merit of these arguments.

■ **15** Hawkins (1982) argues that revolving credit agreements (loan commitments with infinite maturity) are similar to callable bonds. He bases his argument on transaction costs to rationalize loan commitments.

■ **16** See Thakor (1982) for the valuation of fixed-rate loan commitments.

Early papers (Ho and Saunders [1983] and Koppenhaver [1985]) asked whether the bank could use financial futures contracts to hedge against interest and quantity risks. The main finding is that unless the spot loan price and the expected quantity of loan takedowns are perfectly correlated, the bank cannot hedge its risks fully. That is, it can hedge against one of the two variables by buying or selling futures contracts, but if the two variables are not perfectly correlated, a single type of contract is insufficient to hedge against both types of risk. Clearly, these early papers took the increase in banks' risk exposure as a given and did not investigate whether loan commitments actually increase the bank's risk exposure. Avery and Berger (1991) and Boot and Thakor (1991) addressed this issue.[17]

Avery and Berger argue that selling a loan commitment is risky because the bank is locked into lending to a borrower who might suffer a decline in creditworthiness that would otherwise dictate a higher interest rate or no loan at all. To make this argument, they assume that invoking the MAC clause is costly and the bank bears the legal costs. However, they do not clarify why the bank cannot recover the costs ex ante with the commitment fee. Because the borrower's creditworthiness may change over time, the bank has less information about the borrower when the loan commitment is sold than when spot contracts are signed. This leads to moral hazard. Now, suppose there are borrowers with and without moral hazard problems. Due to informational difficulties, the bank may ration moral hazard borrowers. If those who are rationed and wait for the spot market are safe borrowers (information is revealed in the spot market and these borrowers can borrow there), the bank's loan commitment portfolio consists of riskier-than-average borrowers and the bank's risk exposure is augmented. Otherwise, if moral hazard borrowers are the risky ones, the bank's risk exposure is reduced. Avery and Berger empirically find that fewer problem loans and higher bank income are associated with loan commitments. Therefore, commitments reduce the bank's risk exposure.

Boot and Thakor (1991) find that loan commitments lower bank asset portfolio risk for two reasons: First, the loan commitment contract can be designed to resolve the asset substitution problem between the bank and the borrower.[18] Second, if the bank's existing spot loan portfolio in a given period is observable to its loan commitment customers in that period, then optimally the bank will choose to make spot loans to less risky borrowers. The intuition is that the bank's current loan commitment revenue is an increasing function of the likelihood that the bank will be solvent in the future when it will honor the commitment. Hence, an increase in the riskiness of its spot loan portfolio causes a reduction in its loan commitment revenue. From this result, Boot and Thakor draw the following important policy implication: The deposit insurer should insist that all of the bank's outstanding commitments be voided if the bank cannot pay off its depositors and is bailed out by the insurer. That is, the deposit insurer should transfer some of the risk to loan commitment customers to give them an incentive to monitor the bank's spot loan portfolio.

Clearly, the capital requirements that regulators impose on loan commitments to protect the deposit insurer are not needed because, unlike other off-balance-sheet liabilities, such as standby letters of credit for which the bank acts as a guarantor, loan commitments with a MAC clause do not impose any credit risk on the bank. In fact, as Boot and Thakor show, they lower the bank's asset risk when the bank's loan portfolio is observable to customers.

III. Loan Commitments and Monetary Policy

Regulators conduct monetary policy through quantity rationing and interest rate channels by altering the quantity of credit and its price, the interest rate. Tighter monetary policy creates a reserve shortage that raises the cost of funds to banks. When their cost of funds rise, banks raise loan rates, which causes businesses and consumers to cut down expenditures. The interest rate channel implies a relationship between monetary policy and bank loan rates, loan volume, and economic activity. The quantity rationing channel refers to the possibility that when banks' funds costs rise, they choose to reduce the volume of loans above any reduction caused by an increase in interest rates on loan demand. This channel implies a direct link between monetary policy and the quantity of bank loans.

■ **17** Hassan and Sackley (1994) showed empirically that loan commitments reduce a bank's risk exposure.

■ **18** See the discussion on moral hazard in section I.

Since loan commitments protect borrowers from quantity rationing, in the short run, monetary policy changes will affect loans under commitment only through the interest rate channel (Duca and Vanhoose [1990], Morgan [1994], and Woodford [1996]). If monetary policy tightens, banks resort to rationing customers without commitment agreements (Sofianos, Wachtel, and Melnik [1990] and Glick and Plaut [1989]). In the long run, as loan commitments expire, quantity rationing appears in the form of refusing to renew a commitment or reducing its size. Therefore, loan commitments introduce significant lags in the effect of monetary policy (Deshmukh, Greenbaum, and Kanatas [1982] and Morgan [1998]).

IV. Concluding Remarks

I have provided a summary of what we know about loan commitments after years of research. Although we have gained some understanding of what value loan commitments provide, our knowledge has clear limitations. For example, in many instances, economists' conclusions depend on the use of fixed-rate commitments, which are rather uncommon in the market. In papers where loan commitments can be used to distinguish between borrowers with a priori unobservable characteristics, the results are limited to settings where there are *at most* three unobservable types, which is far too restrictive.

There is still much to be learned about loan commitments. I conclude by briefly reviewing three of the major unresolved issues.

First, the courts have often obstructed banks' right to invoke the MAC clause and deny credit to a loan commitment owner, arguing that the banks had not acted in good faith (Edelstein [1991] and Budnitz and Chaitman [1998]). That is, the courts have often interpreted banks' use of the clause as an abuse of power. This is at odds with the current literature, which views the MAC clause in loan commitments as providing the bank discretion that has economic value (Boot, Greenbaum, and Thakor [1993]). Courts' reasons for intervening and the welfare effects of their intervention remain to be understood.

Second, the analysis of loan commitments has been limited to models where, in most instances, the bank collects a fee at time 0 and in return provides a subsidy at time 1. Unfortunately, all these models ignore the fact that bank loans are relationship loans. That is, banks acquire private, firm-specific information during their relationship with borrowers and exploit their informational advantage relative to other lenders to earn positive profits in the future.[19] An important implication is that banks are willing to take losses early if they expect to recover them in the future. In a setting like this, a bank can give the borrower a subsidy with a standard debt contract and recover the subsidy from future transactions rather than with the commitment fee. So it is not clear why a borrower would choose a loan commitment over a spot loan or vice versa. Therefore, we need a model that rationalizes loan commitments in a relationship setting.

Finally, a loan commitment is an incomplete contract. Important issues, such as loan maturity and debt covenants, are left open to negotiation and are finalized before the loan closes. Although loan commitments have been meticulously scrutinized, we know nothing about the properties of loans made under commitment. How much the final loan agreement differs from the terms specified in the loan commitment deserves further investigation.

■ **19** Boot and Thakor (1994) show that long-term relationships are feasible even without the learning component. In their model, the bank initially lends with a secured contract (collateral is costly) at a high interest rate. Once the borrower succeeds, future loans are unsecured and subsidized. This feature induces the borrower to work hard at the outset to succeed as soon as possible. In contrast to Rajan's (1992) relationship setting, in which the borrower is subsidized initially and taxed later, in Boot and Thakor taxation occurs before the subsidy.

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A Simple Model of Money and Banking

by David Andolfatto and Ed Nosal

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Introduction

This article presents a simple environment giving rise to banks that create and lend out money. We define money to be any object that circulates widely as a means of payment. In our model, this object takes the form of a fully secured and redeemable bearer bond. This monetary instrument is issued by an agent that can credibly commit to monitoring a pool of real investments; that is, this capital forms the requisite backing for a circulating private debt instrument. While direct trade in securities is feasible without money, we find that money can economize on monitoring costs, which enhances the efficiency of the exchange process.

We define a bank as an agency that simultaneously issues money and monitors investments. In reality, banks also accept deposits of money, which are then redirected to borrowers. In our model, banks do not accept deposits; we do not view this function as a defining characteristic of a bank.[1] In particular, financial markets also accept deposits of money in exchange for marketable liabilities (equity and debt instruments). We think that banks differ from financial markets in two ways. First, bank liabilities are designed to be high-velocity payment instruments (money). Second, banks specialize in screening and monitoring their investments. Banks in our model perform both of these functions.

While our framework allows private non-bank liabilities to serve as the economy's medium of exchange (as mentioned earlier, exchange is even possible without any money at all), we demonstrate that the cost-minimizing structure has a bank creating liquid funds, which are then lent to borrowers (for example, entrepreneurs) with suitable collateral (contingent claims against future output). These liquid funds constitute real bills of exchange; that is, they are backed by the issuing bank with enforceable claims against real assets (the collateral supplied by borrowers).

■ **1** Needless to say, there are those who would disagree with this point of view. To our knowledge, Bullard and Smith (2001) have the only model featuring intermediaries that simultaneously take deposits, make loans, and issue circulating liabilities.

In reality, the vast bulk of the money supply consists of private debt instruments with contractual features similar to those embedded in the debt instruments that circulate in our model. In addition, the bulk of this money is created by banks; that is, institutions that spend considerable resources monitoring their investment portfolio. Thus, our model goes some way in addressing the questions of why private money takes the contractual form it does, as well as why private money is typically supplied by banks (as opposed to other types of private agencies). In our model, money and banking are inextricably linked.

Of course, we are not the first to explicitly model money and banking together. Some important recent contributions include Kiyotaki and Moore (2000), Bullard and Smith (2001), and Cavalcanti (2001). We view our work as complementary to these papers. In Kiyotaki and Moore (2000), banks are agents endowed with some sort of commitment technology that allows their liabilities to circulate. In Cavalcanti (2001), banks have verifiable histories but non-banks have not; as in Kiyotaki and Moore (2000), this special feature of banks allows their liabilities to circulate. In Bullard and Smith (2001), the pattern in which agents meet endows bank liabilities with relatively low transactions costs, making these instruments the preferred medium of exchange. Our setup is similar to that of Diamond (1984), which emphasizes the role of monitoring in the business of banking; banks are endowed with no special characteristics relative to other agents in the economy. Under some circumstances, it makes sense to have the economy's monitoring agencies (banks) issue the medium of exchange.

I. A Simple Model of Money

The Physical Environment

Consider an economy with four periods, indexed by $t = 0, 1, 2, 3$. Period 0 is interpreted as a "contracting period" (no consumption or production takes place) where individuals may (or may not) meet to trade in securities. In subsequent periods, goods are produced and consumed, and spot markets may (or may not) open. The economy is populated by a large number ($3N$) of individuals who have preferences defined over deterministic, time-dated consumption profiles (c_1, c_2, c_3). Individuals are specialized in the production of a nonstorable time-period good (y_1, y_2, y_3). In particular, we assume that there are three types of individuals and N individuals of each type: Person A produces y_3; person B produces y_1; and person C produces y_2. One interpretation of this setup is that type A (C) individuals are endowed with a long- (short-) term capital project. Let us also assume (for simplicity only) that people have specialized preferences: Person A wants c_1; person B wants c_2; and person C wants c_3 (assume also that each person values his own good just a little bit). The chart below describes, for each individual type, the goods that he desires, c_i, and the good that he produces (is endowed with), y_j.

	A	B	C
Good 1	c_1	y_1	
Good 2		c_2	y_2
Good 3	y_3		c_3

Note the complete lack of double-coincidence of wants: Any bilateral pairing of individuals will result in no exchange of goods.

Trade occurs at a centralized location that is accessible by all agents in each period. In period 0, the only objects available for exchange are *claims* (contracts) against y_1, y_2, and y_3. In an environment where such claims can be costlessly exchanged and enforced, a market needs to open only once (in period 0). In this period, A sells a claim to y_3 and purchases a claim to y_1, B sells a claim on y_1 and purchases a claim on y_2, and C sells a claim on y_2 and purchases a claim on y_3.

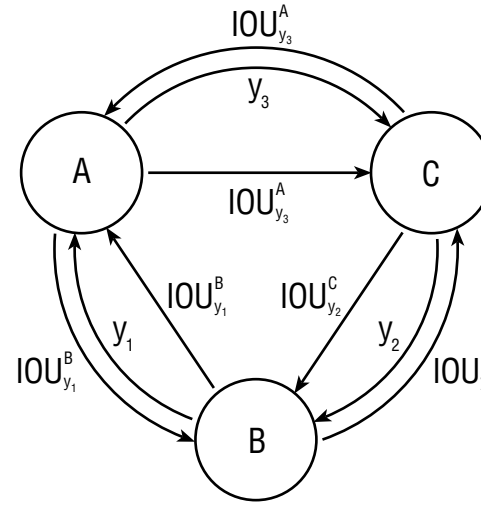

Figure 1

Figure 1 characterizes the various trades that occur in equilibrium. Period-0 trades are denoted by the inner straight-line arrows and the various time-dated trades are given by the outer curved-line arrows. We denote a claim issued by agent j for output produced at time t as $IOU^j y_t$. As time unfolds, previously agreed-to contracts are simply executed, that is, no further trades occur. This "Arrow–Debreu" market delivers an equilibrium allocation that is Pareto optimal without the aid of anything that one might identify as "money" in the model.

Limited Commitment and Monetary Exchange

Consider now an environment in which not all individuals can commit to keeping their promises. In particular, suppose that only type A agents can credibly commit to honoring claims against their anticipated earnings stream, y_3. In this case, the market value of both B's and C's securities as of period 0 equals zero (since these securities represent unenforceable claims against y_1 and y_2, respectively). At first blush, one might be inclined to think that financial markets could break down completely. After all, B (C) can acquire claims to y_2 (y_3) only by selling his claims to y_1 (y_2); but if these latter claims are worthless, then B (C) will be unable to purchase any claims to y_2 (y_3).

In fact, if spot markets open up after period 0, then the Pareto optimal allocation can be implemented with the following sequence of trades: In period 0, "nothing" happens. In period 1, agent A sells his claim y_3 to agent B in exchange for y_1. While agent B does not value y_3 directly, he is nevertheless willing to accept the security as payment, anticipating that he will be able to resell it in the future for something he does value. When the market reopens in period 2, agent B is in a position to purchase y_2 *directly* (instead of trying to collect on a previously negotiated *claim* to y_2; this purchase can be made with the security issued by agent A. Agent C is willing to accept the claim against agent A's output because C values y_3 and the claim against y_3 can (by assumption) be enforced. Figure 2 summarizes the various trades.

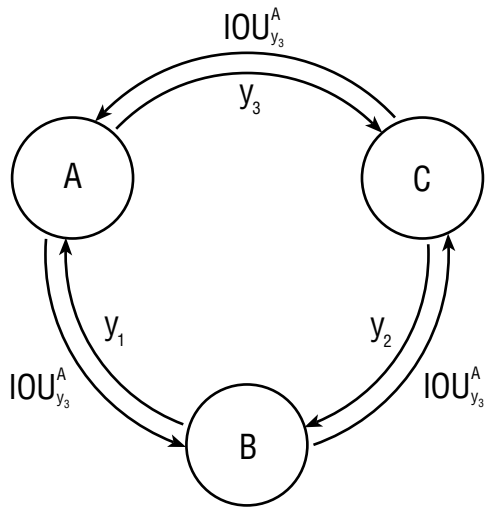

Figure 2

Notice what has happened here. In effect, agent A has issued a debt instrument entitling the *bearer* to the output generated in period 3 by agent A. Since agent A can commit to keeping his promises, this bearer-bond will circulate as a medium of exchange; in other words, agent A's security can be properly identified as "money" in this model economy.

The money that arises in this model takes the form of a circulating private debt instrument, redeemable in some form of good or service. As such, it may appear somewhat removed from most modern-day monies, which primarily take the form of either government-issued fiat currencies or privately-issued debt instruments that are redeemable in government fiat (such as demand deposits). However, there are, in fact, several instances of privately-issued monies that are redeemable in goods or services. For example, the Canadian Tire Corporation has for many years issued small-denomination paper notes (referred to as *Canadian Tire money)* redeemable in a wide array of store products; in small communities, these notes have been known to circulate as a medium of exchange. The *Ithaca hour* is a privately-issued monetary instrument that circulates quite widely in Ithaca, New York; these notes, in various denominations, are meant to be redeemable in the labor services of local residents. As well, if one were to interpret y_3 as gold, then history offers innumerable examples of "gold-backed" monetary instruments.[2]

■ **2** Some of the earliest forms of paper money possessed this feature. In the sixteenth century, for example, merchants would deposit their gold in vaults rented from goldsmiths. Apparently, the receipts issued by the goldsmiths (representing claims against the gold in the vault) began to circulate as a means of payment (primarily among merchants); see Smith (1936).}

The basic lesson here is that money is needed to facilitate some trades because not all individuals have the ability or willingness to commit to their promises (as John Moore has cleverly remarked, evil is the root of all money). The institutions that do arise to supply money will be those that have an ability, either endowed or manufactured, to make credible commitments. By issuing a debt instrument designed to circulate as a means of payment, the supplier of money is, in a sense, renting his commitment power to those who lack it. Specifically, even though individual B lacks commitment, he is able to purchase good y_2 by virtue of the fact that individual A can commit to promises.

One might legitimately ask where agent A's commitment power comes from and why others seem to lack it. The model of Kiyotaki and Moore (2000) provides some foundations to the structure of commitment power that depend on: 1) the existence of multiperiod investment projects; 2) the ability of initial creditors and debtors, if given the opportunity, to conspire against a third party who purchases existing debt; and 3) an institution, called a bank, that by design cannot conspire against anyone. In that environment, it is the bank's liability that circulates in the economy. Below, we provide a different foundation that is based on asymmetric information and monitoring activities, instead of asymmetric distribution of commitment power.

II. Money and Banking

In this section, we modify the physical environment described above in a few simple ways. To begin, assume that all individuals are identical in terms of their willingness and/or ability to commit to their promises and that commitment is feasible only up to what is verifiable (for example, through observation by a third-party enforcement agency).

Assume that there is now some risk associated with the endowment of each agent; in particular, for $t = 1, 2, 3$,

$$y_t = \begin{cases} y & \text{with probability } 1-\lambda \\ 0 & \text{with probability } \lambda. \end{cases}$$

In addition, suppose that there is no aggregate risk, so that $(1-\lambda)Ny$ represents the aggregate output in each period. We will continue to assume that individuals are risk-neutral.

The structure of information is as follows: Each person has the ability to costlessly observe the return realized on his own "project." Other agents are also in a position to observe this return, but only at a utility cost equal to μ; think of this cost as representing the effort exerted in monitoring project returns. This setup is similar to that of Diamond (1984), except that we will assume that if an agent is monitored, the information revealed becomes a matter of public record.[3]

Arrow–Debreu Securities

The type of securities that will be exchanged on this market are contracts that promise delivery of a good in the event that returns are reported to be positive. Since it will always be in the interest of the person who issues a security to report zero output (we assume that people cannot commit to tell the truth), it has to be understood that the holder of any such security will, in equilibrium, monitor project returns.

Clearly, for any kind of trade to occur, agents must have an incentive to purchase claims from other agents and then to monitor them. If the marginal utility of state-contingent consumption is constant (and equal to unity), then the parameter restriction $(1-\lambda)y > \mu$ is sufficient to guarantee that trade and monitoring will occur. As in the previous section, period 0 trades are as follows: A sells a contingent claim to y_3 and purchases one on y_1; B sells a contingent claim on y_1 and purchases one on y_2; and C sells a contingent claim on y_2 and purchases one on y_3. In period 1, agent A will monitor agent B; in period 2, agent B will monitor agent C; and in period 3, agent C will monitor agent A. Note that the total (economy-wide) monitoring costs are $3N\mu$. Figure 3 summarizes the various trades and monitoring.

■ **3** This assumption is made primarily to simplify the exposition; it does not affect our main conclusions.

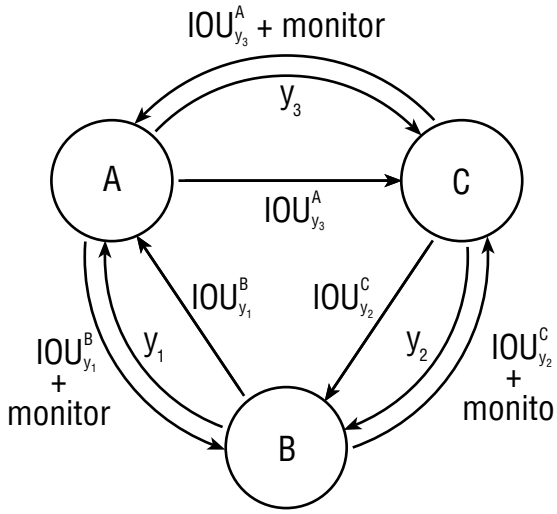

Figure 3

Monetary Exchange

Instead of trades in Arrow–Debreu securities, imagine that trades occur in a sequence of spot markets with the help of a circulating private debt instrument issued by type A agents. The private debt instrument issued by A is a contingent claim, as described earlier. Assume that project returns are realized at the beginning of each period and that a spot trade of money for goods occurs after the period's risk has been resolved.

The sequence of trades is as follows: In period 1, just after project returns are realized, type A agents offer their security to anyone who actually has y_1 to sell (as opposed to a contingent claim against y_1 that they would have purchased before realizing project returns). In the context of this environment, the people who are in a position to approach type A agents are the "successful" type B agents. It is important to note here that under this scenario, successful type B agents can costlessly reveal their success by the very act of displaying the goods they have to trade; in other words, *there is no need for type A agents to monitor.*

Successful type B agents are willing to accept a type A security as payment because they anticipate being able to use this security as payment for future goods that they desire. In particular, following the resolution of risk in period 2, a type B agent can purchase y_2 directly from a successful type C agent. Again, there is no need for monitoring. Type C agents willingly accept type A securities as payment because they represent direct claims against the goods that they desire. In period 3, each type C agent with a claim against y_3 will present the claim for redemption.

In order for any claim against A to be enforced, a monitoring expense must be incurred. Notice that while all N type A agents have issued securities, these securities end up being held by only $(1-\lambda)N$ type C agents. Consequently, each type C agent will hold claims for y_3 that were issued by different type A agents. To avoid coordination and monitoring problems, it makes sense here to appoint a "designated monitor," that is, to let one (arbitrarily chosen) type C agent set up a "monitoring business" that agrees to monitor a type A agent in exchange for some fraction ϕ of the project returns.[4] Since there are N projects that require monitoring (assume that projects cannot be monitored sequentially), the monitor incurs a total cost $N\mu$. Assuming free entry into the monitoring business, the equilibrium monitoring fee ϕ must adjust to ensure zero net returns to monitoring; thus $(1-\lambda)N\phi y = N\mu$ or

$$\phi^* = \frac{\mu}{(1-\lambda)y}$$

Under this "monetary regime," the expected utility payoff for agents A and B is equal to $(1-\lambda)y$, which clearly exceeds the payoff they would have generated under the Arrow–Debreu market structure: $(1-\lambda)y-\mu>0$. For each type C agent (including the monitor), the expected payoff is identical to what he would have generated under the Arrow–Debreu market structure. Consequently, we see that monetary exchange dominates trade in state-contingent securities by economizing on aggregate monitoring costs; that is, $N\mu < 3N\mu$. Figure 4 summarizes the various trades and monitoring. The C agent who does all of the monitoring is denoted by C^M. Note that in Figure 4, C^M receives ϕ^* from another C agent only if that C

■ **4** For values of λ less than half, the typical successful type C agent will hold one plus some fraction of type A IOUs. A type C agent will not have an incentive to monitor the type A agent for which he holds a fraction of an IOU if the fraction is sufficiently small: In this situation, the monitoring cost exceeds its expected benefit. If all type C agents who hold a fraction of an IOU issued by the same type A agent cannot somehow co-ordinate their monitoring activities, then this type A agent will not be monitored. But if a type A agent is not monitored, there will be a misallocation of resources. A designated monitor can overcome these coordination problems.

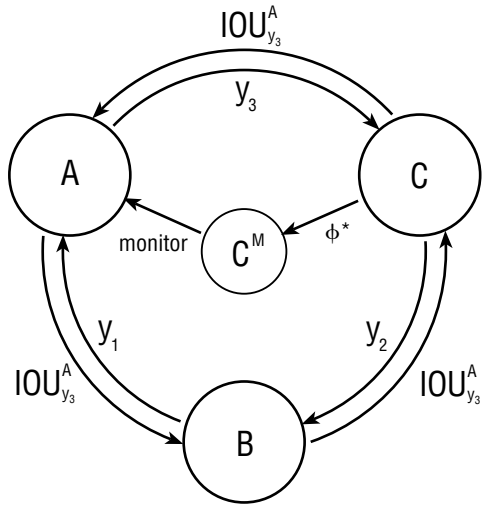

Figure 4

agent's claim pays off. In an attempt to reduce its complexity, figure 4 does not depict the potential exchange of y_3 for a claim against y_3 between agent C^M and an A agent.

Banking

The type of monitoring activity described above is commonly regarded as an important part of the business of banking. But banks are also associated with the business of creating liquidity (nowadays in the form of transaction deposits, but historically also in the form of paper money), which is injected into the economy by way of money loans (as well as wage and dividend payments). In the model described above, the money creation and monitoring activities are undertaken by separate sets of agents; in reality, these activities appear to be bundled. What might account for this bundling?

The first thing to note is that our model is not necessarily inconsistent with the fact that money creation and monitoring activities are bundled (although the model does not necessarily point to bundling as the unique organizational form either). We could, for example, imagine that the monitoring agent also decides to take on the responsibility of creating the economy's monetary instrument. In this case, such an agent would more closely resemble what is commonly called a bank. So let us consider what happens when the monitoring agent also issues money (for example, banknotes).

Trading activity proceeds as follows: In period 0, A agents approach the bank for a money loan. Suppose that each type A agent borrows (M/N) banknotes, which he promises to pay back in period 3 (if his project return is positive) with interest equal to R; that is, $(1+R)(M/N)$ represents the principal and interest that is to be paid back in the form of banknotes. Agent A then takes these banknotes and uses them to purchase y_1 from type B agents with output to sell. Since M "dollars" are exchanged for $(1-\lambda)Ny$ units of output, the first-period price level is

$$P_1^* = \left[\frac{1}{(1-\lambda)y}\right]\frac{M}{N}.$$

In period 2, each B agent with money purchases the output displayed for sale by successful type C agents; the equilibrium price level remains the same, that is, $P_2^* = P_1^*$.

Now, in period 3, type C agents who hold banknotes will want to purchase the output produced by successful type A agents. The question here is whether a type A agent is willing to give up a good that he values (slightly) in exchange for paper that he does not value at all. To give an A agent the incentive to behave "properly," the initial money-loan contract must contain a clause that transfers property rights over project returns from A to the bank in the event of default. In effect, the money loan is collateralized with securities that constitute contingent claims against y_3. As before, all type A agents must be monitored. Consequently, it will do no good for a successful type A agent to claim failure. At this stage, the agent has the choice of either selling his output for the banknotes that he needs to pay back the money loan; or of having his output "seized" by the bank (which owns an enforceable contingent claim against it). Either of these options leaves a type A agent with the same payoff, so the agent might rationally choose either one. A third possibility is that an A agent might renegotiate the terms of the loan contract, leaving both the bank and himself better off (at the expense of type C agents). To prevent either outright default or renegotiation (avoiding both would be necessary for the banknote to circulate in the first place), the monetary instrument must be include a redemption clause: The note-bearer must have the right to redeem the banknote for output.[5]

■ **5** A similar redemption clause appears to be embedded within modern-day private monetary instruments (for example, deposits in checking accounts are typically redeemable in government cash).

Finally, if $R>0$ (as must be the case), then it appears that there are not enough banknotes in circulation: How can A agents acquire the money needed to pay off a debt equal to $(1+R)M$ when there are only M dollars in circulation? It turns out that some "new money" (RM dollars) must be injected into the economy in period 3 by the bank itself. That is, the bank simply prints up RM dollars of new money, which can be used to purchase some period-3 output to compensate the bank for its monitoring services. With free entry in the banking business, the interest rate charged by the bank must result in zero profits; so

$$R^*M = P_3^* N\mu .$$

What prevents a bank from "overissuing" money at this stage? We have to assume that the supply of banknotes is verifiable (that is, the bank's balance sheet can be observed by a court and cannot be falsified). Consequently, the bank will be bound to charge a maximum interest of R^* and will not be in a legal position to inject more than R^*M of new money into the economy. Now, in order to derive R^*, we need an expression for the price level in period 3. Since $(1+R)M$ dollars are exchanged for $(1-\lambda)Ny$ units of output, the price level must satisfy the condition

$$P_3^* = \frac{(1+R^*)M}{(1-\lambda)Ny} .$$

Combining these latter two expressions, we can solve for the equilibrium interest rate and price level:

$$R^* = \frac{\mu}{(1-\lambda)y - \mu} > 0;$$

$$P_3^* = \left[\frac{1}{(1-\lambda)y-\mu}\right]\frac{M}{N} > P_1^* = P_2^* .$$

Notice that period-3 inflation (which is fully expected) has served to diminish the purchasing power of C's money holdings; but in equilibrium, this loss is exactly equal to the amount of purchasing power the type C agent would willingly have transferred to a professional monitor (as demonstrated in the earlier scenario). The various trades and monitoring are depicted in figure 5. The C agent who is the bank is denoted as C^B.

Transaction Costs

The equilibrium allocation associated with this "banking regime" corresponds to the allocation that resulted when money creation and monitoring activities were performed by separate sets of agents. Strictly speaking, the model here is unable to pin down the banking regime as a unique organizational form.

However, suppose that we follow Bullard and Smith (2001) and extend the model slightly by assuming that every time a good "changes hands," a small *fraction* of it, $0 < \varepsilon < 1$, disappears. One can think of ε as being a small transaction cost. Let us now compare the total transactions costs when money creation and monitoring are bundled relative to when they are not.

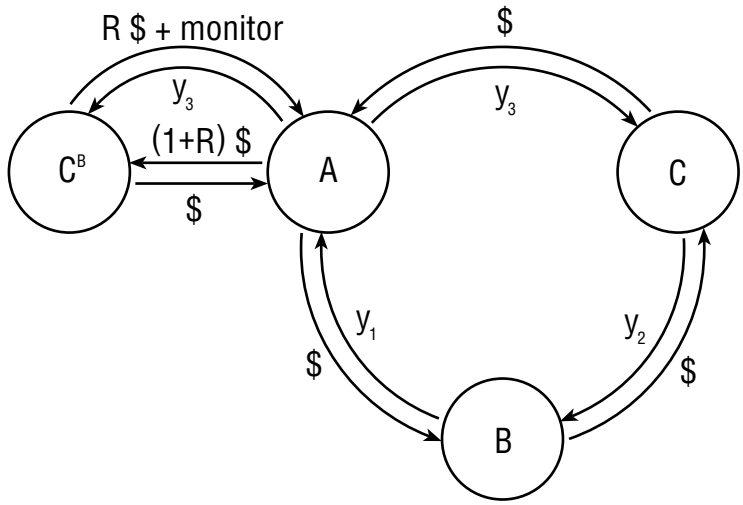

Figure 5

When money creation and monitoring are unbundled, each type A agent issues a security that circulates which is ultimately monitored by one of the type C agents. Goods produced in periods 1 and 2 change hands once, so the total transactions costs in these periods is $2(1-\lambda)N\varepsilon y$. At date 3, however, some of the goods produced will change hands twice: There is a set of transactions between C agents who possess A's security and A agents who produced output; there is also a set of transactions between C agents who now possess goods and the monitor who requires payment for his services. The transactions costs incurred in period 3 are $(1-\lambda)N(1+\phi^*)\,\varepsilon y$ if the monitor did not possess any securities issued by A agents and $(1-\lambda)N(1+\phi^*)\,\varepsilon y - \phi^*\varepsilon y$ if he did. Hence, total transactions costs for the economy are $3(1-\lambda)N\varepsilon y + N(1+\phi^*)\,\varepsilon y - \delta\,\phi^*\,\varepsilon y$, where $\delta = 0$ if the monitor did not possess any securities issued by A agents and $\delta = 1$ if he did (recall that whether the monitor ends up holding A's security depends on whether his project is successful).

In contrast, when money creation and monitoring are bundled, goods change hands only once at each date. In particular, at date 3 the bank's compensation for its monitoring costs takes the form of printing money and *directly* purchasing goods from type A agents. Hence, under this regime, total transaction costs are $3(1-\lambda)N\varepsilon y$, which is strictly less than the total transaction costs associated with the latter arrangement. Hence, when there are transaction costs associated with the exchange of goods, a banking regime—an institutional setup in which monitoring and money creation are undertaken by the same agent—will Pareto dominate an environment in which money creation and monitoring activities are performed by separate agents.

Conclusions

We have constructed an environment in which something that looks like a bank emerges as an efficient exchange mechanism. A bank monitors projects and issues money that circulates as a medium of exchange. When individual transactions are costly, the banking institution turns out to be an efficient trading mechanism because goods are only exchanged between the initial seller and the final consumer. An economy that has private (nonbank) securities circulating will have some fraction of final output exchanging hands more than once; as a result, its transaction costs will be higher than those of a banking economy.

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