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The integration of bank syndicated loan and junk bond markets

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Abstract

This paper hypothesizes that the special role of banks as corporate quasi-insiders has been changing due to developments in informational, legal and institutional infrastructures of syndicated loan markets. We investigate the integration of intermediated and disintermediated financial markets through highly leveraged transaction (HLT) syndicated loans during the 1990s. We demonstrate that, with the emergence of traded HLT syndicated loans as an alternative high-yield asset to high-yield bonds, market integration has dramatically increased. Taking the late 1980s and 1990s together, different factors explain the movement of credit spreads of the two markets. HLT loan market's spreads are strongly affected by bank liquidity. Bank liquidity's effect on HLT loan spreads disappears after 1993. From 1994–1999, junk bond market liquidity factors affect bank loan pricing. We interpret these changes as evidence of the erosion of bank specialness.

JEL classification: G14; G21
Keywords: Syndicated loans; Junk bonds; Disintermediation; Credit spreads; Bank loan pricing; Bank liquidity; Special role of banks; High yield bonds; Highly leveraged transactions

1. Introduction

The banking literature commonly characterizes loans as illiquid assets. The lender is assumed to possess relationship-specific skills and/or information that preclude the

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efficient trading of loans in secondary markets where they would compete with public securities. This characterization helps us to understand the nature of banking, yet it is a simplification of reality. Loans have never been absolutely illiquid. Correspondent banks traditionally have been able to effect portfolio re-balancing by exchanging assets as long as the relationship between buyer and seller was strong enough to generate sufficient trust to mitigate informational asymmetries between them. Loan sales by bankruptcy trustees have long been a part of winding up failed banks. The marketability of bank loans, then, is a question of degree. Today, that degree is rapidly increasing.

Banking is an information industry so it is not surprising that the 1990s revolution in information technology fundamentally affected banking. At the strategic level, leaders of the top banks around the world are unanimous that their models of business are undergoing substantial change. [1] Secondary market loan trading has also developed radically. Legal changes set the stage for standardization of loan trading and a rapid rise in trading volumes. The Loan Syndication and Trading Association has been set up to facilitate this process. Bond rating agencies are now rating syndicated loans.

Given these changes, the financial academic's question, "why are banks special?" perhaps should be rephrased. In a recent article, Bossone (2001) asks, "Are transaction costs and information asymmetries being so dramatically reduced in modern financial systems that what was once special about issuing liquid liabilities and financing illiquid assets is hardly special at all, today?" Bossone answers his question from his theoretical analysis in the negative.

We hypothesize that the special role of banks as corporate quasi-insiders has been changing due to developments in informational, legal and institutional infrastructures of syndicated loan markets. We take an empirical approach, focusing on one banking service: syndicated lending. We ask the question, "are syndicated loans special and, if they are, is that specialness being eroded?" We answer this question by examining the degree to which the pricing of loans that are traded on the secondary market is integrated with the pricing of bonds.

We study highly leveraged transaction syndicated loans (HLTs) [2] and compare their pricing to the pricing of high-yield bonds from January 1987 to December 1999. We build on the work of Angbazo et al. (1998) by estimating a model of the promised spread of HLTs above treasuries and comparing it to an estimated model of the yield spread of high-yield bonds above treasuries. We describe how the degree

[1] See Engler and Essinger (2000) who report wide-ranging interviews with the leaders Bank of Tokyo-Mitsubishi, Banco Santander, Central Hispano, Chase, Citigroup, Deutsche Bank, Goldman Sachs Mediobanca, Merrill Lynch, Morgan Stanley Dean Witter, Paribas, Societe Generale, etc.

[2] The term "HLT" refers to loans to borrowers whose senior debt is non-investment grade and whose loans are priced in excess of 225 basis points above LIBOR *or* whose loan is to be used in a highly leveraged transaction such as a leveraged buyout. Although HLTs are not necessarily syndicated, only those that are syndicated have their terms and conditions widely reported. Hence, all of the HLTs we refer to in this paper are syndicated; moreover, when we refer to HLTs in this paper, we refer only to highly leveraged transaction *syndicated* loans.

of segmentation between bank and bond markets has been severely eroded over the last decade. We show that from 1987 to 1993 an excess (lack) of liquidity in bank markets leads to price falls (rises) in HLT spreads but that this effect disappears from the period 1994–1999. We show that bond market liquidity has no independent effect on HLT pricing in the earlier period but that in the later period increases (decreases) in junk bond market liquidity lead to increases (decreases) in HLT spreads. In summary, we find strong evidence that, in this important part of the lending market, bank specialness is indeed changing.

Our article is organized as follows. A brief introduction to the HLT market is found in Section 2. Section 3 is a review the literature on the specialness of banking and its relationship to syndicated lending. Sections 4–6 discuss our approach to measuring market integration, the data and our findings respectively. Section 7 concludes with a summary, a note concerning the degree to which our findings can be generalized to other banking services, a comment on similar findings in related studies and some suggestions for further research.

2. The highly leveraged transaction syndicated loan market

Syndicated loans – loans that, prior to signing, are shared among groups of banks – have long been a part of corporate finance. A syndicated loan has traditionally allowed a lead bank [3] to arrange a loan so large that the bank, acting alone, could not book it without either breaching prudent concentration limits or reducing unacceptably its ability to do further business with the borrower, the borrower's industry, and/or the borrower's country. Through syndication, a lead bank can increase its return on risk capital from arrangement fee income while participant banks [4] can obtain exposure otherwise not available.

A syndicated loan is usually initiated by an underwritten offer from the lead bank. The offer lists the borrower, underwriters, availability, tenor, interest rate, commitment fees, management fee, agency fees, syndication plan, security, covenants, etc. but is subject to negotiation of the loan agreement which is signed by all lenders, each of which legally acts independently and individually to make the loan. Once the borrower has accepted an underwritten offer, the underwriter(s)/lead manager(s) invites other prospective borrowers, outlining the transaction and the borrower's status in an information memorandum. The loan agreement itself is actually signed by

[3] We use the term "lead bank" to mean the bank *or banks* that initiate(s), underwrite(s) and arrange(s) the syndication transaction. This is typically the bank(s) having a strong relationship with the borrower. We use the term "banks" loosely to include commercial and investment banks as well as other wholesale financial institutions participating in the syndicated loans market.

[4] We use the term "participant bank" to mean the banks in the syndication that do not have a primary role in underwriting, negotiating, syndicating and otherwise arranging the loan (and obtaining fees therefrom) but enter the transaction with the purpose of booking a loan asset. These participants may be labeled as "co-lead managers", "managers" "co-managers", etc., but these names tend to be honorific, with higher sounding titles given to FIs that take larger shares of the loan.

each lender, and loan drawdown does not occur until after loan signing and clearing of legal conditions precedent to drawdown. The agent for the lenders liaises between the borrower and the lenders throughout the life of the loan. It arranges for clearing conditions precedent, receiving notifications for drawdown from the borrower and passing them to the lenders, channeling funds of drawdown and repayment, calculating interest payable, and distributing borrower information.

Lending banks tend to book syndicated loans to maturity, yet lead banks have long recognized the advantage of increasing syndicated loan secondary market liquidity. A more liquid instrument requires from lenders a lower liquidity premium. Borrowers and lenders share the benefits from improved loan pricing. Legal devices and increased informational transparency increase liquidity. Loan documentation typically contemplates loan sales, providing for assignment of loan participation. [5] Information availability facilitates secondary market liquidity: the lead bank formally places a large amount of borrower and facility information in the information memorandum for distribution to prospective lenders during syndication. Information is subsequently updated by borrower communication with the syndicate banks through the bank acting as agent for the lenders. Although not publicly available, these data can be easily and credibly forwarded to interested prospective purchasers in the secondary market. These liquidity-enhancing devices are not new, but the emergence of a true secondary market in syndicated loans is.

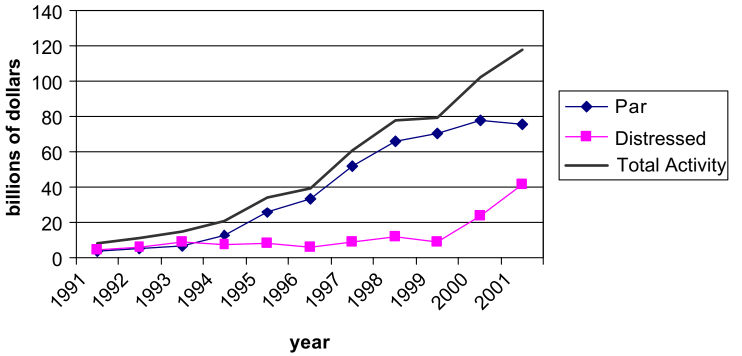
Fig. 1 shows that the volume of trading of syndicated loans on the secondary market rose from $8 billion (of mostly distressed debt) per year in 1991 to $110 billion (of mostly par loans) in 2001. [6] As we demonstrate below, this rapid increase in trading coincided with a change in the basis of pricing syndicated loans from a bank liquidity orientation to a capital markets orientation. Market, regulatory, legal and informational factors combined to stimulate this transformation. [7]

In the mid to late 1980s, the most active component of the secondary market for syndicated loan participations was less developed country (LDC) debt. During the LDC debt crisis, at one time or another, virtually all LDC debt became distressed,

[5] In this discussion, we refer to true sales of loans without recourse. Credit risk *can* be off-laid with risk participations (funded or unfunded) and with various credit derivatives. In such cases, the party that originally booked the loan maintains legally the rights and obligations of the loan but contracts with a third party to off-lay some portion of the risk and/or funding. In a sale by assignment, the sold loan is removed from the seller's balance sheet and the seller has no liability if the loan defaults (unless the buyer can prove seller misrepresentation). Assignments typically require borrower agreement (or at least notification). Loan agreements structured to increase secondary market liquidity frequently contain clauses such that the assignor lender, by simple notice to the agent, legally causes the creation of a new loan ("novation" of the contract) where all parties have the same rights and obligations but the assignee lender is substituted for the assignor. For the LSTA's model assignment agreement, see http://www.lsta.org/.

[6] "Distressed debt" refers to loans that trade for less than 90 cents to the dollar of principal amount. "Par loans" are those that trade at more than 90 cents to the dollar. In 2001 distressed debt trading increased dramatically with the recession.

[7] Fabozzi (1998) has edited a collection of 11 essays by syndications market bankers that describe many of the developments summarized below.



Par = total volume in billions of dollars per annum of loans that are traded at a purchase price of more than 90 cents per dollar of face value.
Distressed = total volume in billions of dollars per annum of loans that are traded at a purchase price of less than 90 cents per dollar of face value.
Total Activity = Par + Distressed.

Source: Loan Pricing Corporation

Fig. 1. Secondary loan market trading volume.

but fair values varied greatly by country and issue, and were subject to dramatic changes over time. These events created an opportunity for profitable trading. Strategic rethinking by lending banks – sometimes under regulatory pressure – led many to exit the LDC debt market providing a supply of LDC debt to the secondary market. The market's intermediaries were globally active commercial and investment banks, but most ultimate buyers and sellers were commercial banks with international portfolios. The market merely increased the scale of existing practices of the international syndications market. The assets' bid-ask spreads were large – being several percentage points – and the market was illiquid relative to securities markets.

HLT syndicated lending was born in the late 1980s US merger boom and provided the assets that eventually extended syndications secondary markets beyond banks. Often a bridging vehicle in corporate mergers and acquisitions, HLT loans provided massive, rapid and flexible financing for leveraged buyouts. The HLT boom led to improvements in disbursement of syndicated lending information. Syndicated lending information is quasi-public: lead managers must distribute at least the summary terms and conditions and often the whole information memorandum to a relatively wide market in order to sell down the transaction. In 1987, Loan Pricing Corporation initiated its *Gold Sheets* that set out in a standardized form primary market information and distributed that information to paying subscribers. [8]

[8] The *Gold Sheets* were not the first syndicated loan information service. In the 1970s, *Agefi* which in the 1980s became *International Financing Review* provided information on offshore Eurobanking syndicated credits. IFR is now owned by Thomson and provides global capital markets and syndicated banking information in competition with LPC, who is currently owed by Reuters.

In 1990, a legal change occurred that allowed the secondary market for syndicated loans to extend beyond banks. Loans are securities. If they were deemed to be *publicly traded* securities, they would be governed in the US by the Securities Act of 1933. The stringent requirements of that act effectively limited the degree to which bank loans could be traded prior to 1990. In 1990, Rule 144A was passed allowing participations in syndicated loans to trade in a lightly regulated institutional investor market.

With the legal basis for broadened trading in syndicated loan participations in place, the credit crunch of 1991–1992 provided a supply of secondary HLT paper as some previously lending banks scrambled to rebalance their portfolios. Five investment and commercial banks rose to the opportunity to make a market in the outstanding loans, bringing liquidity to the market. [9] Some of these assets were distressed, but many were not. In 1994, for the first time, the volume of par value loans traded in the market exceeded the volume of distressed loans. In 1995, two key events indicated that participations in syndicated loans might legitimately be called a capital markets asset class in their own right. First the Loan Syndication and Trading Association was founded to develop the market for the assets and secondly, the bond ratings agency Standard and Poor's initiated its program to rate corporate syndicated loans. Moody's followed suit shortly thereafter. Table 1 provides a summary of factors that promoted the rapid rise of the secondary market for participations in syndicated loans. [10]

Unlike the market in loans prior to the 1990s, when commercial banks formed the main purchasers of loans, institutional investors accounted for most of secondary market demand during the 1990s. The market has gone beyond its banking roots. Syndicated loans provide to institutional investors higher returns than traditional bonds. Yet institutional investors typically need spreads of 175 basis points over LIBOR to attract them into these non-traditional assets. That higher return is available in HLTs. Hence it is not surprising that, although HLTs account for a minority of the total amount of syndicated loans outstanding, they account for more than 80% of secondary market trading. [11] This dominance makes HLT pricing an important and accessible area of study.

HLTs are also of interest for another reason. They have a parallel publicly traded security: non-investment grade (also called "high yield" or "junk") bonds. Moreover, as Fig. 2 shows, the volumes of HLT issuance is of the same order of magnitude as junk bond issuance.

[9] Those first making a market were BT Alex Brown, Bear Stearns, Citibank, Continental Bank, and Goldman Sachs (see Miller, 1997).

[10] For more information on this history see Bavaria (1998), Fabozzi (1998), the Loan Syndication and Trading Association website, Loan Pricing Corporation and Taylor (2000).

[11] Loan Pricing Corporation reports that in 2001, of the $159 billion in secondary market trades of par loans, only $27 billion were for investment grade (i.e., rated BBB and above) loans. Note, however, that HLTs account for only about 20% of total volume of new global syndications: in 2001, total global syndications were about $1.1 trillion while HLT syndications were $218 billion (Coffey, 2002). We return to this point in the concluding discussion of the implications of our study.

Table 1
Events promoting secondary trading in the syndicated loan market

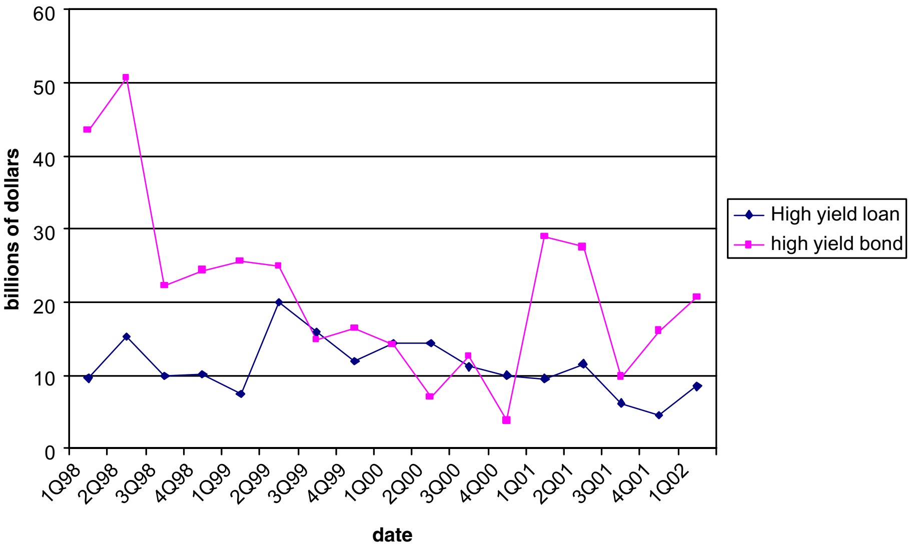
Date	Event	Significance to syndicated loan secondary market development
1985–1989	HLT syndicated lending powers merger boom	HLT syndicated loans emerge as a major commercial bank asset class
1987	Loan Pricing Corporation starts publication of gold sheets	Standardized data on syndicated loan pricing published
1990	Rule 144A – private re-sales of securities to institutions amendment to the Securities Act of 1933 passed by US Congress to allow companies to issue exempt securities for institutional investor market	Legal basis for institutional investor secondary market for syndicated loans established
1991–1992	Loan default rates on syndicated loans increase during recession credit crunch	Bank demands to exit markets through loan sales stimulates five banks to set up secondary loan trading desks
1994	Volume of par value loans traded in secondary market exceeds volume of distressed loans	Portfolio re-balancing of viable asset class of ongoing exposures becomes dominant
1995	Loan Syndication and Trading Association founded and T + 10 convention adopted for par loans	Establishes organization to promote development trading market for corporate loans; standardizes confirmation and settlement procedures
1995	Introduction of bank loan ratings by Standard and Poor's	Establishes instrument-specific rating
1998	LSTA code of conduct published	Promotion of integrity, fairness, efficiency and liquidity through adoption of common standards
2002	CUSIP group of LSTA and Standard and Poor's establish unique identifier for each syndicated loan	Standardization will facilitate identification among market participants analysis by researchers

Sources: LSTA, LPC, Fabozzi (1998).

The above discussion has highlighted several aspects of the HLT market. It emerged from a traditional banking activity. Through time and owing to institutional, legal and informational reform, the volume of HLT trading has increased substantially. We hypothesize that HLTs have changed: they were a special bank service, but they are now priced in the wider capital markets. The existence of a parallel junk bond market serving the same borrowers allows us to test this hypothesis. But before we describe the tests and their results, we review briefly the literature on bank specialness in lending.

3. Bank specialness and syndicated loan sales

A dominant theme in the banking literature is the role of banks in funding projects characterized by informational asymmetries and moral hazard. If banks are truly unique in their solution to these problems, we are left in a quandary: how do we to explain a growing market selling HLTs to non-banks?



High yield loan = total value of new principal of HLT syndicated loans issued in the quarter
High yield bond = total value of new junk bonds issued in the quarter

Source: Loan Pricing Corporation

Fig. 2. Junk bond versus HLT loan issuance.

Diamond's (1984) banks function as delegated monitors, contracting with depositors to pay a fixed return based on portfolio diversification of project risk. HLTs seem to fit Diamond's projects: they are large (relative to investors) and risky (as evidenced by their spreads). As Freixas and Rochet (1997) point out, delegated monitoring in Diamond's sense need not take place in a banking environment. Banks comparative advantage is based on ingredients including scale economies in monitoring, small capacity of investors relative to projects and low costs of delegation. At first glance, the coalition structure of a syndicated loan might even be considered delegated monitoring. In Section 2, we described the role of the agent for the lenders in a loan syndication. The delegation of authority to the agent for the lenders, however, is clearly not delegated monitoring in a Diamond (1984) sense. The agent for the lenders in a syndication performs a relatively mechanical role, almost devoid of discretion. Asset management – particularly the decision to declare the occurrence of an event of default – is in the hands of the participant lenders. The agent bank in the syndication is only a nexus of information and cash flows, with very little discretion.

As we discussed above, institutional investors are increasingly lenders in HLTs. Either these new lenders are forgoing monitoring (and thereby free-riding), or information transparency has progressed for this class of investors to allow monitoring without the lender itself being a quasi-insider-monitor.

In a dynamic context, Sharp (1990) and Rajan (1992) modified Diamond's conclusions to allow for borrower reputation. Borrowers who can build reputation can access public markets, avoiding the more expensive intermediated markets. These models more richly model the interplay between disintermediated and intermediated markets. Diamond (1997) demonstrates the role of banks coexisting with public markets due to the limited participation of some investors in the public markets. An implication of his work is that, as direct participation by more investors in the public markets increases, so does disintermediation. Market demand-driven disintermediation directs more funds towards institutional investors. As noted above, the institutional investors are precisely the net buyers in the secondary markets for HLTs studied by us. In an international cross-sectional study, Buch (2002) documents that the ratio of bank lending to total cross border debt (bank lending plus bonds) is a decreasing function of development of the borrowing country. This finding is consistent with the conjecture that falling information costs, which coincide with development, precipitate disintermediation and reduce the role of bank specialness.

Institutional investors clearly rely on external information in making their credit decisions – they are not Diamond's monitors. Millon and Thakor (1985) model how the problem of information sharing in a world of moral hazard can be solved by non-bank information gathering agencies such as Standard and Poor's and Moody's. Both of these agencies reduce informational asymmetries in the secondary market for syndicated loan participations by issuing ratings and publishing analysis. This innovation has been increasingly evident in the late 1990s.

Bank specialness has been explained by Rajan (1998) in terms of the provision of liquidity in the presence of incomplete contracting. In an environment where, because of legal uncertainty and informational asymmetries, investors cannot contract effectively with funds users, banks with strict contracts to supply liquidity to depositors and unwritten contracts to supply overdraft loans to borrowers can provide the economy with liquidity under incentive compatibility conditions that restrict bankers ability to defraud depositors (see also Calomiris and Kahn, 1991). Rajan describes his incomplete contracting model of banking in historical terms. And he points to the tremendous change in technology, information availability and the legal environment that has substantially reduced contracting incompleteness, leaving banks with essentially a liquidity function in a world where informational asymmetries are not the most important defining condition of banking. He notes in passing that, in the rapidly growing secondary market for loans, which he says his theory partly explains, buyers do not actually examine the loans they buy closely: they trust the sellers. This observation supports the view that banks may maintain their abilities to certify as quasi-insiders. The certification role of investment banks has long been recognized in the literature (Booth and Smith, 1986). Moreover, Datta et al. (1999) have recently demonstrated the complementary monitoring of banks and bond markets: the existence of a banking relationship reduces the at-issue yield spreads for initial public debt offers. Gande et al. (1999) demonstrate that bank entry into bond underwriting markets have lowered spreads, indicating their expertise spans intermediated and disintermediated markets.

Diamond and Rajan (2001) model banks as primarily liquidity transformers. Flannery et al. (2001) has added empirical support to their view by demonstrating that bank assets are fairly transparent. Loans that are bought and sold are likely to be among the most transparent in banks' portfolios. If Rajan (1998)'s conjecture that loan-purchasing banks trust the reputation of loan-selling banks is true, or if by relying on non-bank information gathering agencies, loan-purchasing banks no longer need quasi-insider information, then the problems of informational asymmetries between buyer and seller fall away. Banks will syndicate, participate in and subsequently sell off participations to rebalance credit exposure, and they will do so without moral hazard. Innovations in the syndicated loans' secondary market can be seen as addressing liquidity problems and their development as a tradable capital market instruments can be seen as essentially a question of market mechanics.

In the following section, we describe our tests of the growing extent of this integration.

4. Measuring market integration

We assess market integration by examining the average market spread of the HLT market through time and relate it to the yield to maturity spread of the bond market. [12] First, we construct an index of HLT loan pricing in the primary market. In the spirit of Angbazo et al. (1998) we regress the change in spreads in one market on the change in spreads in the other markets. Then we explicitly measure the pricing in each market by using the error correction model (ECM) of Engle and Granger (1987) following Barnhill et al. (2000)'s application of the model to explaining non-investment grade bond yields. We construct an ECM for the spreads in the HLT loan. As market integration is most evident when the liquidity of one market is used in financing the other, we focus on liquidity – the supply of funds' effect on loan pricing.

Angbazo et al. (1998) examined loan pricing on a loan by loan basis through the regression

$$y_{it} = X_{it}\beta + Z_{it}\gamma + \eta_{it} \tag{1}$$

where y_{it} is the loan's spread over the benchmark as a percent of the base interest rate; X_{it} is a vector of two spreads, the junk bond spread and the Baa bond spread and Z_{it} is a vector of loan specific control variables.

Although much of their paper is concerned with measuring and discussing the coefficients of the Z_{it} loans specific control variable, in terms of measuring market integration, they are interested in β. Particularly, they hypothesize that if β is close to 1, the pricing in the loan and bond markets converge, demonstrating that the markets are integrated. They find that the coefficient is substantially and significantly less than unity, and conclude that the two markets diverge.

[12] We are grateful to Bruce Lehman for suggesting we investigate market integration by constructing an index of the HLT loans market and examining its dynamics, rather than following a loan-by-loan pricing approach.

In point of fact, however, even if the two markets were entirely integrated, the coefficient would not be one unless the credit risk and priorities of the instruments in the two markets was the same. As Angbazo et al. (1998) point out in their first table, the HLT loan market is a senior, secured debt market, whereas the junk bond market is a subordinated loan market. Altman and Suggitt (2000) report that recovery rates in bankruptcy for senior secured loans average from 65% to 87% while for subordinated public bonds the recovery rates average from 28% to 32% in present value terms. Standard deviations for both are around 20% of debt face value. Hence one can characterize the junk bond market as a subordinate debt market whereas the syndicated loan market is a senior (and usually secured) debt market. Using Merton's (1974) characterization of debt in an options framework,

1. senior debt is simply a put option written by the senior lender over the assets of the firm with the strike price being the amount payable to the senior lender on maturity, while
2. junior debt is a put option written by the junior lender over the assets of the firm with the strike price being the amount payable to the junior lender on maturity *plus* the option described in *point 1* above that is purchased by junior lender.

We theoretically examined how the prices of such options would change with the co-movements of asset prices. As we show in Appendix A, in all cases where the borrower is solvent, the volatility of junior debt caused by changes in the underlying assets exceeds that of senior debt price; hence the regression of subordinate debt percent spreads on senior debt percent spreads will always theoretically produce a beta less than one. Although the value of the coefficient of such a regression is interesting, it does not illustrate the lack of integration of the markets.

To investigate market integration, we explicitly model the credit spread in the HLT loan market. Our ECM model is specified as follows: [13]

$$\begin{aligned}\Delta HLT\,Spread_t = a_0[&HLT\,Spread_{t-1} + b_1 default_{t-1} + b_2 tbill_{t-1} + b_3 yieldcurve_{t-1} \\ &+ b_4 liquidity_{t-1} + b_5(t-1) + c] \\ &+ a_1 \Delta default_{t-1} + a_2 \Delta tbill_{t-1} \\ &+ a_3 \Delta yieldcurve_{t-1} + a_4 \Delta liquidity_{t-1} \\ &+ a_5 \Delta HLT\,Spread_{t-1} + Const \qquad (2)\end{aligned}$$

where *HLT Spread* is the loan index over the riskless rate, *default* is the market default rate, *liquidity* is a proxy for loan market liquidity, *tbill* is the 3-month t-bill rate, *yieldcurve* is the slope of the yield curve, being the difference between 5 year

[13] The reader may object that our ECM specification differs from the normal ECM specification of $\Delta y_t = a_0[y_{t-1} - \sum b_1 X_{t-1}] + \sum c_1 \Delta X_{t-1} + a_5 \Delta y_{t-1}$. Usually, factors in the co-integrating relationship are shown with a negative sign. The negative sign emphasizes that the co-integrating relationship is of the form $y_{t-1} = \sum b_1 X_{t-1}$ and the term in the ECM is a deviation of actual y from the long term modeled equilibrium. We change the "−" to "+" so that the sign reported in the estimation table is the sign that enters the model.

government bond yield and three month t-bill rate and t is the time month number indicator going from $t = 1$ to 156. Δ indicates the difference between the $(t-1)$th and the tth observation, a_i and b_I are estimated coefficients and c and *Const* are estimated constants.

Two major credit risk factors drive debt pricing: default and loss given default. So we would expect that observed changes in default rates would affect required spreads. Liquidity is a second factor: Warther (1995) investigates the effects of changes in market liquidity on the returns of stocks, money market and bond funds. He finds that changes in liquidity (expected and unexpected) are correlated with bond fund returns. Clearly, market pricing is affected by liquidity: liquidity is the supply of funds. If the liquidities of two different markets for similar products have little effect on each other, they can be said to be not integrated. We model economy-wide factors by two additional variables common to all models, short-term riskless interest rates and the shape of the yield curve, being long-term riskless fixed interest rates minus short-term rates.

We use the ECM model to overcome familiar time series problems. Augmented Dicky Fuller unit root tests confirm that most of our variables are non-stationary but the first differences of these variables are stationary. The simplest approach to this problem is to estimate the model in first differences, yet that leads to potential loss of information on the long-run interaction of variables. We test for co-integration, determine that it is in evidence, and use the ECM that can describe both short-run dynamic process and long-run relationship between the variables. Following Franses (2001), we choose the model with intercept and trend in co-integration equation and no trend in vector autoregression. To determine the number of lags of the model structure, we use the Schwartz criterion, which suggests that a one period lag structure was appropriate.

In an ECM, the co-integrating vector is contained in the square brackets of line 1 of Eq. (2). The sum of the terms within the brackets takes a positive value when the observed spread is high relative to what it should be as determined by the levels of the independent variables and takes a negative value when spreads are low. The (typically) negative sign of coefficient a_0 serves to pull spreads back to their "correct" long-term value. The term a_0 is typically less than unity (unless there is overshooting), and the closer its value is to unity, the faster spreads adjustment to their "correct" (as estimated by the model) level.

Line 4 of Eq. (2) gives the short-term dynamics using the first differences of the same explanatory variables found in levels in the co-integrating vector. Line 5 of Eq. (2) is the autoregressive component. By analyzing these dynamics, we are able to draw conclusions about the integration the HLT loan with junk bond markets.

5. Data

Our independent variable describing the HLT market loan spread is calculated as the monthly market-value weighted average of the primary market adjusted loan spreads over riskless interest rates. The HLT spread for the tth month is calculated as follows:

$$HLT\,Spread_t = \sum_{i=1}^{n} \frac{AFS_{i,t}}{\sum_{i=1}^{n} AFS_{i,t}} ALS_{i,t} + [3mLibor_t - 3mTbill_t], \tag{3}$$

where $AFS_{i,t}$ is the principal amount of the ith loan in tth month; n is the number of HLT loans in the ith month and $3mLibor_t$, the three-month average Libor rate in the tth month; $3moTbill_t$, the three-month average t-bill rate in the tth month

$$ALS_i = QS_i + AF_i + FEF_i \times \frac{12}{m_i} \tag{4}$$

where ALS_i is the adjusted loan spread of the ith loan; QS_i is the quoted loan spread of ith loan over Libor; AF_i is the annual fee of the ith loan in addition to interest (in most cases zero); FEF_i is the front end fee of the ith loan and m_i is the time to maturity of the ith loan in months.

We use 14,462 syndicated loans that came to market from January 1987 to December 1999 [14] and were recorded by Loan Pricing Corporation (LPC). We include one entry per facility regardless of the number of participant banks. In the case where LPC shows different tranches of the same deal as separate transactions, with tranches differentiated by the maturity or by the use and nature (e.g., revolving, early amortizing) we treated each separately reported tranche as a separate facility.

Our variables for the high-yield bond spreads and the investment grade bond spreads are the Lehman Brothers' high-yield bond and the intermediate corporate bond yield to maturity index from Datastream respectively minus the 5 year treasury bond yield to maturity, also from Datastream.

An explanation of the adjustment in square brackets in Eq. (3) is in order. The dependent variables in our tests are the changes in credit spreads (and, in the co-integrating relationship, the credit spreads themselves) over riskless funds for the appropriate duration. In calculating such a spread, one must be aware of two potential problems: (1) one should subtract off a true riskless cost of funds and (2) the instrument subtracted must be of the appropriate duration. Fig. 3 serves to illustrate the problems. HLT loans in our sample are priced at a spread over LIBOR. At any given rate setting date on a loan, LIBOR would be set as point **L** in Fig. 3. But the true spread over riskless funds would be the quoted spread over six month LIBOR *plus*

[14] We exclude those facilities not priced over Libor (e.g., facilities priced over prime, the CD rate, or those offering fixed interest rates or interest rate options). Initially, we classed the index into three sub-indices: investment-grade loan spread index, speculative-grade loan spread index and non-rated loan spread index according to the loan ratings assigned by S&P to the loans as reported by LPC. However as approximately 95% of the loans were un-rated and because the difference between spreads was small (averaging seven basis points between rated investment grade and rated sub-investment grade), we only report the total index results, not the result of sub-indices.

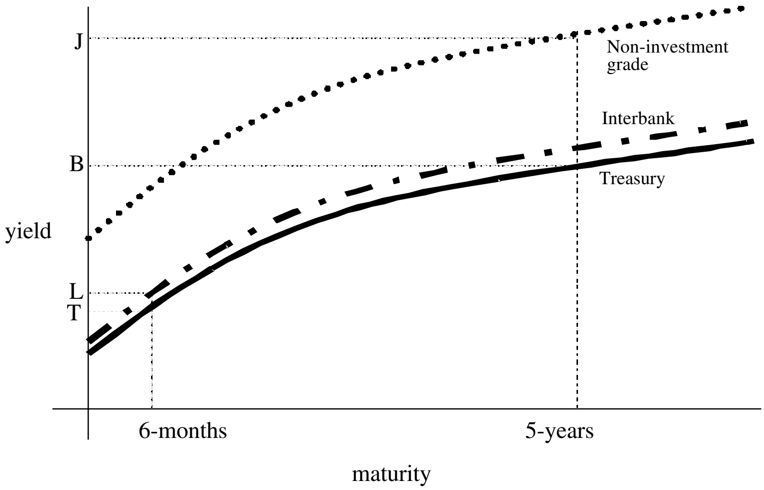
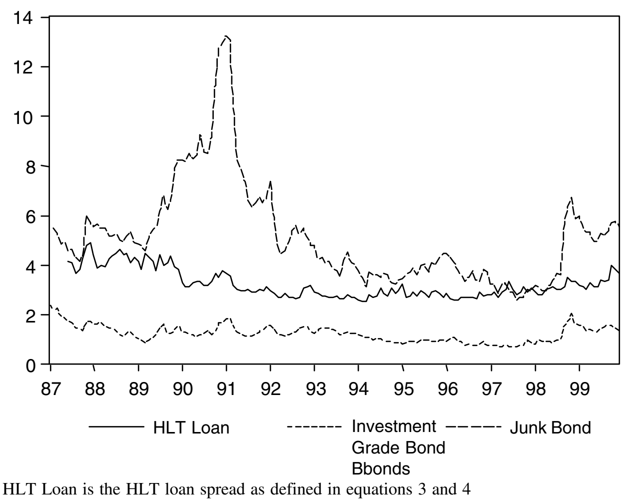


Fig. 3. Credit spreads.



HLT Loan is the HLT loan spread as defined in equations 3 and 4
Investment Grade Bond is the yield to maturity on the index (the Lehman Brothers index) of Baa above investment grade bonds minus the yield to maturity of 5 year treasury bonds
Junk Bond is the yield to maturity on the index of non-investment grade bonds (the Lehman Brothers index) minus the yield to maturity of 5 year treasury bonds.

Fig. 4. Monthly spreads over treasury securities: HLT loan spread index, Lehman Brothers' investment grade bond yield and Lehman Brothers' high-yield bond yield.

the spread of **L–T**. The **L–T** spread represents the spread of unsecured short-term bank risk (typically Aa) over riskless funds. This spread has averaged 49 basis points over our sample period, but the margin fluctuates (standard deviation of 0.28 basis

Table 2
Summary statistics

Period		HLT spread	IG spread	Junk spread	Default	TBill	Yield curve	Loan liquidity $(l-L/D)$	Loan liquidity $(1-T/D)$	Bank liquidity (R/D)	Bond liquidity
1987:1–1999:12	Mean	3.24	1.21	5.18	1.90	5.31	1.45	72.99	8.24	32.00	0.50
	Median	3.02	1.22	4.79	1.50	5.10	1.30	72.52	9.62	31.90	0.95
	Maximum	4.89	2.03	13.25	5.34	8.82	3.20	76.73	15.63	38.48	4.74
	Minimum	2.52	0.72	2.58	0.54	2.61	–0.11	70.52	0.45	27.40	–8.14
	Standard deviation	0.57	0.30	2.12	1.19	1.49	0.86	1.83	5.22	3.31	1.85
1987:1–1993:12	Mean	3.49	1.37	6.29	2.52	5.72	1.72	73.08	12.51	30.44	0.21
	Median	3.29	1.35	5.49	1.95	5.71	1.99	72.20	12.76	28.76	0.66
	Maximum	4.89	1.87	13.25	5.34	8.82	3.20	76.73	15.63	37.52	4.74
	Minimum	2.63	0.88	3.53	0.89	2.61	–0.11	70.52	9.06	27.40	–8.14
	Standard deviation	0.65	0.21	2.27	1.27	1.91	0.87	2.20	2.16	3.30	2.15
1994:1–1999:12	Mean	2.98	1.05	3.96	1.21	4.86	1.15	72.89	3.55	33.71	0.81
	Median	2.91	0.96	3.65	1.06	4.98	1.03	72.55	2.54	32.78	1.10
	Maximum	4.02	2.03	6.72	2.88	5.90	2.76	76.61	13.38	38.48	3.92
	Minimum	2.52	0.72	2.58	0.54	3.03	–0.05	71.41	0.45	30.88	–3.83
	Standard deviation	0.29	0.29	0.99	0.54	0.56	0.74	1.32	3.16	2.35	1.39

HTL spread = the HLT loan spread as defined by equations (3) and (4), IG spread = the yield to maturity on the index of Baa investment grade bonds minus the yield to maturity of 5 year treasury bonds, junk spread = the yield to maturity on the index of non-investment grade bonds minus the yield to maturity of 5 year treasury bonds, Default = Moody's monthly trailing 12-month default rates for all corporate, from http://riskcalc.moodysrms.com/us/research/defrate.asp, $tbill$ = 3 month t-bill return rate, yieldcurve = 5 years treasury bond yield maturity – 3 months t-bill rate, bank liquidity $(1-L/D)$ = 1 – (commercial and industrial loan)/deposits for all US commercial banks, bank liquidity $(1-T/D)$ = 1 – (total loans and leases)/deposits for all US commercial banks, bank liquidity (R/D) = (cash + US Government Securities)/deposits for all US commercial banks, bond liquidity = net new purchases of bond mutual funds.

points) and ranged from 16 to 145 basis points as spreads between Aa credits and treasuries fluctuated. [15] Concerning point (2), we calculate the long-term fixed rate junk bond spread over a similar maturity treasury bond so that the spread over riskless funds is **J**–**B** using the Datastream 5 year treasury yield. [16]

Fig. 4 plots the time trends of the three monthly spreads: HLT loans, junk bonds and investment grade bonds while Table 2 gives their summary statistics. Two facts are immediately apparent:

- The HLT loan spread is much less volatile and substantially lower than the junk bond spread and
- the HLT loan spread has roughly the same volatility but is substantially greater than the investment grade bond spread.

The HLT market's lower volatility and correspondingly lower spread can be explained with the options pricing credit risk model that we refer to in the last section and that we theoretically prove in Appendix A. The HLT market's relationship with the investment grade bond market spreads, however is not a matter of differential credit risk: senior HLT bank loan probabilities of default and losses given default are roughly comparable those of investment grade bonds (Altman and Suggitt, 2000). The higher spread is the price the borrower pays for flexibility. Bank loans can be arranged quickly, involve closer relationships between bank and borrower and can generally be repaid without penalty prior to maturity.

6. Results

Table 3 shows the results of a contemporaneous regression of the change in the monthly HLT loan spread index calculated by us on the change in the Lehman Brothers junk bond and investment grade bond spreads. We confirm Angbazo et al. (1998) results: the HLT loan spread is much more closely tied to the investment grade bond spread than to the junk bond spread. [17] There is a substantial shift in the degree to which HLT loans spreads can be explained by investment grade bond spreads from the earlier seven years to the final six years under study. As reference

[15] See Tuckman (1996) page 201. Another way to compare bond spreads with loan spreads would be to subtract the appropriate maturity interest rate swap rate from the fixed rate bond. Because the swap rate is swapped to LIBOR, it incorporates the AA risk spread in its pricing. This calculation would be similar to a company comparing two loan offers, a fixed rate offer and a floating rate offer on a swap-equivalent basis.

[16] To be accurate, one should use the spread of the zero coupon risky bond over the zero coupon treasury bond for each of the payments. Our use 5 year treasury bond yields is an approximation.

[17] The absolute magnitude of the co-movement of the investment grade bonds and HLT loan spread reported by Angbazo et al. (1998) was approximately 0.3, virtually identical to our 0.27 in panel 3 of Table 3, corresponding to the first half of our sample (1987–1993) which coincides closely with the period in their study (1987–1994).

Table 3
Contemporaneous relationship between the HLT Loan, junk bond and investment bond spreads
$\Delta HLT\,Spread_t = a_0 + b_1\Delta Junk\,Spread_t + b_2\Delta IG\,Spread_t + e_t$

Period	$\Delta IG\,Spread_t$	$\Delta Junk\,Spread_t$	Constant	R-squared	CHOW test F-statistic (probability)
1987:1–1999:12	0.45 (4.27)		0.00 (0.30)	0.13	
1987:1–1993:12	0.40 (3.47)		−0.00 (−0.35)	0.21	0.25 (0.78)
1994:1–1999:12	0.51 (2.91)		0.01 (0.53)	0.10	
1987:1–1999:12		0.07 (2.33)	−0.00 (−0.21)	0.03	
1987:1–1993:12		0.06 (1.60)	−0.01 (−0.69)	0.03	0.55 (0.58)
1994:1–1999:12		0.10 (1.81)	0.01 (0.53)	0.04	
1987:1–1999:12	0.39 (2.71)	0.02 (0.64)	0.00 (0.34)	0.13	
1987:1–1993:12	0.27 (1.75)	0.03 (1.19)	−0.00 (−0.19)	0.24	0.33 (0.80)
1994:1–1999:12	0.55 (2.22)	−0.01 (−0.23)	0.01 (0.53)	0.10	

$\Delta HLT\,Spread_t$ is the one month change in the HLT loan spread as defined in Eqs. (3) and (4). $\Delta IG\,Spread_t$ is the one month change in the investment grade bond spread, being is the yield to maturity on the index of Baa investment grade bonds minus the yield to maturity of 5 year treasury bonds. $\Delta Junk\,Spread_t$ is the one month change in the junk bond spread, being the yield to maturity on the index of non-investment grade bonds minus the yield to maturity of 5 year treasury bonds. Chow test null hypothesis: no change in coefficients from 1987–1993 to 1994–1999.

to the Chow test in the final column in Table 3 shows, however, the change in regimes, while economically substantial, is not statistically significant.

Although our contemporaneous first differences regression above suggests that there is a degree of bond and loan market integration and that the integration seems to be increasing, it tells us very little about the integration process. The first question is "are the spreads themselves co-integrated?" Fig. 4 suggests that the answer is "no" while Table 4 confirms that suggestion. Using the Johansen test (Johansen, 1988, 1991), we are in general unable to reject the null hypothesis that no co-integration of the spreads occurs. In only one sub-period (1987–1993) for one pair (loan spreads and investment grade bond spreads) are we able to reject the hypothesis of no co-integration – with this rejection occurring at the 5% level. Statistical lack of co-integration of the spreads does not mean that the markets are not integrated. Particularly, the spreads are determined in the different market with respect to underlying

Table 4
Co-integration test between HLT loan spreads and bond market yield spreads

Variables	Period	Eigenvalue	Likelihood ratio	5% Critical value	1% Critical value	Hypothesized no. of CE(s)
HLT spread and IG spread	1987:1–1999:12	0.13	21.73	25.32	30.45	None
		0.04	5.11	12.25	16.26	At most 1
	1987:1–1993:12	0.35	29.39	25.32	30.45	None*
		0.19	9.70	12.25	16.26	At most 1
	1994:1–1999:12	0.13	16.83	25.32	30.45	None
		0.09	6.42	12.25	16.26	At most 1
HLT spread and junk spread	1987:1–1999:12	0.05	14.18	25.32	30.45	None
		0.04	5.75	12.25	16.26	At most 1
	1987:1–1993:12	0.23	22.34	25.32	30.45	None
		0.03	2.65	12.25	16.26	At most 1
	1994:1–1999:12	0.15	16.47	25.32	30.45	None
		0.07	4.96	12.25	16.26	At most 1
HLT spread and IG spread and junk spread	1987:1–1999:12	0.14	33.21	42.44	48.45	None
		0.08	15.75	25.32	30.45	At most 1
	1987:1–1993:12	0.25	39.40	42.44	48.45	None
		0.16	16.84	25.32	30.45	At most 1
	1994:1–1999:12	0.18	33.55	42.44	48.45	None
		0.16	19.02	25.32	30.45	At most 1

HTL spread = the HLT loan spread as defined by Eqs. (3) and (4). IG spread = the Lehman Brothers index of yield to maturity of Baa bonds minus the yield to maturity of the 5 year treasury bond. Junk Spread = the Lehman Brothers index of yield to maturity of high-yield bonds minus the 5 year treasury bond. * denotes rejection of the hypothesis at 5% significance level. None denotes the hypothesis of no co-integration relationship. At most 1 denotes the hypothesis of at most 1 co-integration relationship.
We omit tests of in excess of 1 co-integration relationship because failure to reject hypothesis of at most 1 co-integration relationship will also fail to reject higher levels of co-integration.

factors. When we include those underlying factors in the tests for co-integration, we find co-integration in most data sets and their sub-periods, a result that leads us to the ECM. [18]

Table 5 shows the results of our ECM model. The long-term effects are highly significant as evidenced by the *t*-statistic on the negative coefficient of the co-integrating vector, but the significance derives entirely from the latter period (with the coefficient on the vector on the first seven years being insignificant and taking the wrong sign). Looking only at the 1994–1999 period, each month, spreads adjust about 24% of the difference from the long-term steady state spread. This suggests that 80% of the difference between the observed spread and modeled correct spread given default, liquidity and interest rate conditions would be dissipated within six months

[18] We do not separately show test for co-integration of the spreads and the underlying factors. These tests are implicitly supplied by the significance of the estimated coefficient of the ECM in the following section.

Table 5
Error correction model: loan spread

$$\Delta HLT\,Spread_t = a_0[HLT\,Spread_{t-1} + b_1 default_{t-1} + b_2 tbill_{t-1} + b_3 yieldcurve_{t-1} + b_4 liquidity_{t-1} + b_5(t-1) + c] + a_1\Delta default_{t-1} + a_2\Delta tbill_{t-1} + a_3\Delta yieldcurve_{t-1} + a_4\Delta liquidity_{t-1} + a_5\Delta HLT\,Spread_{t-1} + Const$$

Coefficients	1987:1–1999:12	1987:1–1993:12	1994:1–1999:12
Panel A: Coefficients of one lag vector autoregression			
α_0	−0.10	0.01	−0.24
	(0.03)	(0.00)	(0.08)
	(−3.27)	(1.42)	(−2.98)
$\Delta default_{t-1}$	−0.05	−0.03	−0.05
	(0.10)	(0.13)	(0.18)
	(−0.47)	(−0.21)	(−0.30)
$\Delta tbill_{t-1}$	0.30	0.19	0.58
	(0.08)	(0.11)	(0.16)
	(3.67)	(1.72)	(3.53)
$\Delta yieldcurve_{t-1}$	−0.04	0.00	−0.04
	(0.07)	(0.12)	(0.09)
	(−0.56)	(−0.01)	(−0.47)
$\Delta liquidity_{t-1}$	−0.33	−0.59	−0.08
	(0.11)	(0.21)	(0.13)
	(−3.01)	(−2.79)	(−0.60)
$\Delta HLT\,Spread_{t-1}$	0.03	−0.03	0.20
	(0.09)	(0.12)	(0.18)
	(0.32)	(−0.23)	(1.07)
Const	0.00	0.03	−0.01
	(0.02)	(0.03)	(0.02)
	(−0.04)	(0.95)	(−0.39)
R^2	0.16	0.14	0.26

Panel B: Components of the co-integrating vector

	Spread	*default*	*tbill*	*yieldcurve*	*liquidity*	*trend*	*C*
1987:1–1999:12	1.00	−0.45	0.58	0.61	0.33	0.02	−32.13
		(0.13)	(0.16)	(0.22)	(0.06)	(0.00)	
1987:1–1993:12	1.00	5.48	−6.02	−5.83	−3.02	0.11	242.91
		(16.55)	(18.96)	(17.43)	(11.67)	(0.48)	
1994:1–1999:12	1.00	−0.14	0.12	0.42	0.00	0.00	−3.73
		(0.10)	(0.12)	(0.14)	(0.11)	(0.01)	

HTL Spread = the HLT loan spread as defined by equations (3) and (4), Default = Moody's monthly trailing 12-month default rates for all corporate, from http://riskcalc.moodysrms.com/us/research/defrate.asp, *tbill* = 3 month t-bill return rate, *yieldcurve* = 5 years treasury bond yield maturity − 3 months t-bill rate, *liquidity* = 1 − (commercial and industrial loan)/deposits for all US commercial banks. Standard errors are reported below each coefficient. *T*-statistics are reported in panel A.

($(1-0.24)^6 = 0.19$). Not surprisingly, as Panel B shows, the long-term effect of high default rates is to increase spreads while the long-term effect of high liquidity is to decrease spreads. Higher short-term interest rates and sharper yield curves are associated with long-term lower spreads, and in the long run, spreads are declining. [19]

Short-term dynamics are similarly logical. The short-term dynamics describe the effect of the previous month's change in independent variables on the current month's change on the loan spread. [20] Here, only two effects are significant: short-term interest rates and liquidity. A rise in short-term interest rates leads to a substantial and significant rise in loan *spreads* in the following month. In the latter period, a one percent rise in rates would be associated with a 58 basis point rise in spreads in the short run. A most interesting result concerns liquidity. Over the sample period, if bank liquidity rose by 10% (1 minus loans to deposit ratio increases by 0.1) spreads would fall in the next month by 0.03. But this effect is entirely explained by the first seven years. From 1994 to 1999, there is no significant effect of bank changes in liquidity on HLT loan spreads. [21]

6.1. Interaction of liquidity in different markets

Liquidity is at the heart of market integration. In the above analysis, we used the ECM to measure how liquidity (in addition to other factors) in the banking market affected the pricing of HLT loans. In this section, we consider how the liquidity of the junk bonds market, defined as net new purchases of junk bond mutual funds, [22] in addition to bank liquidity affects the pricing of HLT loans. In the above discussion we used only one definition of bank market liquidity: $(1 - L/D)$ where L was the total commercial and industrial loans in the commercial banking system divided by total deposits. This adjusted ratio is also a measure of (unity minus) the portfolio proportionate allocation to a class of loans of which HLT loans is the most liquid component. To more closely approach a measure of genuine liquidity of commercial banks, we use two other measures, $(1 - T/D)$ and R/D. In the former, T/D is the ratio of total loans and leases to deposits, while the latter is a measure of reserves to deposits, being cash plus US government securities over deposits.

[19] The reader will note that, although in Table 5 Panel B, we display standard errors for the coefficients of variables in the co-integrating vector, we do not display *t*-statistics. Those variables' distributions do not follow a simple distribution so their critical values are not known. Although one can make statements about the significance of the whole co-integrating vector, one cannot about the significance of its individual components. See Johansen (1991).

[20] Clearly, our model captures only the one-month lag cause and effect. To the extent that loan market pricing reactions between changes in underlying economic factors occur in a shorter time horizon, our one month ECM is unable to explain the changes in spreads. This may help explain the low R^2.

[21] Although this change in coefficient itself is significant, using a Chow test ($F = 0.84$) one is unable to reject the null hypothesis that there has been a change in the *entire* model coefficients from the first sub-period to the second.

[22] This is clearly not the only variable that could be used to define junk bond market liquidity. We ran the regressions with a second variable, the percentage of cash in junk bond mutual fund portfolios. The orthoganalized results were not substantially different to those described in this section.

Table 6
Correlation between liquidity variables

	Bank liquidity $(1 - L/D)$	Bank liquidity $(1 - T/D)$	Bank liquidity R/D	Bond liquidity
Sample: 1987:1–1999:12				
Bank liquidity $(1 - L/D)$	1.00	0.38	0.79	0.20
Bank liquidity $(1 - T/D)$	0.38	1.00	−0.15	−0.05
Bank liquidity R/D	0.79	−0.15	1.00	0.24
Bond liquidity	0.20	−0.05	0.24	1.00
Sample: 1987:1–1993:12				
Bank liquidity $(1 - L/D)$	1.00	0.64	0.94	0.32
Bank liquidity $(1 - T/D)$	0.64	1.00	0.62	0.50
Bank liquidity R/D	0.94	0.62	1.00	0.31
Bond liquidity	0.32	0.50	0.31	1.00
Sample: 1994:1–1999:12				
Bank liquidity $(1 - L/D)$	1.00	0.96	0.94	−0.15
Bank liquidity $(1 - T/D)$	0.96	1.00	0.84	−0.22
Bank liquidity R/D	0.94	0.84	1.00	−0.10
Bond liquidity	−0.15	−0.22	−0.10	1.00

Bank liquidity $(1 - L/D) = 1 -$ (commercial and industrial loan)/deposits for all US commercial banks, Bank liquidity $(1 - T/D) = 1 -$ (total loans and leases)/deposits for all US commercial banks, Bank liquidity $(R/D) =$ (cash + US Government Securities)/deposits for all US commercial banks, Bond liquidity = net new purchases of bond mutual funds.

Not surprisingly, the three measures of bank liquidity are highly correlated, although the basis of correlation changes from the early period to the latter period.

Table 7 reruns the ECM model in Table 5, but instead of having a single measure of liquidity in each model, we include two measures of liquidity: bank liquidity and junk bond market liquidity. Recognizing the correlations between the markets as shown in Table 6, we orthoganalize one of the liquidity regressors in each of the models. We only report the coefficient of the co-integrating equation and the liquidity coefficients.

First consider the appropriateness of the ECM specification by looking at the significance and sign of the coefficient on the co-integrating equation. No matter which specification of liquidity we use, the co-integrating equation coefficient takes the appropriate significant negative sign, as long as we consider the entire period, 1987–1999. When we look at the sub-periods, however, Panels A and B show that the first period (1987–1993) is devoid of a stable, significant co-integrating relationship. Only when we use the broadest definition of liquidity, R/D (reserves to deposits, in Panel C) does the second period also exhibit a significant long-term co-integrating relationship. [23]

Turning to the coefficients on bank liquidity during the whole period, the short-term effects of change in liquidity remain negative, whatever definition of liquidity

[23] Again, we do not report the long term coefficients of liquidity because of the difficulty in interpretation discussed above (see Footnote 19).

we use. The coefficients, however are not significant in Panels A and B, [24] but are in Panel C. Panels A and B use one minus commercial and industrial loans to deposits (i.e., $1 - L/D$) and one minus total loans and leases to deposits (i.e., $1 - T/D$) as the proxies for liquidity. As mentioned above, these measures might be considered portfolio-balance measures as much as liquidity measures. Banks may have a positive incentive to invest in HLT loans when their commercial and industrial loans in particular and loans and leases in general as a percent of portfolio is low. Panel C's liquidity measure is a measure of reserves to deposits, being cash plus US government securities divided by total deposits. It is a broad measure of how much cash banks have. Whether we use the raw reserves to deposits ratio or the reserves to deposits ratios orthogonalized on the junk bond market liquidity measure, the effect of liquidity on loan pricing is significant. When banks have more cash, there is a significant short-term, downward pressure on HLT loan spreads. Moreover, this effect appears to be stronger than the portfolio rebalancing effect whereby banks would invest in HLT loans when they had insufficient commercial and industrial loans in particular.

But as we noted above, bank liquidity changes cause short-term changes in HLT loan spreads only in the earlier period (i.e., 1987–1993). Examine the last column in Table 7. Regardless of the liquidity specification, and regardless of whether one orthogonalizes bank liquidity on junk bond market liquidity or junk bond market liquidity on bank liquidity, there is no significant relationship in the latter period of between changes in bank liquidity and HLT loan pricing. If banks were the only suppliers of funds to the HLT loan market throughout the entire period, one would be hard pressed to explain this loss of significance. But we have reported that during the 1990s banks have changed from being monopsony purchasers of HLT debt to being but one (albeit a major) participant in a larger, more liquid market.

Turning to the effect of junk bond market liquidity on loan spreads, we again find evidence of increasing market integration. First, note that, in the sub-period 1987–1993, if one uses orthogonalized junk bond market liquidity (i.e., sub-panels (i)), none of the coefficients is significant. This suggests that the significant effects of junk bond market liquidity on loan pricing shown in sub-panels (ii) are caused by the indirect effect of bank liquidity on loan market spreads and the correlation of bank liquidity with junk bond market liquidity. In more recent years, however, there has been a positive effect of bond market liquidity on loan market spreads. Net new purchases of junk bond mutual funds cause loan spreads to increase. This effect is evident in Panel A whether one orthogonalizes junk bond market or bank liquidity. And the effect is significantly evident in Panel C only if the junk bond market liquidity is orthogonalized. These models suggest that in more recent years when consumers shift funds into junk bond mutual funds, HLT loans spreads widen.

[24] When we change the definition of junk bond market liquidity from net new purchases of junk bond mutual funds to the percentage of cash in junk bond mutual fund portfolios, change in bank liquidity is significant in the $(1 - L/D)$ specification for the whole sample and the first sub-period.

Table 7
Investigating cross market liquidity effects

$$\Delta HTLSpread_t = a_0[HTLSpread_{t-1} + b_1 default_{t-1} + b_2 tbill_{t-1} + b_3 yieldcurve_{t-1} + b_{4L} loanliquidity_{t-1} + b_{4B} bondliquidity_{t-1} + b_5(t-1) + c] + a_1 \Delta default_{t-1} + a_2 \Delta tbill_{t-1} + a_3 \Delta yieldcurve_{t-1} + a_{4L} \Delta loanliquidity_{t-1} + a_{4B} \Delta bondliquidity_{t-1} + a_5 \Delta HTLSpread_{t-1} + Const$$

Liquidity measure	Loan spread ECM			Test of structural change	
	1987:1–1999:12	1987:1–1993:12	1994:1–1999:12	Chow test (probability)	Wald test (probability)
Panel A: Proportion of bank portfolio not in C&I loans					
Coefficient on co-integrating equation	−0.13	0.02	−0.23		
	(0.03)	(0.01)	(0.06)		
	(−4.43)	(1.63)	(−4.08)		
i. Total bank liquidity					
Bank liquidity ($1 - L/D$)	−0.15	−0.62	0.00	0.48	8.87
	(0.10)	(0.21)	(0.12)	(0.85)	(0.00)
	(−1.56)	(−2.93)	(−0.04)		
Bond liquidity orthogonalized	0.03	−0.01	0.05		0.96
	(0.01)	(0.01)	(0.02)		(0.33)
	(2.36)	(−0.49)	(2.88)		
ii. Total bond liquidity					
Bank liquidity ($1 - L/D$) orthogonalized	0.01	−0.61	0.00	0.48	14.25
	(0.02)	(0.21)	(0.12)	(0.85)	(0.00)
	(−0.25)	(−2.92)	(0.02)		
Bond liquidity	−0.16	0.21	0.05		21.56
	(0.10)	(0.07)	(0.02)		(0.00)
	(−1.61)	(−2.97)	(2.01)		
Panel B: Proportion of bank portfolio not in loans					
Coefficient on co-integrating equation	−0.01	0.03	−0.04		
	(0.01)	(0.05)	(0.02)		
	(−2.13)	(0.50)	(−2.53)		
i. Total bank liquidity					
Bank liquidity ($1 - T/D$)	−0.07	−0.23	0.01	1.13	9.33
	(0.04)	(0.09)	(0.05)	(0.35)	(0.00)
	(−1.57)	(−2.51)	(0.20)		
Bond liquidity orthogonalized	0.01	−0.01	0.03		2.96
	(0.01)	(0.01)	(0.02)		(0.10)
	(0.96)	(−0.53)	(1.85)		
ii. Total bond liquidity					
Bank liquidity ($1 - T/D$) orthogonalized	−0.07	−0.22	0.01	1.13	11.47
	(0.04)	(0.09)	(0.05)	(0.35)	(0.00)
	(−1.57)	(−2.47)	(0.26)		
Bond liquidity	0.02	−0.12	0.03		13.37
	(0.01)	(0.05)	(0.03)		(0.00)
	(1.64)	(−2.57)	(0.99)		
Panel C: Liquid assets to deposits in banks					
Coefficient on co-integrating equation	−0.15	−0.22	−0.24		
	(0.04)	(0.06)	(0.06)		
	(−4.33)	(−3.62)	(−4.26)		

(*continued on next page*)

Table 7 (*continued*)

Liquidity measure	Loan spread ECM			Test of structural change	
	1987:1–1999:12	1987:1–1993:12	1994:1–1999:12	Chow test (probability)	Wald test (probability)
i. Total bank liquidity					
Bank liquidity R/D	−0.14	−0.32	0.11	2.62	8.97
	(0.07)	(0.12)	(0.08)	(0.01)	(0.00)
	(−2.02)	(−2.65)	(1.45)		
Bond liquidity orthogonalized	0.02	0.01	0.04		1.77
	(0.01)	(0.01)	(0.02)		(0.18)
	(1.87)	(1.24)	(2.87)		
ii. Total bond liquidity					
Bank liquidity R/D orthogonalized	−0.14	−0.32	0.12	2.62	13.89
	(0.07)	(0.12)	(0.08)	(0.01)	(0.00)
	(−2.05)	(−2.66)	(1.49)		
Bond liquidity	−0.04	−0.14	0.02		11.49
	(0.03)	(0.06)	(0.02)		(0.00)
	(−1.47)	(−2.44)	(1.19)		

The above tables present the coefficient on the integrating equation and the liquidity coefficients of the ECM model. Two variables tracking liquidity are used in each regression, one from the junk bond market and one from banks. To eliminate correlation of liquidity variables, one variable is orthogonalized in each sub-panel. In panels (i) the bank liquidity variable is unaltered, while the bond market liquidity variable is the residuals of the regression of the bond market liquidity variable on the bank liquidity variable. In panels (ii) the bond market liquidity variable is unaltered while the bank liquidity variable is the residuals of the regression of bank liquidity on bond market liquidity.

Bank liquidity $(1 - L/D) = 1 -$ (commercial and industrial loan)/deposits for all US commercial banks, Bank liquidity $(1 - T/D) = 1 -$ (total loans and leases)/deposits for all US commercial banks, Bank liquidity $(R/D) =$ (cash + US Government Securities)/deposits for all US commercial banks, Bond liquidity = net new purchases of bond mutual funds. Standard errors and T-statistics are reported below each Loan spread ECM coefficient.

7. Conclusion

Our findings broadly support the hypothesis that syndicated loan pricing has substantially changed in recent years. Increasingly, it is integrated with bond markets. Prior to 1993, bank liquidity affected loan spreads: the more money banks had, the less they charged their HLT borrowers. Following 1993, that relationship ended. Prior to 1993, flows of funds into junk bonds had no effect on HLT spreads. Since 1993, whenever mutual fund fixed income funds increased their junk bond purchases, the consequent cash outflows from of HLT lending have tended to increase HLT spreads. We take these findings to be empirical evidence that the pricing of these syndicated loans has moved beyond banks. HTLs are now priced relative to disintermediated securities markets where institutional investors are major players. We further take this to be evidence that moral hazard between buyer and seller in the HLT market is not a major factor. Our empirical findings corroborate the conjectures we formed from our brief history of the opening of trading in syndicated loans. Major regulatory, legal, structural and technological innovations have coincided to drive the secondary market trading of syndicated loans to unprecedented heights. This trend is a part of the restructuring of the traditional roles of banking, currently being debated in the literature.

We recognize, however, that our findings are limited. Particularly, we have focused on the HLT market, a market that represents 80% of trading in syndicated loans yet accounts for only 20% of syndications. Are our conclusions applicable to untraded syndicated loans and, more broadly still, to non-syndicated loans that make up the bulk of banks portfolios?

The reader will remember that HLTs have higher credit spreads than other syndicated loans. High spreads tend to reflect higher credit risk and higher credit risk uncertainty that may open the door to informational asymmetries and moral hazard. Hence, that portion of the syndicated loan market which one would believe a priori most likely to exhibit moral hazard is the one that we have demonstrated lacks such moral hazard. We suggest that, from the institutional buyers' point of view, the thinner spreads of the non-HLT loans simply do not make these unfamiliar assets sufficiently attractive.

Of course, another explanation of the lack of trades in the non-HLT market is possible. Notwithstanding their lower spreads, non-HLT syndicated loans may exhibit substantial informational asymmetries between buyer and seller and the consequent agency costs may retain their strength simply because there are less returns available to the loan buyer to compensate for the expected costs of moral hazard. At present, the competing hypotheses are difficult to test because the pricing data required to test them are not available. In recent years, however, the rate of growth of par value investment grade debt trading has exceeded the rate of growth in distressed debt trading, suggesting that mainstream syndicated loans are increasingly traded. If this trend continues, the passage of time will make available sufficient data for more conclusive tests.

Syndication is practiced only on very large loans. Although large loans have attracted much attention in the theoretical literature – particularly with respect to the delegated monitoring role of banks – they represent a relatively minor part of most banks' lending activities. Clearly the conclusions we reach in this study concerning the increased integration of bond and bank loan markets are not directly applicable to small, relatively homogeneous assets such as mortgages, personal finance loans, credit card loans, small business loans and auto loans and leases. Large portfolios of such small loans with stable statistical properties make up the bulk of bank assets. Recent studies (e.g., Thomas, 2001), however, find that securitization of such assets is reducing the specialness of bank lending in these assets as well. Bank lending to mid-market customers, on the other hand, generates assets that are too small to be syndicated but too large to be aggregated easily into portfolios eligible for securitizing. Although one would expect the traditional role of bank lender as quasi-insider to prevail here, Gorton and Pennacchi (1995) demonstrate there are considerable sales of commercial and industrial loans by a large money center bank that they study. The sold loans are not explicitly guaranteed and bear no evidence of carrying implicit guarantees by the selling bank. It seems that bank assets in addition to syndicated loans are experiencing the erosion, or at least a change in the nature of bank specialness.

We must exercise care concerning the implications for bank specialness even with respect to HLT loans. While bank roles are clearly changing – HLT loans are now priced in a larger non-bank market – we certainly cannot conclude from this change that bank specialness is on its way to extinction. We have argued, but have not proven, that declining informational asymmetries (coincident with legal, and regulatory change) have reduced banks' roles as quasi-insiders. But our evidence is also consistent with the hypothesis that enlarging the market for HLT loans has broadened the role of banks as quasi-insiders and that banks are now certifying the quality of HLT loans to institutional investors whose demand for these higher yielding assets now affects those assets prices. [25] We leave the task of determining which hypothesis is more valid must to future research.

Our paper's findings suggest several additional research topics. The simple pricing model in Appendix A should be developed further if we are to more directly test market integration. Secondly, in investigating liquidity's effects on parallel capital markets, it would be helpful to have a more compete specification of asset choices for the investor. By focusing on only the junk bonds alternative to the HLT loan market, and by using a mutual funds market proxy for the liquidity of junk bonds market, we have simplified our analytical task at the cost of ignoring the highly complex intermarket liquidity dynamics. Thirdly, bank liquidity and its management have changed substantially over the last two decades. Liquidity, as shown in the literature review, is at the heart of what makes banks special, yet our study has only casually touched on its nature, its effects on capital markets and its changing role in the economy.

Finally, we have shown that, over time, a distinctive class of assets – HLTs – has become integrated with capital markets while remaining a bank-originated asset class. We have not shown, however, that those loans are still "unique" in the sense that James (1987) used the term. James showed that the initiation or renewing of bank lending provided positive information to capital markets concerning the prospects of the borrower. He interpreted this empirical regularity as confirming the quasi-insider role of banks in markets characterized by informational asymmetries. It would be interesting to test HLT and other syndicated loans today to determine whether they preserve the ability to signal to capital markets the quality of borrowers.

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[25] We thank an anonymous referee who pointed out this alternative hypothesis.

Appendix A. Proof that the volatility of return on subordinate debt junior bond is higher than that of senior debt

Consider a simple option pricing model on debt issues of different seniority level, the details are discussed in Ingersoll (1987) and Madan (1998). Suppose a firm has two outstanding zero-coupon bonds maturing at the same time: a senior bond with face value M_1 and a junior bond or subordinated bond with face value M_2. The senior debt has absolute priority over all the assets of the firm. Let V denotes value of the firm, r is short-term interest rate and σ stands for the volatility of the firm value. Following Black and Scholes (1973) and Merton (1974)'s approach, the values of senior bond and junior bond can thus be written as

$$B = VN(-d_1) + M_1 \exp(-rT)N(d_2), \tag{A.1}$$

where $N(\cdot)$ denotes standard normal cumulative distribution function (CDF),

$$d_1 = \frac{\ln(V/M_1) + (r + \sigma^2/2)T}{\sigma\sqrt{T}}$$

and

$$d_2 = d_1 - \sigma\sqrt{T}.$$

The value of junior bond is

$$J = VN(-k_1) + (M_1 + M_2)\exp(-rT)N(k_2) - VN(-d_1) - M_1 \exp(-rT)N(d_2), \tag{A.2}$$

where

$$k_1 = \frac{\ln(V/(M_1 + M_2)) + (r + \sigma^2/2)T}{\sigma\sqrt{T}}$$

and

$$k_2 = k_1 - \sigma\sqrt{T}.$$

Let $E = \frac{\mathrm{d}J/J}{\mathrm{d}B/B}$, $E_B = \frac{\mathrm{d}B/B}{\mathrm{d}V/V}$ and $E_J = \frac{\mathrm{d}J/J}{\mathrm{d}V/V}$, then we have

$$E = \frac{E_J}{E_B} = \frac{\mathrm{d}J/\mathrm{d}V}{\mathrm{d}B/\mathrm{d}V}\frac{B}{J}. \tag{A.3}$$

Because $\mathrm{d}J/J$ and $\mathrm{d}B/B$ denote the growth rate of the value of the senior bond and the junior bond respectively, E stands for the ratio volatility of return on junior bond to that of senior bond. We can say the junior bond is more volatile than the senior bond if $E \geqslant 1$.

Differentiating Eqs. (A.1) and (A.2), we have

$$\frac{\mathrm{d}J}{\mathrm{d}V} = N(-k_1) - N(-d_1), \quad \frac{\mathrm{d}B}{\mathrm{d}V} = N(-d_1). \tag{A.4}$$

Replace $\mathrm{d}J/\mathrm{d}V$, $\mathrm{d}B/\mathrm{d}V$, J and B with (A.1), (A.2) and (A.4), Eq. (A.3) becomes

$$E = \frac{N(-k_1) - N(-d_1)}{N(-d_1)} \times \frac{VN(-d_1) + M_1 \exp(-rT)N(d_2)}{VN(-k_1) + (M_1 + M_2)\exp(-rT)N(k_2) - VN(-d_1) - M_1 \exp(-rT)N(d_2)}, \tag{A.5}$$

arrange items of Eq. (A.5), then we get

$$E = \frac{\{VN(-d_1)N(-k_1) - N(-d_1)[VN(-d_1) + M_1 \exp(-rT)N(d_2)]\} + M_1 \exp(-rT)N(d_2)N(-k_1)}{\{VN(-d_1)N(-k_1) - N(-d_1)[VN(-d_1) + M_1 \exp(-rT)N(d_2)]\} + (M_1 + M_2)\exp(-rT)N(k_2)N(-d_1)}. \tag{A.6}$$

Note that there are similar contents in both the braces in Eq. (A.6), so we can compare last part in the numerator with that in the denominator to ascertain $E \geqslant 1$.

Let us construct a function

$$g(y) = (M_1 + y)N(k_2(y))/N(-k_1(y)), \tag{A.7}$$

where

$$k_1(y) = \frac{\ln(V/(M_1 + y)) + (r + \sigma^2/2)T}{\sigma\sqrt{T}}$$

and

$$k_2(y) = k_1(y) - \sigma\sqrt{T}.$$

Note: only y is variable and others is constant in function $g(y)$.

Notice that $M_2 > 0$, $k_1(M_2) = k_1$, $k_2(M_2) = k_2$, then we have

$$g(M_2) = (M_1 + M_2)N(k_2)/N(-k_1)$$

and

$$g(0) = M_1 N(d_2)/N(-d_1),$$

so if we prove $g(y)$ is a decreasing function, we obtain

$$g(M_2) \leqslant g(0),$$

that is,

$$(M_1 + M_2)N(k_2)/N(-k_1) \leqslant M_1 N(d_2)/N(-d_1). \tag{A.8}$$

Hence,

$$(M_1 + M_2)\exp(-rT)N(k_2)N(-d_1) \leqslant M_1 \exp(-rT)N(d_2)N(-k_1). \tag{A.9}$$

Therefore, we get $E \geqslant 1$.

First of all, we deduce an inequality, which will be used in the following proof. We know that the cumulative distribution function (CDF) and probability density function (PDF) of standard normal distribution can be written as

$$N(z) = \int_{-\infty}^{z} f(x)\,\mathrm{d}x, \quad f(x) = \frac{1}{\sqrt{2\pi}} \exp\left(-\frac{1}{2}x^2\right).$$

According to properties of the definite integral, we have

$$\int_{z}^{+\infty} f(x)\,\mathrm{d}x \leqslant \int_{z}^{+\infty} \frac{x}{z} f(x)\,\mathrm{d}x = f(z)/z \quad \text{for all } z > 0.$$

Then we get the inequality

$$N(-z) = P(\xi > z) \leqslant f(z)/z \quad \text{for all } z > 0, \tag{A.10}$$

where ξ denotes a random variable which has standard normal distribution.

Next, we begin to prove that $g(y)$ is an increasing function by using the inequality (A.10). Differentiating Eq. (A.7), then we obtain

$$\frac{\mathrm{d}g}{\mathrm{d}y} = \frac{N(k_2)N(-k_1) - N(k_2)f(-k_1)/\sigma\sqrt{T} - N(-k_1)f(k_2)/\sigma\sqrt{T}}{(N(-k_1))^2}. \tag{A.11}$$

Note: here k_1 and k_2 should be written as $k_1(y)$ and $k_2(y)$. In order to be concise we drop the function brackets below.

Notice that $k_1 > 0$, using the inequality (A.10) we have

$$N(-k_1) \leqslant f(k_1)/k_1. \tag{A.12}$$

Combining Eq. (A.11) and inequality, we deduce

$$\begin{aligned}\frac{\mathrm{d}g}{\mathrm{d}y} &\leqslant \frac{N(k_2)f(k_1)/k_1 - N(k_2)f(-k_1)/\sigma\sqrt{T} - N(-k_1)f(k_2)/\sigma\sqrt{T}}{(N(-k_1))^2} \\ &= \frac{N(k_2)f(k_1)\left(1/k_1 - 1/\sigma\sqrt{T}\right) - N(-k_1)f(k_2)/\sigma\sqrt{T}}{(N(-k_1))^2} \\ &= \frac{[-k_2N(k_2)f(k_1)/k_1 - N(-k_1)f(k_2)]/\sigma\sqrt{T}}{(N(-k_1))^2}.\end{aligned} \tag{A.13}$$

When $k_2 \geqslant 0$, we have

$$\frac{\mathrm{d}g}{\mathrm{d}y} \leqslant 0. \tag{A.14}$$

When $k_2 < 0$, using the inequality (A.10) we have

$$-f(k_1) \leqslant -k_1N(-k_1) \quad \text{and} \quad -f(k_2) \leqslant k_2N(k_2). \tag{A.15}$$

So we obtain

$$\frac{\mathrm{d}g}{\mathrm{d}y} \leqslant \frac{N(k_2)N(-k_1) - N(k_2)N(-k_1)k_1/\sigma\sqrt{T} + N(-k_1)N(k_2)k_2/\sigma\sqrt{T}}{(N(-k_1))^2}$$
$$= \frac{N(k_2)N(-k_1) - N(k_2)N(-k_1)(k_1/\sigma\sqrt{T} - k_2/\sigma\sqrt{T})}{(N(-k_1))^2}$$
$$= \frac{N(k_2)N(-k_1) - N(k_2)N(-k_1)}{(N(-k_1))^2} = 0. \tag{A.16}$$

Combine inequality (A.14) and (A.16), we can say $g(y)$ is a decreasing function QED.

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